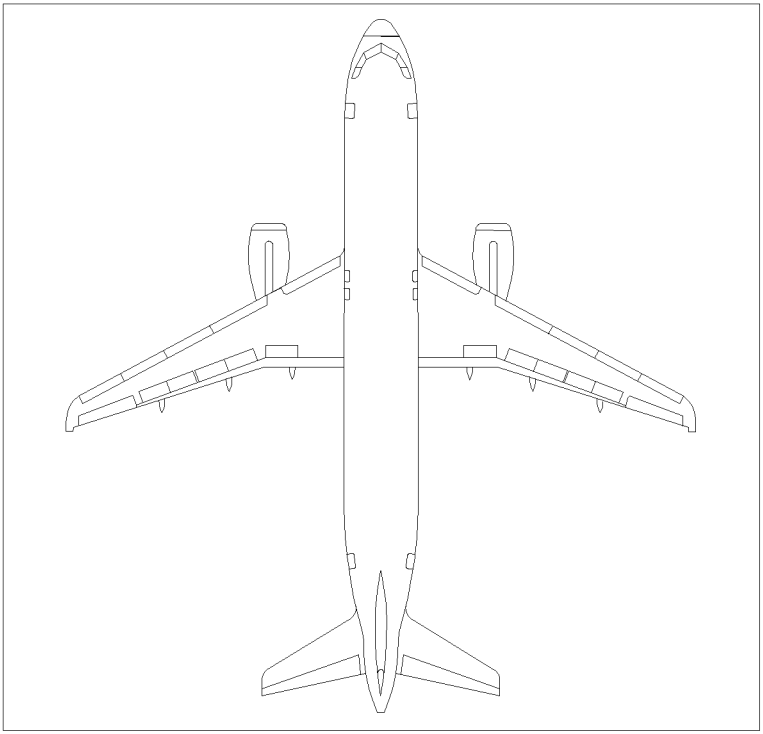
A318/A319/A320/A321

FLIGHT CREW OPERATING MANUAL



SYSTEMS DESCRIPTION

1

AIRBUS®

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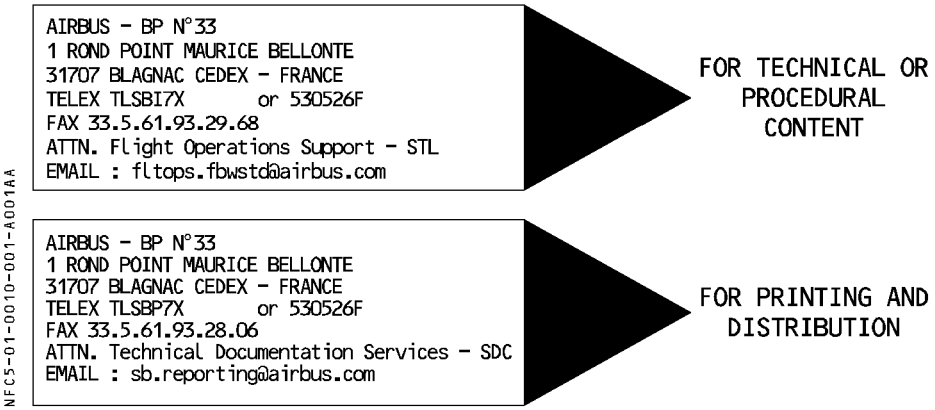
FOREWORD

This manual complements the approved Flight Manual. Airbus has attempted to ensure that the data contained in this manual agrees with the data in the Flight Manual. If there is any disagreement, the Flight Manual is the final authority.

COMMENTS — QUESTIONS — SUGGESTIONS

All manual holders and users are encouraged to submit any Flight Crew Operating Manual questions and suggestions to :

R



CONTENT

R The Flight Crew Operating Manual (FCOM), and the associated Quick Reference Handbook
R (QRH), are developed specifically for flight crews, in order to provide them with all of the
R necessary information about the operational, technical, procedural, and performance
R characteristics that are required for the safe and efficient aircraft operation. These manuals
R take into account all of the operational procedures to be applied during normal and
R abnormal/emergency situations that may occur on ground or in flight.
R The manuals are not designed to provide basic airmanship skills or piloting techniques.
R They are intended for flight crews that have already been trained to fly this type of aircraft,
R and are familiar with the aircraft's handling characteristics.
R In addition, the purpose of the FCOM is to :
R — Be used as a comprehensive reference guide during initial and refresher flight crew
R training. Practical and training-related information is addressed in the Flight Crew
R Training Manual (FCTM).
R — Provide Airbus operators with a basis for their development of a customized airline
R operations manual, in accordance with applicable requirements.

The content is divided into four volumes :
Vol 1 = Systems' description (description of the aircraft systems).
Vol 2 = Flight preparation (performance information plus loading data).
Vol 3 = Flight operations (operating procedures, techniques, and performance information).
Vol 4 = FMGS pilot's guide (procedures for FMGS use).

USE

As a comprehensive set of references, the FCOM :
- can be used by an operator's flight operations department to supplement its own crew manual
- can be issued directly to crew members for training and subsequently for line operations.

WARNINGS, CAUTIONS AND NOTES

WARNING : an operating procedure, technique, etc, which may result in personnel injury or loss of life if not carefully followed.
CAUTION : an operating procedure, technique, etc, which may result in damage to equipment if not carefully followed.
NOTE : an operating procedure, technique, etc, considered essential to emphasize.

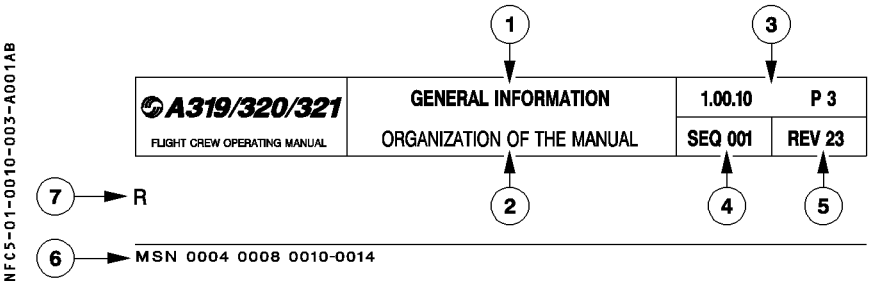
COMPLEMENTARY INFORMATION

The manual includes technical information required for training as well as complementary information.
- Where a paragraph or schematic is preceeded by the heading **FOR INFO** the details given are considered to be nice to know. Knowledge of these items is not required for the type rating qualification.
- ECAM warnings and cautions are summarized in a table at the end of each chapter of volume1. Numeric values are given for information only.

OPTIONAL EQUIPMENT

The legend ◁ indicates that a paragraph or a schematic is applicable only if the related equipment is installed.

PAGINATION



(1) Chapter title

(2) Subchapter title

(3) FCOM volume number, chapter number, section number, page number

(4) Sequence number is used for Airbus Industrie management of different aircraft configurations and allows to enter into list of effective pages.

(5) Revision number of the manual at which the page has been revised.

(6) Aircraft MSN

R – 0004 0008 means that the page is applicable to aircraft MSN 0004 and MSN 0008

R – 0010–0014 means that the page is applicable from aircraft MSN 0010 to MSN 0014

– ALL means that the page is applicable to all aircraft covered by the manual.

Correspondance between MSN and registration may be found in the cross reference table.

(7) An R in front of a line indicates that the line has been revised.

REVISIONS

NORMAL REVISIONS

There are issued periodically to cover non-urgent corrections and changes and to add new data.
They are accompanied by filing instructions and an updated list of effective pages that includes customized pages.
A normal revision record sheet is at the front of each volume.
In addition, each volume has a list of modifications affecting the manual that gives a simple explanation of the technical content of each incorporated modification and its validity per aircraft.

R INTERMEDIATE REVISIONS

R They are issued between normal revisions to cover changes in the definition of the aircraft
R or changes in the composition of the fleet of an airline. They are numbered in ascending
R sequence e.g. 20A, 20B, 20C... for intermediate revisions issued between normal revisions
R 20 and 21.
R They are accompanied by filing instructions and an updated list of effective pages.

TEMPORARY REVISIONS

Printed on yellow paper the Temporary Revisions (TR) are issued to provide information between normal revisions. They are accompanied by filing instructions and an updated, customized list of effective TR.
A yellow temporary revision record sheet is at the front of each volume.

INCORPORATION OF SERVICE BULLETINS IN THE MANUAL

When a service bulletin has been accomplished on one or more aircraft of the operator fleet, and notified to Airbus Industrie, all affected manuals will reflect the new aircraft
R configuration at next revision. If judged necessary by Airbus Industrie, or requested by the
R operator, a temporary revision or an intermediate revision is issued between normal revisions.

OPERATIONS ENGINEERING BULLETINS

The Operations Engineering Bulletins (OEB) are issued as the need arises to give operators revised or new, but significant, technical or procedural information.
OEBs are provided with an OEB record sheet. This record sheet is re-issued with each normal revision to update the bulletin embodiment status.
They are accompanied by filing instructions and an updated customized list of effective OEBs.

HOW TO INSERT A REVISION

FILING INSTRUCTIONS

Use the filing instructions as follows :

R REMOVE : The page must be removed. It may be replaced by a new page if associated with an INSERT instruction. If not, the page is cancelled.

INSERT : The page must be inserted. If not associated with a REMOVE instruction, the page is new for the operator fleet and does not replace an existing one.

R The column NOTE indicates EFFECTIVITY CHANGE ONLY if the page is revised due to an
R effectivity change and not due to a technical content.

LIST OF EFFECTIVE PAGES (LEP)

The manual after revision must comply with the LEP, which lists all the pages that are in the manual. The new pages are indicated by N and the revised pages by R.

BEST WAY TO GET UPDATED DOCUMENTATION

As soon as any change has been completed on any airplane, the best way to get updated documentation is to advise :
AIRBUS INDUSTRIE
BP 33
31707 BLAGNAC CEDEX
FRANCE
Telex : TLSBP7X.. or 530526F
FAX 33.5.61.93.28.06
ATTN : Customer Service Directorate – Technical Documentation Services (AI/SE – D)

To simplify automatic LEP processing some modifications have been grouped under a common code.

	CODE	DESIGNATION
R	0001	Mod : (22013+31283) = (24105+28479+31283) = (24105+28702+31283) = (24105+28916+31283) = (26335+28479+31283) = (22013+28479+31283) = (22013+28916+31283) = (26335+28916+31283) = (26334+28479+28916+31283) = (22013+28479+31283+34862+37809) = (24105+28479+31283+34862+37809) = (24105+28702+31283+34862+37809) = (24105+28916+31283+34862+37809) = (26335+28479+31283+34862+37809) = (22013+28916+31283+34862+37809) = (26335+28916+31283+34862+37809)
R	0002	MSN 0069 0070 0071 0072 0078 0083 0086 0093 0094 0104 0110 0111 0116 0017 0135 0137 0147 0161 0162 0172 0200 0201 0202 0209 0216 0217 0218 0267 0268 0269 0346 0382 0401 0412 0458 0468 0473 0474 0484 0493 0502 0505 0518 0560 0563 0564 0567 0595
	0003	Mod : 25053 = 25416 = 25538 = 25871 = 25893 = 26338 = (25053+26338) = (25416+25871) = (25538+25893) = (25416+25871+25893)
	0004	Mod : 20682 = 20683 = 20686 = 20723 = 20724 = 20859 = 21373 = 21531 = 21710 = 21876 = 21930 = 22221 = 22442 = 22508 = 22579 = 22742 = 22748 = 23099 = 23284 = 23298 = 23399 = 23897
	0005	STD = Mod : (22941+23453) = (22941+23531)
R	0006	Mod : 22562 = 35864 = (22562+25888+27609) = (25888+27609+35864)
R	0007	Mod : 25888 = (22562+25888) = (35864+25888)
R	0008	Mod : (22536+37009) = (23227+37009) = (23529+37009) = (22536+30368+35270+37009) = (23227+30368+35270+37009) = (23529+30368+35270+37009)
R	0009	Mod : 30368 = (22536+31056) = (23227+31056) = (25564+31056) = (23529+31056) = (27740+31056) = (22536+31056+35270) = (23529+31056+35270) = (23227+30368+31056+35270) = (23529+30368+31056+35270)
R	0010	Mod : 28238 = (28238+32635+35649)
R	0011	Mod : (28238+30368) = (28238+30368+32635+35649)
R	0012	Mod : (24035+25863) = (24035+25345+25863) = (24035+25346+25863) = (24160+25345+25863) = (24189+25345+25863) = (24035+25345+25346+25863) = (24189+24211+25345+25863) = (24035+25345+25863+28925+34282) = (24189+25345+25863+28925+34282) = (24035+25863+28551+34195) = (24035+25345+25863+28551+34195) = (24035+25346+35863+28551+34195) = (24160+25345+25863+28551+34195) = (24189+25345+25863+28551+34195)
	0013	Mod : 25529 = 25819 = 26117 = 26270 = 26345 = (25529+25819) = (26117+26270) = (25529+26345+26378)
	0014	Mod : (23742+24211) = (23585+23742+24035) = (23585+23742+24160) = (23585+23742+24211) = (23585+23742+24035+24211)
R	0015	Mod : 36368 = 35216 = 26965 = 33376 = (26965+33376)
R	0016	Mod : (26925+36368) = (26925+35216) = (26925+33376) = (26925+32731+33376) = (26925+26965+33376) = (26925+26965+32731+33376)
	0017	Mod : 25295 = 27522 = (25295+27522+28360)
	0018	Mod : 25404 = (25053+25404) = (25404+25416) = (25404+25538) = (25404+25871) = (25404+25893) = (25404+26338) = (25053+25404+26338) = (25404+25416+25871) = (25404+25893+26338) = (25404+25416+25871) = (25404+25538+25893)
R	0019	Mod : (20059+20084+20586) (20059+20084+37565) = (20059+20084+20586+22707) = (20059+20084+20586+22706+22707) = (P2878+20059+20084+20586+22706+22707) = (P2878+20059+20084+20586+22706+22707+30066+30067)

	CODE	DESIGNATION
	0020	Mod : 31896 = 31897 = 32475 = 32929 = (31896+32402) = (31897+32401) = (31896+32332+32475) = (31896+32332+35119) = (31897+32333+32929) = (26999+28495+31896) = (26999+28495+31897) = (26999+28495+32475) = (26999+28495+32929) = (26999+28495+31896+32402) = (26999+28495+31897+32401) = (26999+28495+31896+32332+35119)
	0021	Mod : (22562+25000) = (22562+26608)
	0022	Mod : 25000 = 26608 = (25000+25072) = (25072+26608)
	0023	Mod : (20477+20559) = (20175+20477+20559)
	0024	Mod : 27522 = (25295+25381) = (25381+27522) = (25295+25381+27522+28360)
	0025	Mod : (K2211+25577) = (K2211+27170)
	0026	Mod : 24035 = 24160 = 24189 = (24189+24211)
R R	0027	Mod : (20057+20082+22706+22707+20586) = (20057+20082+22706+22707+37565) = (P2879+20057+20082+22706+22707+20586)
	0028	Mod : (22562+24871+25000) = (22562+24871+26608)
R R	0029	Mod : (20057+20059+20082+20586+22706+22707) = (20057+20059+20082+22706+22707+37565)
	0030	Mod : 24035 = 24160 = 24211 = (24035+24211) = (24035+26497+28290) = (24160+26497+28290) = (24211+26497+28290)
R R	0033	Mod : 36368 = 35216 = 26965 = 33376 = (24449+36368) = (24449+35216) = (24449+26965) = (24449+33376) = (24449+26965+33376)
R R R R R	0034	Mod : STD = 32332 = 32333 = 32401 = 32402 = 32475 = 32929 = (26999+28495) = (26999+28495+32332) = (26999+28495+32333) = (26999+28495+32401) = (26999+28495+32402) = (26999+28495+32475) = (26999+28495+32929) = (26999+28495+32333+35651) = (26999+28495+32333+37588)
R R R R R	0035	Mod : (20059+20084) = (30066+30067) = (20059+20084+22707) = (20057+20059+20084+22707) = (20059+20084+22706+22707) = (20057+20059+20084+22706+22707) = (P2878+20059+20084+22706+22707) = (P2878+P2879+20057+20059+20082+20084+22706+22707) = (20057+20059+20082+20084)
	0036	Mod : 26999 = 28382 = 30241 = 30635 = (26999+28382+28495)
R R R R	0037	Mod : (25205+28916) = (26111+28916) = (26999+28916) = (28382+28916) = (28916+30241) = (28916+30635) = (26485+28916) = (28916+30631) = (26999+28382+28495+28916) = (25205+26999+28495+28916) = (26717+26999+27831+28382+28495+28916+31897+32333)
	0038	Mod : 21237 = (21237+25072) = (21237+22562+25072) = (21237+25888+27609) = (21237+22562+25072+25888+27609)
	0039	Mod : 23885 = 24075 = (23885+24075+26999+28495)
	0040	Mod : (22013+25404) = (25053+25404) = (25404+26338) = (25053+25404+26338)
	0041	Mod : (20522+26526) = (20361+20522+26526+27638)
	0042	Mod : (20067+20069+20071+33100) = (20067+20069+20071+31283+33100+34862)
R R R R R R R	0043	Mod : (24211+34573) = (24035+34573) = (24035+31896+34573) = (24035+31897+33036) = (24035+32475+32997) = (24211+32475+32997) = (24035+32929+34076) = (24211+31896+34573) = (24035+31897+35526) = (24035+34573+35119) = (24035+31896+32402+32997) = (24035+32401+32929+34076) = (24035+31897+32401+34076) = (24035+31896+32332+32475+32997) = (24035+31897+32333+32929+34076)
R R	0044	Mod : (22249+25381) = (22249+25295+25381+27522+28499) = (22249+25295+25381+27522+28360+28499)
	0045	Mod : 26723 = 27410 = 27639 = 27763 = 30277 = (26723+27572) = (27572+30277) = (27255+27572+27639)
	0046	Mod : 24310 = 24624 = 25625 = 26169 = 26191 = 26203 = (20283+26203+28684) = (20283+26169+26203+28684)
	0048	Mod : (25110+26723) = (25110+27410) = (25110+27639) = (25110+27763) = (25110+30277) = (25110+30385) = (25110+30386) = (25110+26723+27572) = (25110+27572+30277) = (25110+26723+27572+27639)

	CODE	DESIGNATION
R	0049	Mod : (22249+25295) = (22249+25295+27522+28360) =
R		(22249+25295+25381+27522+28500) = (22249+25295+25381+27522+2800+28360)
	0050	Mod : (24511+27276) = (24511+24745+27276)
R	0051	Mod : (22249+27522) = (22249+25295+25381) = (22249+25295+27522) =
R		(22249+25381+27522) = (22249+25295+25381+27522+28360)
R	0052	Mod : (20024+20586) = (20024+37565) = (20024+20586+30368+35270) =
R		(20024+30368+35270+37565)
	0053	Mod : (20081+20818) = (20042+20081+20818+25735)
R	0054	Mod : 36562 = 36609 = 36772 = (32475+34313+36562) = (31896+32402+36562) =
R		(32929+34809+36609) = (32929+34809+36772) = (31897+32401+34809+36772) =
R		(31897+32401+34809+36609) = (31896+32402+34313+36562) =
R		(31897+32929+34809+36609) = (32333+32929+34809+36609) =
R		(31896+32332+32475+34313+36562) = (31897+32333+32929+34809+36609) =
R		(31897+32333+32929+34809+36772)
R	0055	Mod : (20024+20586+22013) = (20024+22013+37565)
R	0056	Mod : 34313 = 34809 = (32929+34809) = (32475+34313) = (32402+34313) =
R		(32401+34809) = (32333+32929+34809) = (31897+32929+34809) =
R		(31897+32401+34809) = (31896+32402+34313) = (31897+32333+32929+34809) =
R		(31896+32332+32475+34313)
	0057	Mod : (23672+26111) = (23672+23885) = (23510+26999+28218) =
		(23510+28218+28382) = (23510+28218+30241) = (23510+28218+30635) =
		(23510+25204+25205) = (23510+25204+28382) = (23510+25204+26999) =
		(23510+25205+25294) = (23510+25294+26999) =
		(23510+25204+26999+28382+28495) = (23510+28218+26999+28382+28495) =
		(23510+25204+25205+26999+28495
R	0058	Mod : (25205+32929) = (25205+32475) = (26999+31896) = (26999+31897) =
R		(26999+32475) = (26999+32929) = (28382+31896) = (28382+31897) =
R		(28382+32475) = (28382+32929) = (30241+31896) = (30241+31897) =
R		(30631+32475) = (30631+32929) = (30631+31896) = (26999+35119) =
R		(26999+31897+32401) = (26999+31896+32402) = (30241+31896+32402) =
R		(30241+31897+32401) = (26999+28382+28495+31896) =
R		(26999+28382+28495+31897) = (26999+31896+32332+32475) =
R		(26999+32897+32333+32929) = (26999+28382+28495+32475) =
R		(26999+28382+28495+32929) = (25205+26999+28382+32401) =
R		(25205+26999+28382+32402) = (26999+31896+32332+35119) =
R		(26999+28382+28495+31896+32402) = (26999+28382+28495+31897+32401) =
R		(26999+28382+28495+31897+32333+32929) =
R		(26999+28382+28495+31896+32332+32475)
	0060	STD = 27646 = (26358+30980) = (26999+28495) = (26358+26999+27917+30980) =
		(26358+26999+28495+30980) = (26999+27917)
	0061	Mod : 24035 = 24084 = (24035+24084)
	0062	Mod : 24035 = 24084 = (24035+24084) = (20586+22802+24035) =
		(20586+22802+24084) = (20586+22802+24035+24084)
	0063	Mod : 20850 = 22461 = (20850+22461)
	0064	Mod : 23885 = 26999 = 28382 = 30631 = 26485 = (23885+26111) = (24075+25205)
		= (26111+26999) = (27646+28382) = (27646+30241) = (23885+26999) =
		(23885+26111+26999) = (24075+27646+28382) = (26999+27646+30241) =
		(23885+26111+26358+30980) = (24075+25205+26358+30980) =
		(26111+26358+26999+30980) = (26111+27646+28382+30635) =
		(26358+27646+28382+30980) = (26358+27646+30241+30980) =
		(26999+27646+28382+28495) = (23885+26111+26358+26999+30980) =
		(24075+26358+27646+28382+30980) = (26358+26999+27646+30241+30980) =
		(26111+26358+27646+28382+30635+30980) =
		(26358+26999+27646+28382+28495+30980)
	0065	Mod : (20024+25415) = (20024+22802+25415) = (20024+22802+25415+L)
	0066	Mod : (22461+23408) = (20850+22461+23408)
	0067	Mod : (20081+20230+20818) = (20042+20081+20230+20818+25735)

	CODE	DESIGNATION
	0068	Mod : (26621+26678) = (21437+23480+26621+26678)
	0069	Mod : (20057+20082) = (20057+20059+20082+20084)
R	0072	Mod : (26999+31896) = (26999+31897) = (26999+32475) = (26999+32929) =
R		(28382+31897) = (28382+32475) = (30631+32475) = (26999+35119) =
R		(30631+31896) = (26999+28382+28495+31896) = (26999+28382+28495+31897) =
R		(26999+28382+28495+32475) = (26999+28382+28495+32929) =
R		(26999+31896+32332+32475) = (30241+31896) = (25205+32929) =
R		(25205+31896+32332+35119) = (26999+31896+32332+35119) =
R		(28382+31896+32332+35119) = (30241+31896+32332+35119) =
R		(30631+31896+32332+35119) = (26999+31897+32333+32929) =
R		(26999+28382+28495+31896+32332+35119) =
R		(26999+28382+28495+31897+32333+32929)
	0073	Mod : (22013+22089+27993) = (22013+24871+27993)
R	0074	(20586+22707) = (22707+37565) = (20586+22707+30368+35270) =
R		(22707+30368+35270+37565)
	0075	Mod : 23885 = 24075 = 25205 = 26111 = (24075+25205+26999+28495)
	0076	Mod : 24035 = 24160 = (24035+24211) = (24189+24211) = (24035+25863+28551)
		= (24160+25863+28551) = (24035+24211+25863+28551) =
		(24189+24211+25863+28551)
R	0077	Mod : (20586+30368)= (30368+37565) = (20586+24035+24084+30368) =
R		(24035+24084+30368+37565)
R	0078	Mod : (26999+31896) = (26999+31897) = (28382+31897) = (26999+32929) =
R		(26999+32475) = (26999+35119) = (26999+28382+28495+31896) =
R		(26999+31896+32332+32475) = (26999+31897+32333+32929) =
R		(26999+28495+28382+32475) = (26999+28495+28382+31897) =
R		(26999+28495+28382+31897+32333+32929) =
R		(26999+28495+28382+31896+32332+32475) = (28382+31475) =
R		(26999+28382+28495+32929) = (25205+32929) = (30241+31896) =
R		(26999+31896+32332+35119) = (26999+28382+28495+31896+32332+35119)
R	0079	Mod : (24035+37565) = (20586+24035) = (20586+24084) = (20586+24160) =
R		(20586+24189) = (20586+24035+24084) = (20586+24035+24160) =
R		(20586+24035+24189) = (20586+24084+24160) = (20586+24084+24189) =
R		(20586+24160+24189) = (20586+24035+24084+30368+35270)
R	0080	20586 = 37565 = (20586+30368+35270) = (30368+35270+37565)
R	0081	20586 = 37565 = (20586+30368+35270) = (37565+30368+35270)
R	0082	Mod : (30241+31896) = (26999+31896) = (26999+31897) = (28382+31897) =
R		(26999+35119) = (26999+28382+28495+31896) = (26999+28382+28495+31897) =
R		(26999+31896+32332+35119) = (28382+31896+32332+35119) =
R		(26999+31897+32401+37588) = (26999+28382+28495+31896+32332+35119) =
R		(26999+28382+28495+31897+32401+35651)
R	0083	Mod : (26999+32475) = (26999+32929) = (28382+32475) = (25205+32929) =
R		(26999+31896+32402) = (26999+31897+32401) = (30241+31896+32402) =
R		(26999+31896+32332+32475) = (26999+28382+28495+32475) =
R		(26999+31897+32333+32929) = (26999+28495+28382+32929) =
R		(25205+26999+28382+32402) = (26999+28382+28495+31896+32402) =
R		(26999+28495+28382+31897+32401) =
R		(26999+28495+28382+31897+32333+32929) =
R		(26999+28495+28382+31896+32332+32475)
	0084	Mod : (20059+20084) = (30066+30067) = (20059+20084+22707) =
		(20057+20059+20084+22707) = (20059+20084+22706+22707) =
		(20057+20059+20084+22706+22707) = (P2878+20059+20084+22706+22707)

	CODE	DESIGNATION
R	0085	Mod : 26093 = 26243 = 26716 = 26717 = 26799 = 26968 = 27780 = 27831 = 27832 = 28416 = (26093+32332) = (26039+32333) = (26243+32332) = (26243+32333) = (26716+32332) = (26716+32333) = (26717+32332) = (26717+32333) = (26799+32332) = (26799+32333) = (26968+32332) = (26968+32333) = (27780+32332) = (27780+32333) = (27831+32332) = (27831+32333) = (27832+32332) = (27832+32333) = (28416+32332) = (28416+32333) = (26093+32401) = (26093+32402) = (26093+32929) = (26093+32475) = (26243+32401) = (26243+32402) = (26243+32929) = (26243+32475) = (26716+32401) = (26716+32402) = (26716+32929) = (26716+32475) = (26717+32401) = (26717+32402) = (26717+32929) = (26717+32475) = (26799+32401) = (26799+32402) = (26799+32929) = (26799+32475) = (26968+32401) = (26968+32402) = (26968+32929) = (26968+32475) = (27780+32401) = (27780+32402) = (27780+32929) = (27780+32475) = (27831+32401) = (27831+32402) = (27831+32929) = (27831+32475) = (27832+32401) = (27832+32402) = (27832+32929) = (27832+32475) = (28416+32401) = (28416+32402) = (28416+32929) = (28416+32475) = (26717+26999+27831+28495)
R	0086	Mod : (20024+20586+28238) = (20024+28238+37565)
R	0087	Mod : (20024+20586+22013+30422) = (20024+22013+30422+37565) = (20024+20586+22013+25453+30422) = (20024+22013+25453+30422+37565)
	0088	Mod : (22013+22681) = (22013+25839) = (22013+25903) = (22013+26539)
R	0089	Mod : (20024+20586+30368+P7092) = (20024+30368+37565+P7092)
R	0090	Mod : (20024+20586+22013+30368) = (20024+22013+30368+37565)
	0091	Mod : 20457 = 20458 = 21144 = 22681 = 25125 = 25386 = 25839 = 26155 = 26539
	0092	Mod : (20057+20082) = (20059+20084) = (20057+20059+20084) = (20057+20059+20082) = (20057+20059+20082+20084)
R	0093	Mod : 25205 = 26111 = 26485 = 26999 = 28382 = 30241 = 30631 = 30635 = (25205+32332) = (25205+32333) = (26111+32332) = (26111+32333) = (26485+32332) = (26485+32333) = (26999+32332) = (26999+32333) = (28382+32332) = (28382+32333) = (30241+32332) = (30241+32333) = (30631+32332) = (30631+32333) = (30635+32332) = (30635+32333) = (22205+26999+28495) = (26999+28382+28495) = (25205+26999+28495+32332) = (25205+26999+28495+32333) = (26999+28382+28495+32332) = (26999+28382+28495+32333) = (26999+27831+28382+28495)
R	0094	Mod : (P7092+20024+20586+28238+30368) = (P7092+20024+28238+30368+37565)
	0095	Mod : 22536 = 23227 = 23529 = 25564 = 31699 = MSN : 163 = 164 = 168 = 169 = 179 = 193 = 221 = 222 = 230 = 294 = 299 = 301 = 338 = 348 = 349 = 362 = 363 = 424 = 429 = 437 = 444 = 449 = 476
R	0096	Mod : (26999+32475) = (26999+32929) = (26999+31896+32402) = (26999+31897+32401) = (26999+31896+32332+32475) = (26999+28382+28495+32475) = (26999+31897+32333+32929) = (26999+28495+28382+32929) = (26999+28382+28495+31896+32402) = (26999+28495+28382+31897+32401) = (26999+28495+28382+31897+32333+32929) = (26999+28495+28382+31896+32332+32475) = (28382+32475) = (30631+32475) = (25205+32929) = (30241+31896+32402) = (25205+26999+28382+32401) = (25205+26999+28382+32402)
	0097	Mod : (MP K2211+21144) = (MP K2211+26155)
	0098	Mod : (30793+34429) = (27620+30793+34429)
R	0099	Mod : (20024+22013+20586+30368+30422) = (20024+22013+30368+30422+37565)
	0100	MSN : 163 = 164 = 168 = 169 = 179 = 193 = 221 = 222 = 230 = 294 = 299 = 301 = 338 = 348 = 349 = 362 = 362 = 363 = 424 = 429 = 437 = 444 = 449 = 476
	0101	Mod : 20173 = 25650 = 26274 = (26274+26999+28495) = (20173+26358+30980) = (26274+26358+30980) = (20173+25650+26358+30980) = (20173+26274+26358+30980) = (26274+26358+26999+28495+30980)
	0102	Mod : 36627 = (34637+36627) = (26526+34637+36627)

	CODE	DESIGNATION
R	0103	Mod : (22013+28479) = (22013+28916) = (24105+28479) = (24105+28702) =
R		(24105+28916) = (26334+28479) = (26334+28702) = (26334+28916) =
R		(26335+28479) = (26335+28702) = (26335+28916) = (23885+26999) =
R		(23885+28382) = (22013+31283+34861) = (24105+31283+34862) =
R		(26335+31283+34862) = (24105+28479+31283+34862)
	0104	Mod : 26526 = (22769+26526) = (20361+22769+26526) = (20361+26526+27638) =
		(20361+22769+26526+27638)
	0105	Mod : (36627+35542) = (34637+36627+35542) = (26526+34637+36627+35542)
	0106	Mod : 20024 = 20167 = (20024+20167)
	0107	STD = (30368+35270) = (31283+34861) = (31283+34862) = (31283+34864) =
		(30368+31283+34862) = (30368+31283+35270)
	0108	Mod : 24035 = 24160 = 24211 = (24035+28290) = (24035+26497+28290) =
		(24160+26497+28290)
	0109	Mod : (23742+24035) = (23742+24160) = (23742+24211) = (23742+24035+24197)
	0110	Mod : (23742+24035) = (23742+24160) = (23742+24211) =
		(23742+24035+26497+28290) = (23742+24160+26497+28290)
	0111	Mod : 23853 = (22311+23853) = (22311+23853+25184) =
		(22311+23853+25184+27285) = (22311+22791+23853+25184+30389)
R	0112	Mod : (26526) = (26526+27046) = (26999+35119) = (30631+31896) =
R		(26526+28244+30170) = (26526+28244+28308+30170) =
R		(26526+28244+28308+28811+30170) =
R		(26526+28244+28308+28811+30170+34604)
	0113	Mod : 22791 = (22311+22791) = (22311+22791+25184) =
		(22311+22791+25184+27285) = (22311+22876+25184+28952)
	0114	Mod : (20283+21252+26169) = (20283+21252+26203) =
		(20283+21252+26169+26203)
R	0115	Mod : (26999+28916+31896) = (26999+28916+31897) = (26999+28916+32475) =
R		(28916+30631+32475) = (26999+28916+32929) = (25205+28916+32929) =
R		(26999+28916+35119) = (28916+30631+35119) = (25205+28916+35119) =
R		(26999+28382+28495+28916+31896) = (26999+28382+28495+28916+32475) =
R		(26999+28382+28495+28916+32929) = (26999+28382+28495+28916+35119) =
R		(26999+28916+31896+32332+35119) = (28916+30631+31896+32332+35119) =
R		(25205+28916+31896+32332+35119) =
R		(25205+26243+26717+27831+28916+32929) =
R		(26968+26999+28916+31896+32332+32475) =
R		(26999+28382+28495+28916+31896+32332+35119) =
R		(26243+26999+27831+28382+28495+28916+31897) =
R		(26717+26999+27831+28382+28495+28916+31897) =
	0116	STD = Mod : 25072 = (22562+25072) = (25888+27609) =
		(22562+25072+25888+27609)
	0117	Mod : 20042+20081+20230+21746+22260
	0118	Mod : 20457 = 20458 = 21144 = 25125 = 25386 = 26155 = 32682
	0119	Mod : (25184+26670) = (22311+25184+26670) = (22791+26670+30389) =
		(22311+25184+26670+27285) = (22311+22791+25184+26670+30389)
	0120	Mod : 22013 = (22013+24511) = (22013+24745) = (22013+24511+24745)
	0121	STD = Mod : 25072 = (22562+25072) = (25888+27609)
	0122	Mod : (24871+25000+27777) = (24871+26608+27777) =
		(22562+24871+25072+27777) = (22562+24871+25072+26608+27777) =
		(24871+25072+26608+27777)
	0123	Mod : (25184+26235) = (22311+25184+26235) = (22311+25184+26207+26235) =
		(22311+25184+26235+27285)
	0124	Mod : 23853 = (22311+23853) = (22311+23853+25184) =
		(22311+23853+25184+27285) = (22311+22791+23853+25184+30389)
	0125	Mod : (22769+36627) = (26526+34637+36627+22769)
	0127	Mod : (22769+35220+36627) = (22769+26526+34637+35220+36627)

	CODE	DESIGNATION
R	0128	Mod : (26999+31896) = (26999+31897) = (28382+31897) = (26999+32929) =
R		(26999+32475) = (28382+32475) = (30241+31896) =(26999+35119) =
R		(28382+35119) = (30241+35119) = (26999+31897+32333+32929) =
R		(26999+31896+32332+32475) = (26999+28382+28495+31896) =
R		(26999+28382+28495+31897) = (26999+28382+28495+32929) =
R		(26999+28382+28495+32475) = (26999+28382+28495+35119) =
R		(26999+31896+32332+35119) = (28382+31896+32332+35119) =
R		(30241+31896+32332+35119) = (27780+28416+30631+31896) =
R		(25205+26243+26717+27831+32929) = (25205+26243+26717+27831+35119) =
R		(26999+28382+28495+31897+32333+32929) =
R		(26999+28382+28495+31896+32332+35119)
	0129	Mod : 27777 = (26608+27777)
	0130	Mod : 26017+IAE V2500 = V2522 = V2524 = V2527 = V2527E = V2527M
	0131	IAE V2522 = V2524 = V2527 = V2527E = V2527M
	0132	STD = Mod : 26963 = (25419+26963) = (25419+26963+27992)
	0133	Mod : (25440+26231) = (25440+26231+26275+28293)
	0134	STD = Mod : 28684 = (20283+28684)
	0135	Mod : 34429 = (27620+34429) = (34429+30793+36814) =
		(27620+34429+30793+36814)
R	0137	Mod : (27531+31896) = (27531+31897) = (27531+35119) =
R		(27531+31896+32332+35119) = (27531+31897+32401+35651)
	0138	Mod : 22013 = 25053 = 26338 = (25053+26338)
R	0139	Mod : 31896 = 31897 = 35119 = (31896+32332+35119) = (31897+32401+35651) =
R		(31897+32401+34076+34809+37588)
	0140	Mod : (23885+28916) = (24075+28916) = (24075+25205+26999+28495+28916)
	0141	MSN : 0633 = 0993 = 1024 = 1695 = 1984 = 2021
R	0142	Mod : 36562 = 36609 = 36772 = (31896+32402+36562) =
R		(31897+32401+34809+36772) = (31897+32401+34809+36609) =
R		(31896+32402+34313+36562) = (31896+32332+32475+34313+36562) =
R		(31897+32333+32929+34809+36609)
	0143	Mod : (22311+22536+23346) = (22311+22536+23346+25184) =
		(22311+23346+22536+25184+27285)
	0144	Mod : (30206+K4337) = (36136+K4337) = (30206+20081+K4337) =
		(36136+20081+K4337)
R	0146	Mod : 31896 = 31897 = 35119 = (31896+32332+35119) = (31897+32401+35651) =
R		(31897+32401+37588)
	0147	Mod = 24064 = 24065 = 24066 = 24067 = 27831 = (24064+26497+28290) =
		(24065+26497+28290) = (24066+26497+28290) = (24067+26497+28290)
R	0148	Mod : 31896 = 31897 = (31896+32332+35119) = (31897+32401+35651) =
R		(31897+32401+34809+37588)
	0149	Mod : (22536+22791) = (22311+22791+23227) = (22311+22536+22791+25184) =
		(22311+22791+23227+25184) = (22311+22791+23529+25184) =
		(22311+22791+23227+25184+27285) = (22311+22876+23529+25184+28952)
R	0150	Mod : (20024+20586) = (20024+37565) = (20024+20586+30368+35270) =
R		(20024+30368+35270+37565)
R	0151	Mod : (20024+20586+22013) = (20024+22013+37565)
	0152	Mod : (24064+26497) = (24066+26497) = (26968+26497) =(27831+26497)
	0153	Mod : 20850 = 22461 = 23408 = (20850+22461) = (22461+23408) =
		(20850+22461+23408)
R	0154	Mod : 31896 = 31897 = 32402 = 32401 = 32475 = 32929 = 35119 =
R		(31896+32332+32475) = (31897+32333+32929) = (31896+32332+35119)
R	0155	Mod : (32042+32402) = (31896+32042+32402) = (32042+32401+32076)
	0156	Mod : 25053 = 26338 = (25053+26338)

	CODE	DESIGNATION
	0157	Mod : 22013 = 24035 = 24160 = 24189 = (22013+24035)
R	0158	Mod : (20024+20167) = (20024+20167+37331+37332)
	0159	Mod : 31896 = 31897 = (26999+28495+31896) = (31896+32332+35119) = (26999+28495+31896+32332+35119) = (26999+28495+31897+32401+35651)
R R	0160	Mod : 31896 = 31897 = (31896+32332+35119) = (31897+32401+35651) = (31897+32401+34076+37588)
	0161	Mod : (22536+25184+26670) = (22311+22536+25184+26670) = (22311+23227+25184+26670) = (22311+23529+25184+26670) = (22311+22536+25184+26670+27285) = (22311+23227+25184+26670+27285) = (22311+23529+25184+26670+27285)
	0162	Mod : 24035 = 24084 = 24160 = (24035+24084) = (24035+24160) = (24084+24160) = (24035+24084+24160)
	0163	Mod : 20024 = (20024+22802) = (20024+22802+L)
	0164	Mod : (22013+25415) = (20024+22013+25415)
	0165	(32087+32088) = (32087+32090) = (32088+36414) = (32090+36414)
	0166	Mod : (22013+23839) = (20024+22013+23839)
R R	0167	Mod : 31896 = 31897 = 32475 = 32929 = 35119 = (31896+32332+32475) = (31897+32333+32929) = (31896+32332+35119)
R R R	0168	Mod : 31896 = 31897 = 32401 = 32402 =32475 = 32929 =35119 = (31896+32402) = (31897+32401) = (31896+32332+32475) = (31897+32333+32929) = (31896+32332+35119)
	0169	STD = Mod : (20176+24748) = (20176+20210) = (20176+20461) = (20176+22296) = (20176+25480) = (20173+20176+24748)
R	0170	Mod : (20024+20586+30368) = (20024+30368+37565)
	0171	Mod : (22249+24035+31897+32600+33909) = (22249+24035+31897+32600+33910)
R	0172	Mod : (20024+20167+34456+37331) = (20024+20167+37226+37331)
	0173	Mod : (24035+33909) = (24035+33910)
	0174	Mod : (24215+33910) = (24588+33910) = (25534+33910)
	0175	Mod : (24035+33910) = (24160+33910) = (24189+33910) = (24035+33910+35220) = (24160+33910+35220) = (24189+33910+35220)
	0177	Mod : (24035+32600) = (24211+32600) = (24160+32600)
R R R R R	0178	Mod : (31896+22249) = (22249+31897) = (22249+32475) = (22249+32929) = (22249+24035+31896) = (22249+24035+31897) = (22249+24035+32475) = (22249+24035+32929) = (22249+24035+35119) = (22249+31896+32332+35119) = (31896+32332+32475+22249) = (22249+31897+32333+32929) = (22249+24035+31896+32332+35119)
	0179	Mod : (22311+25184+26193) = (22311+22876+25184+26380) = (22311+22876+25184+26380+27285)
R R	0180	Mod : 24035 = 24160 = 24211 = (24035+24211) = (24211+32475) = (24035+24211+32475)
	0181	Mod : (20057+20059+20082+20084+36856)
R R R	0182	Mod : 31896 = 31897 = 32475 = 32929 = 35119 = (31896+32332+32475) = (31897+32333+32929) = (31896+32332+35119) = (28925+31896+34282) = (28925+31897+24282) = (20701+23892+31896) = (20701+23892+32475)
R R R	0183	Mod : (24035+24064) = (24035+24065) = (24035+24066) = (24035+24067) = (24064+24211) = (24065+24211) = (24067+24211) = (24067+24160) = (24066+24211)
R R R R R	0184	Mod : 31896 = 31897 = 32475 = 32929 = (31896+32402) = (31897+32401) = (28495+31896) = (26999+28495+31896) = (31896+32332+32475) = (26999+28495+32475) = (26999+28495+32929) = (26999+28495+32475) = (31896+32332+35119) = (28495+31896+31896) = (26999+28495+31896+32402) = (26999+28495+31896+32332+35119)

	CODE	DESIGNATION
R	0185	Mod : (26999+31896) = (26999+31897) = (28382+31897) = (26999+32929) = (26999+32475) = (30631+32475) = (28382+32475) = (25205+32929) = (30241+31896) = (26999+35119) = (30631+31896) = (26999+28382+28495+31896) = (26999+31896+32332+32475) = (26999+31897+32333+32929) = (26999+28495+28382+32475) = (26999+28495+28382+31897) = (26999+28382+28495+32929) = (26999+31896+32332+35119) = (26382+31896+32332+35119) = (25205+26999+28382+32401) = (25205+26999+28382+32402) = (26999+28382+28495+31896+32402) = (26999+28495+28382+31897+32333+32929) = (26999+28495+28382+31896+32332+32475) = (26999+28382+28495+31896+32332+35119)
	0186	Mod : 27699 = (27699+32526+32886) = (27699+30162+36466) = (27699+32526+32886+30162+36466)
	0187	Mod : 31907 = (31907+32526+32886)
R	0188	Mod : (20024+20167+34456) = (20024+20167+37226) = (20024+20167+34456+37331+37332) = (20024+20167+37226+37331+37332)
R	0189	Mod : (24035+34079) = (24035+25863+35526) = (24189+24211+34573) = (24035+25863+32222) = (24035+25863+32997) = (24035+25863+34076) = (24035+25863+32160) = (24035+32475+32997) = (24035+25863+34573) = (24189+24211+25863+34573) = (24035+25863+28551+32997) = (24189+24211+32475+32997) = (24035+24211+25863+34573) = (24211+25863+32475+32997) = (24035+24211+25863+32222+34573) = (24035+24211+25863+32997+34573) = (24035+25863+28551+32475+32997) = (24035+25863+28551+32222+34195) = (24035+25863+28551+32997+34195) = (24035+25863+28551+34076+34195) = (24035+25863+28551+34076+34195) = (24035+25863+28551+32160+34195) = (24035+25863+38551+34195+34573) = (24035+25863+34076+35526+37588)
	0190	Mod : 27558 = (22311+22876) = (22311+22876+25184) = (22311+22876+25184+27285) = (22311+25184+26875+27285) = (22311+25184+26670+27285+27558)
	0191	Mod : (22311+23346) = (22311+23346+25184) = (22311+23346+25184+27285)
R	0192	Mod : 31896 = 31897 = 32402 = 32401 = 32475 = 32929 = 35119 = (31896+32332+32475) = (31897+32333+32929) = (31896+32332+35119)
R	0193	Mod : (22013+31896) = (22013+31897) = (22013+32475) = (22013+32929) = (24105+31896) = (24105+31897) = (24105+32475) = (24105+32929) = (25225+31896) = (25225+31897) =(25225+32475) = (25225+32929) = (22013+35119) = (22013+31896+32332+32475) = (22013+31897+32333+32929) = (24105+31896+32332+32475) = (24105+31897+32333+32929) = (25225+31896+32332+32475) = (25225+31897+32333+32929) = (25225+31896+32332+35119) = (22013+31896+32332+35119) = (25225+28399+31896+32332+32475) = (25225+28399+31897+32333+32929)
R	0194	Mod : 31896 = 31897= 32475 = 32929 = (25225+28399+31896) = (25225+28399+31897) = (25225+28399+32475) = (25225+28399+32929) = (31896+32332+32475) = (31897+32333+32929) = (31896+32332+35119) = (25225+28399+35119) = (25225+28399+31896+32332+35119)
R	0195	Mod : 31896 = 31897 = 32475 = 32929 = (24035+35119) = (31896+32332+32475) = (31897+32333+32929) = (31896+32332+35119)
	0196	Mod : 30368 = (27699+30162+30368)
	0197	STD = Mod : (30368+35270) = (27699+30162)
	0198	Mod : 27699 = (27699+30162+36466)
	0199	Mod : (27699+30368) = (27699+30368+30162+36466)
	0200	MSN : 119 = 123 = 124 = 205 = 370 = 390 = 402 = 511
	0201	Mod : 33505 = 33253 = (25440+26194+26275+28293+33253) = (25440+26194+26275+26560+33253+35555)
R	0202	Mod : (20024+20586+22013+30368) = (20024+22013+30368+37565)

	CODE	DESIGNATION
R	0203	Mod : (25295+34809) = (27522+34809) = (27522+34313) = (25295+34313) =
R		(25295+27522+34313) = (25295+27522+34809) = (25295+27522+28360+34313) =
R		(25595+27522+28360+34809)
	0204	Mod : 24404 = 24405 = 25530 = 27640
	0205	Mod : 27650 = (25440+26185+27650) = (25440+26275+27650+28293) =
		(25440+26185+26275+27650+28293) = (25440+26194+26275+27650+28293) =
		(25440+26194+26275+26560+27650+35555)
	0206	Mod : 20175 = 25738 = (20175+25808) = (25440+26194) = (25440+26194+26275)
		= (25440+26231+26829) = (25440+26194+26829) = (25440+26194+26275+28293)
		= (25440+26231+26275+26829+28293) = (25440+25808+26231+26829) =
		(25440+26194+26275+26560+35555)
	0207	Mod : 22914 = 34383 = (20175+20704) = (20175+34383) = (20175+21441) =
		(21441+22183) = (21441+22192) = (25440+26275) = (20175+21441+22192) =
		(20175+21441+22914) = (20175+25440+26275) = (25440+26275+26560+35555)
	0208	Mod : (20024+23839+25415) = (20024+22013+23839+25415) =
		(20024+22013+23839+25415+30206)
	0209	Mod : 26117 = 26270 = (26117+26270) = (25819+26270+35554) =
		(25819+26117+35554)
	0210	Mod : (25184+26193) = (22311+22876+25184+26380) =
		(22311+22876+25184+26380+27285)
	0211	Mod : 25819 = 25529 = 26345 = (25529+25819) = (25819+26117+35555) =
		(25529+26117+35555)
R	0212	Mod : (20586+24035) = (20586+24084) = (24035+37565) = (24084+37565) =
R		(20586+24035+24084) = (24035+24084+37565)
	0213	Mod : (27046+28244+28308+31426) = (26526+27046+28244+31426+28308)
R	0214	Mod : (25295+27522+28360+36562) = (25595+27522+28360+36609) =
R		(25295+27522+28360+36772) = (27522+34809+36772) = (37522+34809+36609) =
R		(27522+34313+36562) = (25295+34809+36772) = (25295+34809+36609) =
R		(25295+34313+36562) = (25295+27522+34313+36562) =
R		(25295+27522+34809+36609) = (25295+27522+34809+36772)
	0215	Mod : (26526+27046+28244+28308+31375+31426+34825)
R	0216	Mod : (20586+30368) = (30368+37565) = (20586+24035+24084+30368) =
R		(24035+24084+30368+37565)
R	0217	Mod : (27522+36562) = (25295+36609) = (25295+36772) = (27522+36609) =
R		(27522+36772) = (25295+36562) = (25295+27522+36562) = (25295+27522+36609)
R		= (25295+27522+36772)
	0218	Mod : 26877 = 27698 = 27740 = 27753 = 28738 = 28739 = 30163 = 31699 =
		(23529+33055) = (22536+27698) = (23227+28739) = (23529+27740) =
		(23529+27753+33055)
R	0219	Mod : 25295 = 27522 = (25295+27522+28360) = (25295+27522+37588) =
R		(25295+27522+36772+37588)
	0220	Mod : (22536+22876) = (22536+27558) = (22311+22876+23227) =
		(22311+22536+22876+25184) = (22311+22876+23227+25184) =
		(22311+22876+23529+25184) = (22311+22536+22876+25184+27285) =
		(22311+22876+23227+25184+27285) =
		(22311+23529+25184+26670+27285+27558)
R	0221	STD = (26999+28495) = (22013+23672+23219) = (23672+24105+25294) =
R		(22013+23219+23672+26999+28495) = (23672+24105+25294+26999+28495)
R	0222	Mod : (26526+27046+28244+28308+34825) =
R		(26526+27046+28244+28308+34825+31426+34825+35074)
R	0223	Mod : 25205 = 26111 = 26485 = 26999 = 28382 = 30241 = 30631 = 30635 =
R		(25205+26999+28495) = (26999+28382+28495)
	0224	Mod : (22536+25184+26235) = (22311+22536+25184+26235) =
		(22311+23529+25184+26235) = (22311+22536+25184+26235+27285)
	0225	Mod : 22707+IAE V2500 = V2522 = V2524 = V2527 = V2527E = V2527M

	CODE	DESIGNATION
	0226	IAE V2500 = V2522 = V2524 = V2527 = V2527E = V2527M
	0227	Mod : 24404 = 24405 = 25530 = 27640
R	0228	Mod : (25205+28916) = (26999+28479) = (26999+28702) = (26999+28916) = (28382+28916) = (28916+30631) = (26111+28479) = (26485+28479) = (30241+28479) = (30635+28479) = (26111+28916) = (26485+28916) = (30241+28916) = (25205+31283) = (30635+28916) = (26999+28382+28495+28916) = (26999+28382+28479+28495) = (25205+26999+28495+28916) = (26270+26999+28382+28479+28495+34514)
R	0229	Mod : (26270+28382) = (25205+25529) = (25529+26999) = (25529+28382) = (25529+30241) = (26117+26999) = (26270+26999) = (30631+25529) = (30631+26117) = (30631+26270) = (30631+26345) = (30241+26117) = (30241+26270) = (30241+26345) = (25529+26111) = (26117+26111) = (26111+26270) = (26111+26345) = (26485+25529) = (26485+26117) = (26485+26270) = (26485+26345) = (30635+25529) = (30635+26117) = (30635+26270) = (30635+26485) = (25529+26999+28382+28495) = (26270+26999+28382+28495) = (25529+26999+31283+34864)
R	0230	Mod : (26111+28479+32600) = (26111+28916+32600) = (26485+28479+32600) = (26485+28916+32600) = (30241+28479+32600) = (30241+28916+32600) = (30635+28479+32600) = (30635+28916+32600) = (30631+28479+32600) = (26999+28479+32600) = (26999+28916+32600) = (28916+30631+32600) = (26999+28382+28479+28495+32600) = (26999+28382+28495+28916+32600) = (26999+28382+27917+28916+32600)
R	0231	Mod : 25108 = 35793 = (22013+23672) = (23672+24105) = (24581+36529) = (24785+36529) = (25108+30020) = (22013+23219+36529) = (24105+25294+36529) = (24105+25108+30020) = (24581+30020+36529) = (24785+30020+36529) = (25108+26999+28495) = (22013+23219+23672+35793) = (22013+23219+23672+36529) = (23672+24105+25294+35793) = (23672+24105+25294+36529) = (23672+24105+26999+28495)
R	0232	Mod : (25205+26270+28916) = (25529+26999+28479) = (25529+26999+28916) = (25529+28382+28916) = (26117+26999+28479) = (26117+26999+28916) = (26270+26999+28479) = (26270+26999+28916) = (25529+26111+28479) = (25529+26111+28916) = (26111+26117+28479) = (26111+26117+28916) = (26111+26270+28479) = (25205+26117+26270+28916) = (25529+26999+28382+28479+28495) = (25529+26999+28382+28495+28916) = (26117+26999+28382+28495+28702) = (26270+26999+28382+28479+28495) = (26270+26999+28382+28495+28916) = (25529+26111+26345+26378+28479)
	0235	Mod : 24211 = (23742+24035) = (23742+24160) = (23742+24211) = (23742+24035+26497+28290)
	0236	Mod : (24211+26497) = (23742+24035+26497) = (23742+24160+26497)
	0237	Mod : 24414 = (24035+24414) = (24211+24414)
	0239	Mod : 35220 = (31283+35220) = (22013+24044+35220) = (25951+32239+35220) = (28479+31283+35220) = (22013+24044+31283+35220)
	0240	Mod : 23346 = (22311+23346) = (22311+23346+25184) = (22311+23346+25184+27285)
	0241	Mod : 23853 = (22311+23853) = (22311+23853+25184) = (22311+23853+25184+27285)
	0243	Mod : 26497 = (24035+26497) = (24160+26497) = (24211+26497)
	0245	Mod : (20173+26358) = (25650+26358) = (26274+26358) = (26274+26358+26999+28495) = (26274+26358+26999+27646+28382+28495) = (26274+26358+26999+27531+27646+28382+28495+35638)
	0246	Mod : 22536 = 23227 = 23529 = (22536+28308+28811) = (23227+28308+28811) = (23529+28308+28811) = MSN : 163 = 164 = 168 = 169 = 179 = 193 = 221 = 222 = 230 = 294 = 299 = 301 = 338 = 348 = 349 = 362 = 363 = 424 = 429 = 437 = 444 = 449 = 476
R	0247	Mod : MSN 1071=1078=1090=1091=1126=1129=1131=1149=1164=1167

	CODE	DESIGNATION
	0248	Mod : 20175 = 25738 = (20175+25808) = (25440+26194) = (25440+26194+26275) = (25440+26231+26829) = (25440+26194+26829) = (25440+26194+26275+28293) = (25440+26231+26275+26829+28293) = (25440+25808+26231+26829) = (25440+26194+26275+26560+35555
	0250	Mod : (20024+20167+22013+30422) = (20024+20167+22013+25453+30422)
	0251	Mod : (20024+22013+25415) = (20024+22013+25415+28652)
	0253	Mod : 33751 = (25440+26275+26560+33751) = (25440+26194+26275+26560+33751+35554)
	0254	Mod : 26269 = (21310+34392) = (21441+26269) = (25440+26269) = (25440+26382) = (26194+30571) = (25440+26194+30571) = (25440+26269+26275+28293) = (25440+26275+26382+28293) = (25440+26194+26275+28293+30571)
	0255	Mod : (28244+34825) = (26526+28244+28308+31375+31426+33450+34825+35074+36720) = (26526+28244+28308+30170+31375+31426+33450+34825+35074+36720
	0256	Mod : 25381 = 27522 = (25295+25381) = (25295+27522)
	0258	Mod : 23885 = 24075 = 25205 = 26111 = (24075+25205+26999+28495)
	0259	Mod : 25205 = 26111 = (24075+25205+26999+28495)
	0260	STD = Mod : 25069 = (25440+26185) = (25440+26208) = (25440+26382+30387) = (25440+26185+26275+28293) = (25440+26208+26275+28293) = (25440+26231+26275+28293+30951)
R	0261	Mod : (27699+30162) = (27699+30162+32562+32886)
	0263	Mod : (23529+23853) = (22311+22536+23853) = (22311+23529+23853) = (22311+225326+23853+25184) = (22311+23227+23853+25184) = (22311+23529+23853+25184) = (22311+23529+23853+25184+27285) = (22311+22791+23529+23853+25184+30389)
	0266	Mod : 35538 = 32262 = 32766 = (27256+32262) = (27256+32766) = (27256+27541+32262) = (27256+27541+35538)
	0267	Mod : 23742 = (26358+30980) = (23742+26358+30980) = (23742+26274+30955) = (23742+26274+27531)
	0268	Mod : 26358 = (23742+26358) = (23742+26274+26358+30955) = (23742+26274+26358+27531)
	0269	Mod : (23742+26274+26358) = (20173+23742+26358) = (20173+23742+26274+26358)
	0272	Mod : 32475 = 32401 = 32402 = 32929 = 34076 = (31896+32402) = (31897+32401) = (31897+34076) = (31896+32332+32475) = (31897+32333+32929)
	0273	Mod : 32475 = 32401 = 32402 = 32929 = 34076 = (31896+32402) = (31897+32401) = (31896+32332+32475) = (31897+32333+32929) = (31897+32929+34076)
	0275	Mod : 34313 = 34809 = (31896+32402+34313) = (31896+32332+32475+34313) = (31897+32401+34076+34809) = (31897+32929+34076+34809)= (31897+32333+32929+34076+34809)
	0277	Mod : 34313 = 34809 = (31896+32402+34313) = (31897+32401+34809) = (31897+32929+34809) = (31896+32332+32475+34313) = (31897+32333+32929+34809)
R R	0278	Mod : 31896 = 31897 = 32475 = 32929 = 35119 = (31896+32332+32475) = (31897+32333+32929) = (31896+32332+35119)
	0279	Mod : 34313 = 34809 = (25225+28399+34313) = (25225+28399+34809)
	0281	Mod : 21310 = (25440+26231) = (25440+26231+26275+28293)
R	0282	Mod : (k1170+33254+36475) = (k1170+k5043+33254+36475)
	0283	Mod : 22769 = (20361+22769+27638) = (22769+26526+28956)
R R	0287	Mod : 31896 = 31897 = 32401 = 32402 = 32475 = 32929 = 35119 = (31896+32332+32475) = (31897+32333+32929) = (31896+32332+35119)
R R R	0288	Mod : 20075 = 20219 = 21776 = 24266 = 24267 = 31006 = 37563 = 36873 = (20075+20219) = (20075+24267) = (24266+24267) = (24266+27979+37536) = (24266+32310+37536)

	CODE	DESIGNATION
	0290	Mod : (21437+26621+31119) = (K11050+21437+26621)
	0292	STD = Mod : (26526+28956) = (26526+28244+28956)
	0293	Mod : 22769 = (26526+28956) = (22769+26526+28956)
	0294	Mod : (22562+24404) = (22562+24405) = (22562+25530) = (22562+27640)
	0295	Mod : (22562+24404+27993) = (22562+24405+27993) = (22562+25530+27993) = (22562+27640+27993)
R	0296	Mod : 20075 = 20219 = 21776 = 24266 = 24267 = 31006 = 37563 = 36873 =
R		(20075+20219) = (20075+24267) = (24266+24267) = (24266+30368+35270) =
R		(24267+30368+35270) = (24266+27979+37536) = (24266+32310+37536)
R	0297	Mod : (20075+30368) = (20219+30368) = (21776+30368) = (24266+30368) =
R		(30368+31006) = (30368+37536) = (30368+36873) = (24266+27979+30368+37536)
R		= (24266+30368+32310+37536)
	0299	Mod : 27993 = (22089+27993) = (24871+27993)
	0300	Mod : (K2211+21144) = (K2211+22681) = (K2211+25839) = (K2211+26155) = (K2211+25386)
	0303	Mod : 27230 = 28677 = 28778 = 31134 = 31177 = 27540 = 30467 = 30338 = 30335 = (30339+K7358)
	0305	Mod : STD = 28413 = (27189+28413) = (27014+28413)
R	0306	Mod : 22013 = 23119 = 24105 = 27014 = 27189 = 30020
R	0307	Mod : (27620+32007) = (27620+32007+37285)
R	0308	Mod : (27620+26999) = (27620+26999+37285) = (26999+27620+28382+28495) =
R		(26999+27620+28382+28495+37285)
	0310	Mod : 20057=20059=30067=35236 = (20057+20059)
	0311	Mod : (20818+K2211) = (K2211+20818+K0385+K7738)
	0312	Mod : (20818+30206) = (20818+30206+K0385+K7738)
	0313	Mod : (20818+K5043) = (K5043+20818+K0385+K7738)
	0314	STD = Mod : (22875+25398) = (22875+30249)
	0315	Mod : (20818+27170+31265) = (20818+27170+31266) = (20457+20818+26703+27170)
	0317	Mod : (28240+30292) = (28221+28240+30292)
	0318	Mod : (27993+30020) = (22089+27993+30020)
R	0319	Mod : (26999+32007) = (26999+28382+28495+32007) =
R		(26999+27620+32007+33497)
	0321	Mod : (20818+21144) = (20818+26155) = (20818+31265) = (20818+31266)
	0322	Mod : 20067 = 20069 = (20067+20069)
	0323	Mod : (20510+20818+21144) = (20510+20818+26155) = (20510+20818+26539) = (20510+20818+31265) = (20510+20818+31266)
	0324	Mod : (31266+36043) = (26703+31266) = (25577+31266) = (31265+36043) = (25904+31265) = (20457+26703) = (20457+27170) = (20458+27170) = (21144+27170) = (25125+27170) = (25386+25577) = (25576+25577) = (25839+27170) = (25903+25904) = (26155+27170) = (26539+27170) = (25386+25576+25577) = (20457+26703+27170) = (20457+31266+36043) = (25386+31266+36043) = (22681+25904+27170+31265)
	0325	STD = Mod : (K0385+K7738) = (K0385+K7738+20818+35120) = (20818+35120)
R	0327	Mod : (26999+27620+32007) = (26999+27620+32007+37285)
	0330	STD = (31283+34864) = (31283+34862) = (31283+34861) = (28479+30660+31283+34864)
	0332	STD = Mod : (22013+24044) = (25951+32239)
	0333	Mod : (28925+31896) = (28925+31897) = (28925+32929) = (28925+32475) = (28925+31896+32332+32475) = (28925+31897+32333+32929) = (28925+31896+32332+35119)
	0338	Mod : (20057+20082+22706+22707) = (P2879+20057+20082+22706+22707)

	CODE	DESIGNATION
	0339	Mod : (20057+20059+20082+20084) = (P2878+P2879+20057+20059+20082+20084+22706+22707) = (20057+20059+20082+20084+22706+22707)
	0340	Mod : (P2878+P2879+20057+20059+22706+22707)
	0343	Mod : (25110+26923) = (25110+27255) = (25110+27572)
R	0344	Mod : 27620 = (27620+37285) = (27620+33497+37285)
	0346	Mod : (22013+34313) = (22013+34809) = (24105+34313) = (24105+34809) = (25225+34313) = (25225+34313) = (25225+34809)
	0347	Mod : (24035+24414+32600) = (24305+24414+25346+32600)
	0348	Mod : (20024+22013+30422) = (20024+22013+25453+30422)
	0349	Mod : (20024+30422) = (20024+25453+30422)
	0350	Mod : 25381 = (25295+25381+28499)
R R	0352	Mod : 27620 = (21126+27620) = (27620+37285) = (21126+35643+27620) = (21126+27620+37285)
	0353	Mod : (22013+20047) = (22013+20047+US)
	0354	Mod : (24105+20047) = (24105+20047+US)
	0358	STD = Mod : (31896+32332) = (31897+32333)
	0359	Mod : (28479+32600) = (28916+32600) = (26999+28479+28495+32600)
R	0364	Mod : 27620 = (27620+37285) = (20316+27620) = (20316+27620+37285)
	0365	Mod : (20117+27620) = (21678+27620) = (20117+21678+27620)
	0367	Mod : (22536+25205+25529) = (22536+25529+26999) = (22536+25529+28382) = (22536+26117+26999) = (22536+26270+26999) = (23227+25529+26999) = (23227+25529+28382) = (23227+25529+30241) = (23227+26117+26999) = (23227+26270+26999) = (23529+25205+26270) = (23529+25529+26999) = (23529+25529+28382) = (23529+26117+26999) = (23529+26270+26999) = (23529+26270+28382) = (22536+23885+25529) = (23227+23885+26117) = (23227+23885+26270) = (23227+26270+28382) = (23529+23885+26270) = (23227+26117+26999+28382+28495) = (22536+25529+26999+28382+28495) = (22536+26117+26999+28382+28495) = (22536+26270+26999+28382+28495) = (23227+25529+26999+28382+28495) = (23227+26270+26999+28382+28495) = (23529+25529+26999+28382+28495) = (23529+26270+26999+28382+28495) = (23529+26117+26999+28382+28495)
	0368	Mod : (23529+25205) = (22536+25205) = (23529+23885) = (23529+28382) =(23529+23885+26111)
	0369	Mod : (22536+25205+25409) = (22536+25409+26999) = (22536+25409+28382) = (22536+25409+30631) = (23227+25205+25409) = (23227+25409+26999) = (23227+25409+28382) = (23227+25409+30241) = (23227+25409+30631) = (23529+25205+25409) = (23529+25409+26999) = (23529+25409+28382) = (23529+25409+30631) = (23529+23885+25409) = (22536+23885+25409+26111) = (23227+23885+25409+26111) = (23529+23885+25409+26111) = (23227+25205+25409+26999+28495) = (23227+25409+26999+28382+28495) = (23529+25409+26999+28382+28495)
	0370	Mod : (25409+26999) = (23885+25409) = (23885+25409+26111) = (25409+26999+28382+28495)
	0371	Mod : (26526+31426) = (26526+28244+30170+31426)
	0372	Mod : (20067+33100) = (20069+33100) = (20067+20069+33100)
	0374	Mod : 24414 = 25346 = (24414+32600) = (25346+32600)
R	0376	Mod : 27620 = (27620+37285) = (27620+30793+36814)
	0378	Mod : (22013+28479) = (22013+28916) = (24105+28479) = (24105+28702) = (24105+28916) = (26334+28479) = (26334+28702) = (26334+28916) = (26335+28479) = (26335+28702) = (26335+28916) = (22013+31283+34861) = (24105+31283+34862) = (26335+31283+34862) = (24105+28479+31283+34862)
	0379	STD = Mod : (31896+32332) = (31897+32333)
	0381	Mod : (27522+35227) = (27522+34869+35227)

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	0382	Mod : 34313 = 34809 =(31896+32402+34313) = (31897+32401+34809) = (31897+32333+32929+34809) = (31896+32332+32475+34313)
R	0383	Mod : (27620+30793) = (27620+30793+37285)
	0384	Mod : 20701 = (31896+32332+20701) = (31897+32333+20701)
R	0385	Mod : 27620 = (27620+37285) = (27620+30793+36814)
R	0386	Mod : 27620 = (27620+37285) = (27620+28191+36816) = (27620+30793+36814) =
R		(27620+28191+30793+36813+36814)
	0387	STD = Mod : (31896+32332) = (31897+32333)
R	0388	Mod : (27620+30793) = (27620+30793+37285) = (27620+28191+30793+36813)
R	0390	Mod : (27620+28191) = (27620+28191+37285) = (27620+28191+30793+36814)
	0391	Mod : (30660+31371) = (27522+30660+31371)
R	0392	Mod : (27620+28191+30793) = (27620+28191+30793+37285)
	0393	Mod : 20067+20069+20071+21708+25426
	0394	Mod : (26526+27046+28308) = (26526+27046+28308+30368) =
		(26526+27046+28308+30368+35270)
	0395	Mod : (20067+20069+20071+31424) = (20057+20067+20069+20071+31424) =
		(20059+20067+20069+20071+31424)
	0396	Mod : 27522 = (27522+31371+31728) = (P0164+27522+30660+31371+31728)
	0397	Mod : 20117 = 21678 = (20117+21678) = (21678+26999+28495)
	0398	Mod : 26999 = 27646 = 30631 = (26999+28382+28495)
R	0400	Mod : (27620+30793) = (27620+30793+37285)
R	0401	Mod : (27620+30639) = (27620+30639+37285)
R	0402	STD = Mod : (31897+32332) = (31897+32333)
R	0403	Mod : 28369 = (28369+31896+32332) = (28369+31897+32333)
R	0404	Mod : 31896 = 31897 = 32222 = 32401 = 32402 = 32475 = 32929 = 35119 =
R		(31896+32222) = (31896+32402) = (31896+32402) = (31897+32401) =
R		(32401+32929) = (31896+32332+32475) = (31896+32402+32475) =
R		(31897+32401+ 32929) = (31896+32332+35119) = (31897+32333+32929)
R	0405	Mod : (28369+31896) = (28369+31897) = (28369+32222) = (28369+32401) =
R		(28369+32402) = (28369+32475) = (28369+32929) = (28369+31896+32402) =
R		(28369+31897+32401) = (28369+32401+32929) = (28369+31896+32222) =
R		(28369+31897+32401+32929) = (28369+31896+32332+35119) =
R		(28369+31897+32333+32929)
R	0407	Mod : (P7092+31896) = (P7092+31897) = (P7092+32222) = (P7092+32401) =
R		(P7092+32402) = (P7092+32475) = (P7092+32929) = (P7092+31896+32402) =
R		(P7092+31897+32401) = (P7092+31896+ +32222+32402)
R		=(P7092+31896+32332+32475)= (P7092+31896+32402+32475) =
R		(P7092+31896+32222+32402+32475) = (P7092+31896+32332+35119) =
R		(P7092+31897+32333+32929)
	0413	Mod : (24871+27993) = (22562+25072+27993) = (22562+24871+25072+27993)
R	0415	Mod : (20081+26858+28479) = (20081+28479+33254)
R	0416	Mod : 30206 = 36136 = (20081+30206) = (20081+36136) =
R		(20081+28479+33254+36136)
R	0417	Mod : (K4337+20081+36475) = (K4337+20081+28479+33254+36475))
R	0418	DLH + (MSN : 0069 = 0070 = 0071 = 0072 = 0078 = 0083 = 0086 = 0093 = 0094
R		= 0104 = 0110 = 0111 = 0116 = 0117 = 0135 = 0137 = 0147 = 0161 = 0162 =
R		0172 = 0200 = 0201 = 0202 = 0209 = 0216 = 0217 = 0218 = 0267 = 0268 = 0269
R		= 0346 = 0382 = 0401 = 0412 = 0458 = 0468 = 0473 = 0474 = 0484 = 0493 =
R		0502 = 0505 = 0518 = 0560 = 0563 = 0564 = 0567 = 0595)
R	0419	DLH + (MSN : 0069 = 0070 = 0071 = 0072 = 0078 = 0083 = 0086 = 0093 = 0094
R		= 0104 = 0110 = 0111 = 0116 = 0117 = 0135 = 0137 = 0147 = 0161 = 0162 =
R		0172 = 0200 = 0201 = 0202 = 0209 = 0216 = 0217 = 0218 = 0267 = 0268 = 0269
R		= 0346 = 0382 = 0401)
	0420	Mod : 30368 = (24035+24084+30368)

	CODE	DESIGNATION
R	0422	DLH + (MSN : 0412 = 0458 = 0468 = 0473 = 0474 = 0484 = 0493 = 0502 = 0505
R		= 0518 = 0560 = 0563 = 0564 = 0567 = 0595)
	0423	Mod : (20024+22013) = (20024+22013+32650+32651)
	0424	Mod : 20024 = (20024+32650+32651)
	0426	Mod : (IAE Eng+30368) = (24105+30368) = (IAE Eng+24105+30368)
	0427	Mod : (20024+22013+30368+30422) = (20024+22013+25453+30368+30422)
	0430	Mod : 32475 = 32929 = (31896+32402) = (31897+32401) = (31896+32332+32475)
		= (26999+28495+32475) = (26999+28495+32929) = (26999+28495+31896+32402)
R	0436	Mod : (24035+26497+32600) = (24160+26497+32600) = (24211+26497+32600)
R	0437	Mod : (23742+24035+32600) = (23742+24160+32600) = (23742+24211+32600)
R	0438	Mod : (23742+24035+26497+32600) = (23742+24160+26497+32600) =
R		(23742+24211+26497+32600)
R	0439	Mod : (23742+24035+32600) = (23742+24160+32600) = (23742+24211+32600) =
R		(23742+24035+28925+32600+34282) = (23742+24211+28925+32600+34282) =
R		(23742+24160+28925+32600+34282)
	0440	Mod : (31495+20151) = (31495+31112) = (31495+23092)
	0441	Mod : (26925+30368) = (26925+30368+P7084)
	0443	Mod : (22013+28479) = (22013+28916) = (25951+28479) = (25951+28916) =
		(25951+28702)
R	0445	Mod : (24035+32600) = (24160+32600) = (24211+32600) =
R		(24035+28925+32600+34282) = (24211+28925+32600+34282) =
R		(24160+28925+32600+34282)
R	0447	Mod : (23742+24035+28925+32600) = (23742+24211+28925+32600) =
R		(23742+24160+28925+32600)
R	0448	Mod : (24035+28925+32600) = (24211+28925+32600) = (24160+28925+32600)
R	0449	STD = Mod : (31896+32332) = (31897+32333)
R	0450	Mod : 32600 = (32600+31896) = (32600+31897) = (32600+35119) = (32600+32929)
R		= (32600+32475) = (32600+31896+32332) = (32600+31897+32333) =
R		(32600+31896+32332+35119) = (32600+31896+32332+32475) =
R		(32600+31897+32333+32929)
R	0451	Mod : 31896 = 31897 = 32929 = 32475 = 35119 = (31896+32332+35119) =
R		(31896+32332+32475) = (31896+32333+32929)
R	0452	Mod : 35240 = (27608+35240) = (23211+27608+35240)
R	0454	Mod : (23853+35240) = (22311+23853+35240) = (22311+23853+25184+35240) =
R		(22311+23853+25184+27285+35240) =
R		(22311+22791+23853+25184+30389+35240)
R	0456	Mod : (22791+35240) = (22311+22791+35240) = (22311+22791+25184+35240) =
R		(22311+22791+25184+27285+35240) = (22311+22876+25184+28952+35240)
R	0457	Mod : (23346+35240) = (22311+23346+35240) = (22311+23346+25184+35240) =
R		(22311+23346+25184+27285+35240)
	0458	Mod : 26358 = (26358+26999+28495) = (26358+26999+27917)
	0459	Mod : 32475 = 32401 = 32402 = 32929 = (31896+32402) = (31897+32401) =
		(31896+32332+32475) = (31897+32333+32929)
R	0461	Mod : (26193+35240) = (26380+35240) = (25184+26193+35240) =
R		(22311+22876+25184+26380+35240) =
R		(22311+22876+25184+26380+27285+35240)
R	0463	Mod : (26235+25184+35240) = (22311+25184+26235+35240) =
R		(22311+25184+26235+27285+35240)
R	0467	Mod : (26193+35240) = (26380+35240) = (22311+22876+25184+26380+35240) =
R		(22311+22876+25184+26380+27285+35240)
R	0468	Mod : (20029+20062) = (20449+20062) = (200029+23398) = (20049+23398)
	0470	STD = Mod : (24404+25502) = (24405+25501) = (25530+26505)
R	0472	Mod : (20062+24105+30020) = (23398+24105+30020)

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	0473	Mod : (24105+32208) = (24105+32208+US)
	0474	STD = Mod : (22013+24785) = (22013+30400) = (24105+25294) = (24105+30020) = (24105+30400) = (25108+30400)
R	0475	Mod : (20029+20062+22013+22992) = (20029+22013+22992+23398)
R R	0476	SDT = Mod : (20029+21065) = (20449+21065) = (20029+21065+30368+35270) = (20449+21065+30368+35270)
	0477	Mod : 26111 = 25205 = 26999 = 28382 = 30241 = (23885+26111) = (25205+26999+28495) = (26999+28495+28382) = (26999+31896+32332) = (26999+31897+32333) = (26999+28495+28382+31897+32333)
R R	0478	Mod : 22707 = (22707+30368+35270) = (20029+21065+22707) = (20449+21065+22707) = (20029+21065+22707+30368+35270)
	0479	Mod : (30631+32402) = (30631+32401) = (26485+32402) = (26485+32401) = (30631+32929) = (26485+32929) = (30631+32475) = (30631+31896+32332+32475) = (26485+31896+32332+32475) = (30631+31897+32333+32929) = (26485+31897+32333+32929)
	0480	STD = Mod : (25225+28399) =(31896+32332) = (31897+32333) = (25225+28399+31896+32332) = (25225+28399+31897+32333)
	0481	Mod : 22013 = 24105 = 25225 = (22013+31896+32332) = (22013+31897+32333) = (24105+31896+32332) = (24105+31897+32333) = (25225+31896+32332) = (25225+31897+32333)
R R	0482	Mod : (20029+22707) = (20449+22707) = (20029+22707+30368+35270) = (20049+22707+30368+35270)
R	0483	Mod : (20029+22013+22707+22992) = (20029+22013+22707+22992+30368+35270)
R	0484	Mod : (20029+22013+22707) = (20029+22013+22707+30368+35270)
	0485	Mod : (20047+24105+30020) = (20047+24105+30020+US)
R R	0486	Mod : (22707+30368) = (20029+21065+22707+30368) = (20449+21065+22707+30368)
R R	0487	Mod : (20029+22707+30368) = (20449+22707+30368)
R R	0488	Mod : (20029+22013+22707+22992+30368)
R R R R R	0489	Mod : 25667 = (20175+25667) = (26269+26560) = (25440+26185+26275) = (25440+26275+26430) = (25440+26275+26560) = (25440+26275+36274) = (25440+26194+26275+28293+31838) = (25440+26194+26275+28293+31838) = (25440+26194+26275+26560+35554)
R R R R R	0490	Mod : 25667 = (20175+25667) = (26269+26560) = (25440+26185+26275) = (25440+26275+26430) = (25440+26275+26560) = (25440+26275+36274) = (25440+26194+26275+28293+31838) = (25440+26194+26275+28293+31838) = (25440+26194+26275+26560+35554)
R R R	0491	Mod : (20067+20069+20071+26402+31424) = (20067+20069+20071+26402+31424+32514)
R R R	0492	Mod : (20067+20069+20071+34883) = (20067+20069+20071+36665) = (20067+20069+20071+34881+34883)
R R R R R R	0494	Mod : 27211 = (22013+25903+25904) = (22013+22681+27211) = (22013+25839+27170) = (22013+26539+27170) = (22013+25904+31265) = (22013+27170+31265) = (22013+27211+31265) = (22013+31265+36043) = (22013+31265+37095)
R R	0496	Mod : (22013+27170) = (22013+25904) = (22013+36043) = (22013+37095)
R R R R R	0497	Mod : (31266+37095) = (20457+26703) = (20457+27170) = (20458+27170) = (21144+27170) = (25125+27170) = (25386+25577) = (25386+27170) = (25576+25577) = (26155+27170) = (31266+36043) = (25386+25576+25577) = (20457+26703+27170) = (25386+31266+36043) = (20457+31266+36043)

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R	0498	Mod : 27211 = (31265+37095) = (31266+37095) = (20457+26703) = (20457+27170)
R		= (20458+27170) = (21144+27170) = (22681+27170) = (22681+27211) =
R		(25125+27170) = (25386+25577) = (25386+27170) = (25576+25577) =
R		(25839+27170) = (25903+25904) = (26155+27170) = (26539+27170) =
R		(31265+25904) = (31265+27170) = (31266+25577) = (31266+27170) =
R		(31266+26703) = (31265+27211) = (31266+36043) = (31265+36043) =
R		(25386+25576+25577)
R	0499	Mod : 25904 = 26703 = 27170 = 36043 = 37095
R	0500	Mod : (20510+26703+31266) = (20510+31265+36043) = (20510+25904+31265) =
R		(20510+31266+36043) = (20510+31265+37095) = (20510+31266+37095) =
R		(20510+25577+31266) = (20510+25577+27170+31266)
R	0501	Mod : (20510+36043) = (20510+26703) = (20510+37095) = (20510+25577) =
R		(20510+25577+27170)
R	0503	"Mod : 20458+20510+20818+27170+31266 "
R	0504	Mod : (22536+25409+26999+36725) = (23227+25409+26999+36725) =
R		(23529+25409+26999+36725) = (22536+23227+25409+26999+36725) =
R		(22536+23529+25409+26999+36725) =
R		(22536+25409+26999+28382+28495+36725) =
R		(23227+25409+26999+28382+28495+36725) =
R		(23529+25409+26999+28382+28495+36725) =
R		(22536+23227+25409+26999+28382+28495+36725) =
R		(22536+23529+25409+26999+28382+28495+36725)
R	0506	"Mod : 36725 = (30368+36725) = (22707+30368+36725) "
R	0507	"Mod : (20586+36725) = (20586+30368+36725) "
R	0508	Mod : (30626+MP P9801) = (22013+30626+MP P9801)
R	0510	Mod : 27531 = (27531+32475) = (27531+32929) = (27531+31897+32401) =
R		(27531+31896+32332) = (27531+31897+32333) = (27531+31896+32402) =
R		(27531+31896+32332+32475) = (27531+31897+32333+32929)
R	0511	Mod : (27531+31897) = (27531+31896) = (27531+35119) =
R		(27531+31896+32332+35119) = (27531+31897+32401+35651)
	0515	STD = Mod : (20701+23892) = (31896+32332) = (31897+32333)
	0516	Mod : 25205 = 26111 = 26999 = 28382 = 30241 = 30631 = 26485 = (23885+26111)
		= (25205+26999+28495) = (26999+28495+28382) = (26999+31897+32333) =
		(26999+28495+28382+31897+32333) = (26999+31896+32332)
R	0521	Mod : (27522+34869+35865) = (27522+31286+34869+35865)
R	0522	Mod : (27522+35865) = (27522+34869+35865)
R	0523	Mod : (27522+31371+35227) = (27522+31371+35865)
R	0524	Mod : (27522+30660+31371+35227) = (27522+30660+31371+35865)
	0525	Mod : (26358+26999) = (26358+28382) = (25205+26358+26999+28495) =
		(26358+26999+28382+28495) = (26358+26999+28382+28495+30635)
R	0527	Mod : (27522+31371+32494+32496+35865)
R	0528	Mod : (27522+35227) = (27522+35865) = (27522+34869+35227) =
R		(27522+34869+35865)
R	0529	Mod : (26358+26999) = (26358+27646) = (26358+28382) = (26358+30241) =
R		(26358+30631) = (26274+26358+27646+30955) = (26358+26999+28382+28495) =
R		(26358+26999+27531+35638) = (26358+27531+27646+35638) =
R		(26358+26999+33503+37589) = (26274+26358+27646+28382+30955) =
R		(26358+27531+27646+28382+35638) = (26358+26999+27531+27646+35638) =
R		(26358+26999+27646+28382+28495) =
R		(26358+26999+27646+28382+33503+37589+28495)
	0530	Mod : 20994 = (P3451+20994) = (P3451+P3452+20994) = (P3451+P3453+20994) =
		(P3452+P3453+20994)
R	0531	Mod : (26358+26999+33503) = (26358+26999+27646+28382+28495+33503)

	CODE	DESIGNATION
	0532	Mod : (23885+26111) = (24075+25205) = (26111+26999) = (27646+28382) = (27646+30241) = (23885+26111+26999) = (24075+27646+28382) = (26999+27646+30241) = (23885+26111+26358+30980) = (24075+25205+26358+30980) = (26111+26358+26999+30980) = (26111+27646+28382+30635) = (26358+27646+28382+30980) = (26358+27646+30241+30980) = (26999+27646+28382+28495) = (23885+26111+26358+26999+30980) = (24075+26358+27646+28382+30980) = (26358+26999+27646+30241+30980) = (26111+26358+27646+28382+30635+30980) = (26358+26999+27646+28382+28495+30980)
	0533	Mod : 26358 = (26358+26999+27917) = (26358+26999+28495) = (24075+25205+26358+26999+28495)
	0536	Mod : 20175 = 25738 = (20175+25808) = (25440+26194) = (25440+26194+26275) = (25440+26231+26829) = (25440+26194+26829) = (25440+26194+26275+28293) = (25440+26231+26275+26829+28293) = (25440+25808+26231+26829)
	0538	Mod : 21441 = 25440 = (25440+26275+28293) = (25440+26194+28293) = (25440+26194+32225) = (25440+26275+26560+32225)
	0539	Mod : 21441 = 21595 = 25440 = (25440+26275+28293) = (25440+26194+28293) = (25440+26194+32225) = (25440+26275+26560+32225)
R	0540	STD = Mod : (20210+31003) = (33503+37589)
	0541	Mod : 30354 = 33100 = 33300 = 33516 = (30354+33300) = (33100+33516)
	0542	Mod : 20067 = 20069 = 22006 = (20067+20069) = (20067+20069+22006)
R	0543	Mod : 20461 = 25480 = (20210+20461) = (20461+33503+37589) =
R		(25480+33503+37589)
R	0545	STD = Mod : 33503 = (20210+31003) = (33503+37589)
R	0546	Mod : 22296 = (22296+25480+33134) = (22296+33503+37589)
	0547	Mod : (20024+20164+22013+30422) = (20024+20164+22013+25453+30422) = (20024+22013+25453+30422+32555)
	0551	Mod : (20024+20164+22013+30422) = (20024+20164+22013+25453+30422) = (20024+22013+25453+30422+32555)
	0553	Mod : 26526 = (21391+26526+33450)
R	0554	Mod : 23885 = 25205 = 26999 = 28382 = 30241 = 30631 = (26999+27620+33497)
R		= (26999+28382+28495) = (25205+26999+28495) =
R		(26999+27620+28382+28495+33497)
R	0555	STD = Mod : 25888 = (25888+35864) = (22562+25888) = (22562+25072)
R	0556	Mod : 22562 = 35864 = (22562+35864) = (22562+25888+27609)
R	0557	STD = Mod : 25072 = 25888 = (25888+35864) = (22562+25888) = (22562+25072)
R	0560	Mod : (24035+31896) = (24035+32997) = (24035+32475) = (24035+32929) =
R		(24211+32475) = (24211+31896) = (24035+35119) = (24035+31897+32401) =
R		(24035+31896+32402) = (24035+31896+32332+35119)
R	0561	Mod : (21391+22769+26526) = (21391+22769+26526+31426+35074)
R	0567	Mod : (20361+22769+26526) = (21391+22769+26526)
	0568	Mod : (26526+27046+28308) = (26526+27046+28244+30170+28308)
R	0571	Mod : (20024+30368+34456) = (20024+30368+37226)
R	0573	Mod : (20024+28378) = (20024+33973) = (20024+34456) = (20024+37226)
R	0574	Mod : (20164+37226) = (20164+25453) = (20164+28378) = (20164+30422) =
R		(20164+33973) = (20164+34456) = (20164+25453+30422) = (25453+30422+32265)
R	0575	Mod : (20024+28378+30368) = (20024+30368+33973) = (20024+30368+37226)
R	0577	Mod : (20024+28378) = (20024+34456) = (20024+37226)
	0578	STD = Mod : 30955 = (26999+28495) = (26358+30980) = (26358+30955+30980) = (26358+26999+28495+30980)
R	0580	Mod : (20024+28378) = (20024+28378) = (20024+34456) = (20024+37226)

	CODE	DESIGNATION
R	0581	Mod : (20024+28238+30368) = (20024+30368+33973) = (20024+30368+30422) =
R		(20024+28378+30368) = (20024+30368+37226)
R	0582	Mod : (20024+30368+37226+P7092) = (20024+30368+30422+P7092) =
R		(20024+28378+30368+P7092) = (20024+30368+34456+P7092) =
R		(20024+30368+33973+P7092) = (20024+28238+30368+P7092) =
R		(20024+30368+30422+22013+P7092)
R	0583	Mod : (20024+28378) = (20024+33973) = (20024+34456) (20024+37226)
R	0584	Mod : (20024+20164+28378) = (20024+20164+37226) = (20024+20164+33973) =
R		(20024+20164+34456)
R	0585	Mod : (23885+25108) = (26999+35793) = (25108+26999) = (25108+26111) =
R		(25108+28382) = (25108+30241) = (22013+23672+26111) = (22013+23672+26999)
R		= (23672+24105+26999) = (22013+23672+30241) = (22013+23672+23885) =
R		(22013+23672+28382) = (23672+24105+28382) = (23672+23885+24105) =
R		(23672+24105+24075) = (25108+26999+28495+28382) =
R		(26999+28495+28382+35793) = (23672+24105+25294+26999+35793) =
R		(23672+24105+25294+26999+36529) = (23672+24105+26999+28382+28495) =
R		(22013+23672+26999+28382+28495) =
R		(24105+24785+25108+26999+30020+35793) =
R		(22013+23219+23672+24785+26999+35793) =
R		(23672+24105+25294+26999+28382+28495+35793) =
R		(24105+24785+26999+28382+28495+30020+35793) =
R		(22013+23219+23672+24785+26999+28382+28495+35793)
R	0586	Mod : 32401 = 32402 = 32929 = 32475 = (31896+32402) = (31897+32401) =
R		(31896+32332+32475) = (31897+32333+32929)
R	0587	Mod : (32475+34313) = (32929+34809) = (32333+32929+34809) =
R		(31897+32401+34809) = (31897+32929+34809) = (31896+32402+34313) =
R		(31896+32332+32475+34313)
	0588	Mod : (25296+26540) = (25477+26540) = (25296+25477+26540)
	0589	Mod : (30020+30626) = (26363+30020+30626)
R	0590	STD = Mod : 32475 = 32929 = (32933+32929) = (31896+32332) = (27531+35638) =
R		(31897+32929) = (31897+32401) = (31896+32402) = (31897+32333) =
R		(31896+32332+32475) = (31897+32333+32929)
	0591	Mod : 31371 = (27522+31371) = (27522+28360+31371)
R	0592	Mod : (22536+26540+37445) = (23227+26540+37445) = (23529+26540+37445) =
R		(23227+26540+28738+37445) = (23227+26540+28739+37445) =
R		(23529+26540+27740+37445)
	0593	Mod : P7092+20024+22013+30368
R	0594	Mod : (20024+20167+28378+37331) = (20024+20167+33973+37331)
R	0595	Mod : 24035 = 24160 = 24211 = (24035+24211)
	0596	Mod : (24035+22249) = (24160+22249) = (24211+22249) = (31896+32332) =
		(31897+32333) = (22249+24035+31896+32332) = (22249+24035+31897+32333)
R	0597	Mod : 27541 = 35538 = 32262 = 32766 = (27256+32262) = (27256+32766) =
R		(27256+35538) = (32262+32766) = (27256+32262+32766) = (27256+32262+35538)
	0599	Mod : (22249+24035+32600) = (22249+24160+32600) = (22249+24211+32600) =
		(31896+32332+32600) = (31897+32333+32600) =
		(22249+24035+31896+32332+32600) = (22249+24035+31897+32333+32600)
R	0601	Mod : 24035 = 24160 = 24211 = (24035+24211)
R	0602	Mod : 24414 = 25346 = (24414+25346)
R	0603	Mod : 32600 = (24035+32600) = (24211+32600)
R	0604	Mod : (24035+24414) = (24160+24414) = (24211+24414) = (24035+25346) =
R		(24160+25346) = (24211+25346) = (24035+24414+25346) = (24211+24414+25346)
R	0605	Mod : (21678+26999+27620+28658+33503) =
R		(21678+26999+27620+27646+28382+28495+28658+33503)
R	0606	Mod : (21678+26999+27620+28658+33497+33503) =
R		(21678+26999+27620+27646+28382+28495+28658+33497+33503)

	CODE	DESIGNATION
R	0607	Mod : (21678+26999+28658) = (21678+26999+27620+28658+33497) = (21678+26999+28658+33503+37589) = (21678+26999+27646+28382+28495+28658) = (21678+26999+27620+28658+33497+33503+37589) = (21678+26999+27620+27646+28382+28495+28658+33497+33503+37589)
R	0608	Mod : (20117+26999+27620) = (21678+26999+27620) = (21678+27646+27620) = (21678+26999+27620+27646) = (21678+25205+26999+27620) = (21678+26999+27620+28658) = (21678+25205+26999+27620+28382) = (21678+26999+27620+27646+28382+28495) = (21678+26999+27620+28658+33503+37589) = (21678+26999+27620+27646+28382+28495+28658) = (21678+26999+27620+27646+28382+28495+28658+33503+37589)
R	0609	Mod : (20173+26358+26999) = (20173+26358+27646) = (20173+26358+30631) = (26274+26358+26999) = (26274+26358+27646) = (26274+26358+28382) = (20173+26274+26358+26999) = (20173+26358+27646+28382) = (26274+26358+26999+27646) = (26274+26358+26999+28382+28495) = (26274+26358+27646+28382) = (20173+26274+26358+26999+28382) = (26274+26358+26999+33503+37589) = (20173+26358+26999+27646+28382+28495) = (26274+26358+26999+27646+28382+28495+33503+37589)
R	0610	Mod : (20117+26999) = (20117+30631) = (21678+26999) = (21678+27646) = (21678+28382) = (21678+30631) = (21678+26999+27646) = (21678+25205+26999) = (21678+23885+26999) = (21678+27646+28382) = (21678+26999+28382+28495) = (21678+26999+27620+33497) = (21678+26999+27646+28382+28495) = (21678+26999+28382+28495+27620+33497)
	0611	STD = Mod : (31896+32332) = (31897+32333)
	0612	Mod : (20994+P3453) = (20994+33171) = (20994+33171+P3453)
	0613	Mod : (32494+32496) = (27522+31371+32494+32496)
R	0615	Mod : 31896 = 31897 = 32475 = 32929 = 35119 = (31896+32475) = (31897+32929) = (32333+32929) = (31896+32332+32475) = (31897+32333+32929) = (31896+32332+35119)
	0616	Mod : (20067+20069+22561+30354) = (20067+20069+22561+33100) = (20067+20069+22561+30354+33300) = (20067+20069+22561+33100+33516)
R	0617	Mod : 34313 = 34809 = (31896+34313) = (31897+34809) = (32475+34313) = (32929+34809) = (28238+31897+34809) = (31897+32929+34809) = (28238+31896+34313) = (32333+32929+34809) = (31896+32332+32475+34313) = (31897+32333+32929+34809)
R	0618	STD = Mod : 35270 = (30368+35270)
	0619	Mod : (20069+20071) = (20069+20816) = (20069+20071+20816) = (20059+20069+20816)
	0620	Mod : (20067+20069+20071+30354) = (20067+20069+20071+33100) = (20067+20069+20071+33300) = (20067+20069+20071+33516) = (20067+20069+20071+30354+33300) = (20067+20069+20071+33100+33516)
R	0621	STD = Mod : 30368 = (26358+30980)
R	0622	Mod : 26358 = (26358+35270) = (26358+30368+35270)
R	0623	Mod : (26358+26999+30368) = (26358+26999+28382+28495+30368) = (26358+26999+28925+30368+34282) = (25205+26358+26999+28382+30368) = (26358+26999+28382+28495+30368+30635) = (26358+26999+28382+28495+28925+30368+34282)
R	0624	Mod : 25205 = 26111 = 26485 = 26999 = 28382 = 30241 = 30631 = 30635 = (26111+26999) = (26999+30241) = (26999+30368) = (26111+28382+30635) = (26999+28382+28495) = (25205+26999+28495) = (26358+26999+28382+28495+30980)

	CODE	DESIGNATION
R	0625	Mod : (26358+26999) = (26358+28382) = (26358+26999+35270) = (25205+26358+26999+28382) = (25205+26358+26999+28495) = (26358+26999+28382+28495) = (26358+26999+30368+35270) = (26358+26999+28382+28495+30635) = (26358+26999+28382+28495+35270) = (26358+26999+28382+28495+30368+35270)
	0626	Mod : (21678+30354) = (21678+33100) = (21678+33300) = (21678+33516) = (21678+30354+33300) = (21678+33100+33516)
R	0627	Mod : 30020 = 35220 = (30020+35220)
R	0628	Mod : 22249 = (22249+35270) = (22249+26270+34514) = (22249+30368+35270)
R	0629	Mod : (22249+25521) = (22249+25529) = (22249+25819) = (22249+26117) = (22249+26270) = (22249+26345) = (22249+25529+25819) = (22249+25529+26345) = (22249+26117+26270) = (22249+26270+35270) = (22249+25529+35270) = (22249+25529+26117+26270) = (22249+26270+30368+35270) = (22249+26117+30368+35270) = (22249+25529+30368+35270) = (22249+26117+26270+30368+35270)
	0630	Mod : (23742+24211+24414) = (23585+23742+24035+24414) = (23585+23742+24160+24414) = (23585+23742+24211+24414)
R	0630	Mod : (22249+25521+30368) = (22249+25529+30368) = (22249+25819+30368) = (22249+26117+30368) = (22249+26270+30368) = (22249+26345+30368) = (22249+26117+26270+30368) = (22249+25819+26117+30368) = (22249+25529+26117+30368) = (22249+25529+25819+30368) = (22249+25529+25819+26117+30368)
R	0631	Mod : (22249+25529) = (22249+25819) = (22249+26117) = (22249+26270) = (22249+26345) = (22249+25529+25819) = (22249+25529+26345) = (22249+26117+26270) = (22249+26270+35270) = (22249+25529+35270) = (22249+25529+26117+26270) = (22249+26270+30368+35270) = (22249+26117+30368+35270) = (22249+25529+30368+35270) = (22249+26117+26270+30368+35270)
R	0632	Mod : (22249+25529+30368) = (22249+25819+30368) = (22249+26117+30368) = (22249+26270+30368) = (22249+26345+30368) = (22249+25529+26345+30368) = (22249+26117+26270+30368) = (22249+25819+26117+30368) = (22249+25529+26117+30368) = (22249+25529+25819+30368) = (22249+25529+25819+26117+30368)
	0633	Mod : 25205 = 26111 = 26999 = 28382 = 30241 = 30635 = (23885+26111) = (24075+25205) = (24075+28382) = (26999+28382+28495) = (23885+26111+26999) = (24075+25205+26999+28495)
R	0634	STD = Mod : 35270 = (26270+34514) = (30368+35270)
	0635	Mod : (28925+30368) = (24035+28925+30368)
R	0636	Mod : 25529 = 25819 = 26117 = 26270 = 26345 = (25529+26345) = (25529+25819) = (26117+26270) = (26270+35270) = (25529+35270) = (25529+26117+26270) = (26270+30368+35270) = (25529+30368+35270) = (26117+30368+35270)
R	0640	Mod : 30368 = (25529+30368) = (25819+30368) = (26117+30368) = (26270+30368) = (26345+30368) = (25529+26345+30368) = (25529+25819+30368) = (25529+26117+30368) = (25819+26270+30368) = (26117+26270+30368) = (25819+26117+30368) = (25529+25819+26117+30368)
R	0641	Mod : 25529 = 25819 = 26117 = 26270 = 26345 = (25529+25819) = (25529+26345) = (26117+26270) = (25819+26117) = (25529+26117) = (25529+25819+26117) = (25529+26117+26270)
R	0642	STD = 23450 = 28244 = (20406+23450) = (46358+30980) = (23450+28244) = (23450+26358+30980) = (20406+23450+28244) = (26358+28244+30980) = (20406+23450+26358+30980)
	0643	Mod : (20327+32619) = (20327+33239) = (20327+32619+33239)
R	0644	Mod : 26358 = (26358+28244) = (20406+23450+26358)
	0645	Mod : (20024+32650) = (20024+24035)
R	0646	Mod : 25590 = (25590+34862) = (25590+31283+34861) = (25590+31283+34862)
	0647	Mod : 30977= 30020 = 33879 = (30020+30977) = (24105+30020+30977)

	CODE	DESIGNATION
R	0648	Mod : (K1170+33254) = (K0385+33254) = (K0385+K5043+26858) =
R		(K1170+K5043+33254) = (K0385+K1170+33254)
	0651	Mod : (22249+30368) = (22249+26270+30368+34514)
	0654	Mod : 23885 = 25205 = 26999 = 28382 = 30241 = 30631 = (25205+26999+28495)
		= (26999+28382+28495) = (26999+31896+32332) = (26999+31897+32333) =
		(26999+28382+28495+31897+32333)
R	0657	Mod : (36609+26999+28495) = (36609+26999+27917) = (36772+26999+28495) =
R		(36772+26999+27917) = (36562+26999+28495) = (36562+26999+27917) =
R		(27780+34078+36562) = (26799+27780+34078+36562)
	0658	Mod : STD = (26999+28495) = (26999+28479+28495)
R	0662	Mod : 28479=28702=28916=(28479+28916) = (28702+28916)
R	0663	STD = Mod : 28308 = 28811 = 34604 = (28308+28811) = (28308+28811+34604) =
R		(28308+31896+32332) = (28308+31897+32333)
R	0664	Mod : 31896 = 31897 = 32475 = 32929 = (28308+35119) = (28308+31896) =
R		(28308+31897) = (28308+32475) = (28308+32929) = (28308+28811+32475) =
R		(28308+32333+32929) = (28308+31896+32475) = (28308+31897+32929) =
R		(23308+31896+32332+32475) = (31896+32332+35119) =
R		(28308+31896+32332+35119) = (28308+31897+32333+32929)
R	0666	STD = Mod : 23450 = 28308 = (28369) = (23450+28308) = (20406+23450) =
R		(23450+28369) = (28308+28811) = (20406+23450+28308) = (28308+28369+28811)
R		= (28308+28811+34604) = (23450+28308+28369+28811) =
R		(20406+23450+28308+28369+28811)
R	0667	Mod : 31896 = 31897 = 32475 = 32929 = 35119 = (32333+32929) = (31896+32475)
R		= (31897+32929) (31896+32332+32475) = (31897+32333+32929) =
R		(31896+32332+35119)
R	0668	STD = Mod : 22190 = 33129 = 34664 = 35270 = (30368+35270)
R	0669	Mod : (20024+20167+28378) = (20024+20167+33973) =
R		(20024+20167+28378+37331+37332) = (20024+20167+33973+37331+37332)
R	0670	Mod : (28238+37331) = (28238+32635+35649+37331)
	0671	Mod : (K0385+K5043+20818+26858) = (K0385+K5043+20818+33254)
	0672	Mod : 33254 = (K5043+33254) = (K5043+26858) = (K0385+K7738+k5043+33254) =
		(K0385+26858+K0385+K7738)
R	0673	STD = (26999+28495) = (26999+27917)
R	0674	Mod : 28238 = (28238+32635+35649) = (28238+37331+37332) =
R		(28238+32635+35649+37331+37332)
R	0675	Mod : (28238+32635) = (28238+32635+37331+37332)
	0676	Mod : 31459 = 20047 = (20047+20199) = (20047+31459)
	0678	Mod : 20242 = (20036+20037+20170+20242)
	0679	Mod : 25819 = 25529 = 26345 = 26117 = 26270
R	0681	Mod : 26254 = 34617 = 33065 = 30820 = (22567+33065) = (22567+30820) =
R		(22567+26254+33065) = (ANA+22567+26254) = (ANA+22567+22874)
	0682	Mod : 34443 = (21437+23480+26621+26678+34443)
	0683	Mod : (26358+26999+28925+30368) = (26358+26999+28382+28495+28925+30368)
R	0686	Mod : 22226 = 22567 = 25115 = 27886 = 31517 = (22226+22567) = (22567+31517)
R		= (22567+25115) = (22567+27886) = (22433+22567) = (22230+22567) =
R		(22432+22567) = (22431+22567) = (22485+22567) = (22473+22567) =
R		(22226+22431+22567)
R	0687	Mod : 22473 = 35391 = 26254 = 33065 = 34617 = 26589 = 30820 = (22567+35391)
R		= (22567+30820) = (22567+26589) = (22567+33065) = (22567+26254) =
R		(ANA+22567+26254) = (ANA+22567+22874)
R	0688	Mod : 22226 = 22567 = 25115 = 27886 = 31517 = (22226+22567) = (22567+31517)
R		= (22567+25115) = (22567+27886) = (22433+22567) = (22230+22567) =
R		(22432+22567) = (22431+22567) = (22485+22567) = (22473+22567) =
R		(22226+22431+22567)

	CODE	DESIGNATION
R	0689	Mod : (20173+26999) = (26274+26999) = (26274+27646) = (20173+27646) = (20173+30631) = (26274+28382) = (20173+28382) = (20173+27646+28382) = (20173+26274+26999) = (26274+27646+28382) = (26274+26999+28382+28495) = (20173+26358+26999+30980) = (20173+26358+27646+30980) = (20173+26358+30631+30980) = (26274+26358+26999+30980) = (26274+26358+27646+30980) = (26274+26358+28382+30980) = (26274+26999+27646+30241) = (20173+26274+26358+26999+30980) = (20173+26358+27646+28382+30980) = (26274+26358+26999+27646+30980) = (26274+26358+26999+28382+28495+30980)
	0690	STD = Mod : 28809 = (27624+28809) = (27624+28258+28809)
R	0691	Mod : (26358+26999+27351) = (26358+27531+27646) = (26358+26999+27531+27646) = (26358+27531+27646+28382) = (26358+27531+27646+28382) = (26358+26999+27531+33503+37589) = (26358+26999+27531+27646+28382+28495)
	0694	Mod : STD = 20036 = 20037 = 20170 = (20036+20037) = (20036+20037+20170)
	0697	Mod : 20308 = 26023 = 26433 = K4453 = (K4453+26433)
	0698	Mod : (20283+24042) = (20283+24310) = (20283+24624) = (20283+25625) = (20283+26169) = (20283+26191) = (20283+26203) = (24624+20283) = (26169+20283) = (20283+24042+24624) = (20283+24042+26169) = (20283+24624+26203) = (20283+25625+26203) = (20283+26169+26203) = (20283+26191+26203) = (20283+26169+26191+26203)
	0699	Mod : 20682 = 20683 = 20686 = 20723 = 20724 = 20859 = 21373 = 21531 = 21710 = 21876 = 21930 = 22221 = 22442 = 22508 = 22579 = 22742 = 22748 = 23099 = 23284 = 23298 = 23399 = 25958 = 26691 = 31215 = 31216 = (20682+20723) = (20682+26691) = (20683+23099) = (20686+26691) = (21710+23099) = (21710+23298) = (22221+23099) = (22221+26691) = (22508+26691) = (23099+23399) = (23099+25958) = (20682+20723+26691) = (20683+23099+25958) = (20683+31215+31216) = (20686+22221+26691) = (23099+31215+31216)
	0700	Mod : (26999+30368) = (26999+28382+28495+30368)
	0702	Mod : (22536+25409) = (23227+25409) = (23529+25409) = (23227+25409+26999+28495) = (23529+25409+26999+28495)
R	0703	Mod : (26526+35220) = (22769+26526+35220)
R	0704	Mod : (22769+34637) = (22769+26526+34637) = (22769+26526+34637+34825)
R	0705	Mod : (22769+34637+35220) = (22769+26526+34637+35220) = (22769+26526+34637+34825+35220)
	0706	Mod : 22536 = 23227 = 23529 = (23227+26999+28495) = (23529+26999+28495)
	0707	Mod : 23885 = 26999 = (26999+28382+28495)
R	0708	Mod : (27620+34429) = (27620+35536) = (27620+37285+35536) = (27620+34429+35536)
	0709	Mod : (22536+25529) = (23227+26270) = (23529+25529) = (23529+26270) = (22536+26270)
R	0710	Mod : (27620+30639+34429) = (27620+30639+35536)
R	0711	Mod : (34665/56-5-B1/B2/B3/B4/B5/B6/B7/B8/B9) = (30368+35270+34665/56-5-B1/B2/B3/B4/B5/B6/B7/B8/B9)
R	0715	Mod : (20850+34665) = (22461+35665) = (20850+22461+34665)
	0716	Mod : (21678+23885) = (21678+25205) = (21678+25205+26999+28495)
	0718	Mod : (20024+28378) = (20024+33973)
	0719	Mod : (20024+28378+30368) = (20024+30368+33973)
	0720	Mod : (20024+20164+28378) = (20024+20164+33973)
	0722	Mod : (20024+25415) = (20024+33973) = (20024+25415+26110) = (20024+25415+28652)
R	0723	Mod : (20024+34456) = (20024+37226) = (20024+37226+L) = (20024+34456+L)

	CODE	DESIGNATION
R	0724	Mod : 31896 = 31897 = 35119 = (31897+32401+35651) = (31896+32332+35119) =
R		31897+32401+37588)
R	0726	Mod : STD = (31896=31897=35119) = (31896+32332) = (31897+32333) =
R		(31897+32401+35651) = (31896+32332+35119) = (31897+32401+34809+37588)
	0728	Mod : (20024+22013+25453) = (20024+22013+22802+25453) =
		(20024+20586+22013+22802+25453)
	0729	Mod : (P7092+20024+28378) = (P7092+20024+22802+30368)
	0733	Mod : (P7092+20024+30368) = (P7092+20024+22013+30368)
R	0734	Mod : 31896 = 31897 = 35119 = (31896+32332+35119) = (31897+32401+35651) =
R		(31897+32401+34809+37588) = (31897+32401+34809+36772+37588)
R	0737	Mod : (30020+31283) = (24105+30020+31283) = (30020+31283+34862+37809) =
R		(24105+30020+31283+34862+37809)
R	0741	Mod : (20151+31495+36725) = (31112+31495+36725)
R	0742	Mod : (26270+34637) = (26117+34637) = (25529+34637) = (25819+34637)
R	0745	Mod : 31896 = 31897 = 35119 = (26093+31896) = (26093+31897) = (26243+31896)
R		= (26243+31897) = (26716+31896) = (26716+31897) = (26717+31896) =
R		(26717+31897) = (26799+31896) = (26799+31897) = (26968+31896) =
R		(26968+31897) = (27780+31896) = (27780+31897) = (27831+31896) =
R		(27831+31897) = (27832+31896) = (27832+31897) = (28416+31896) =
R		(28416+31897) = (26999+28495+31896) = (26999+28495+31897) =
R		(26999+28495+35119) = (26999+28495+31897+35651) =
R		(26999+28495+31897+37588) = (26999+28495+32401+35651) =
R		(26999+28495+32929+35651) = (26999+28495+32401+37588) =
R		(26999+28495+32929+37588) = (26999+28495+34076+35651) =
R		(26999+28495+34076+37588) = (26999+28495+34809+37588) =
R		(26999+28495+36609+37588) = (26999+28495+36772+37588)
R	0746	Mod : 34076 = 34078 = 34313 = 34809 = (26093+34076) = (26093+34078) =
R		(26093+34313) = (26093+34809) = (26243+34076) = (26243+34078) =
R		(26243+34313) = (26243+34809) = (26716+34076) = (26716+34078) =
R		(26716+34313) = (26716+34809) = (26717+34076) = (26717+34078) =
R		(26717+34313) = (26717+34809) = (26799+34076) = (26799+34078) =
R		(26799+34313) = (26799+34809) = (26968+34076) = (26968+34078) =
R		(26968+34313) = (26968+34809) = (27780+34076) = (27780+34078) =
R		(27780+34313) = (27780+34809) = (27831+34076) = (27831+34078) =
R		(27831+34313) = (27831+34809) = (27832+34076) = (27832+34078) =
R		(27832+34313) = (27832+34809) = (28416+34076) = (28416+34078) =
R		(28416+34313) = (28416+34809) = (34076+26999+28495) = (34078+26999+28495)
R		= (34313+26999+28495) = (34809+26999+28495)
	0747	STD = Mod : 28308 = 28811 = 34604 = (28308+28811+34604) =
		(28308+31896+32332) = (28308+31897+32333)
R	0748	Mod : 36609 = 36772 = 36562 = (26093+36609) = (26093+36772) = (26093+36562)
R		= (26243+36609) = (26243+36772) = (26243+36562) = (26716+36609) =
R		(26716+36772) = (26716+36562) = (26717+36609) = (26717+36772) =
R		(26717+36562) = (26799+36609) = (26799+36772) = (26799+36562) =
R		(26968+36609) = (26968+36772) = (26968+36562) = (27780+36609) =
R		(27780+36772) = (27780+36562) = (27831+36609) = (27831+36772) =
R		(27831+36562) = (27832+36609) = (27832+36772) = (27832+36562) =
R		(28416+36609) = (28416+36772) = (28416+36562) = (26999+28495+36609) =
R		(26999+28495+36772) = (26999+28495+36562)

	CODE	DESIGNATION
R	0749	Mod : (25205+31896) = (25205+31897) = (26111+31896) = (26111+31897) =
R		(26485+31896) = (26485+31897) = (26999+31896) = (26999+31897) =
R		(28382+31896) = (28382+31897) = (30241+31896) = (30241+31897) =
R		(30631+31896) = (30631+31897) = (30635+31896) = (30635+31897) =
R		(25205+35119) = (26111+35119) = (26485+35119) = (26999+35119) =
R		(28382+35119) = (30241+35119) = (30631+35119) = (30635+35119) =
R		(25205+31897+35651 = (26111+31897+35651) = (26485+31897+35651) =
R		(26999+31897+35651) = (28382+31897+35651) = (30241+31897+35651) =
R		(30631+31897+35651) = (30635+31897+35651) = (25205+31897+37588) =
R		(26211+31897+37588) = (26485+31897+37588) = (26999+31897+37588) =
R		(28382+31897+37588) = (30241+31897+37588) = (30631+31897+37588) =
R		(30635+31897+37588) = (31896+25205+26999+28495) =
R		(31897+25205+26999+28495) = (31896+26999+28382+28495) =
R		(31897+26999+28382+28495) = (35119+25205+26999+28495) =
R		(35119+26999+28382+28495) = (25205+26999+28495+31897+35651) =
R		(26999+28382+28495+31897+35651) = (25205+26999+28495+31897+37588) =
R		(26999+28382+28495+31897+37588)
R	0750	STD = Mod : 32401 = 32402 = 32929 = 32475 = (32333+32929) = (31897+32929)
R		= (31896+32402) = (31897+32401) = (31896+32332) = (31897+32333) =
R		(31896+32332+32475) = (31897+32333+32929)
R	0752	Mod : 27531 = (27531+32475) = (27531+32401) = (27531+32402) = (27531+32929)
R		= (27531+31896+32402) = (27531+31897+32401) = (27531+31896+32332) =
R		(27531+31897+32333) = (27531+31896+32332+32475) =
R		(27531+31897+32333+32929)
R	0753	Mod : (27531+35638) = (27531+35638+32401) = (27531+35638+32402)
R		=(27531+35638+32475) = (27531+35638+32929) = (27531+35638+31896+32332)
R		= (27531+35638+31897+32333) = (27531+35638+31896+32332+32475) =
R		(27531+35638+31897+32333+32929)
	0755	Mod : 25205 = 26111 = 26485 = 26999 = 28382 = 30241 = 30631 = 30635 =
		(26111+26999) = (26999+30241) = (26111+28382+30635) = (26999+28382+28495)
		= (25205+26999+28495) = (25205+26358+26999+28495) =
		(26358+26999+28382+28495+30980)
R	0756	Mod : 31896 = 31897 = 35119 = (31896+32332+35119) = (31897+32401+35651)
	0757	STD = (31896+32332) = (31897+32333)
	0758	Mod : 25205 = 26111 = 26999 = 28382 = 30241 = 30635 = (26111+26999) =
		(26999+30241) = (25205+26999+28382) = (26111+28382+30635) =
		(26999+28382+28495) = (25205+26999+28495) = (26999+28382+28495+30635)
R	0759	Mod : (27531+35638+31896) = (27531+35638+31897) = (27531+35638+35119) =
R		(27531+35638+31896+32332+35119) = (27531+35638+31897+32401+35651)

	CODE	DESIGNATION
R	0760	Mod : (25205+32401) = (25205+32402) = (25205+32929) = (25205+32475) =
R		(25205+34076) = (25205+34078) = (25205+34313) = (25205+34809) =
R		(26111+32401) = (26111+32402) = (26111+32929) = (26111+32475) =
R		(26111+34076) = (26111+34078) = (26111+34313) = (26111+34809) =
R		(26485+32401) = (26485+32402) = (26485+32929) = (26485+32475) =
R		(26485+34076) = (26485+34078) = (26485+34313) = (26485+34809) =
R		(26999+32401) = (26999+32402) = (26999+32929) = (26999+32475) =
R		(26999+34076) = (26999+34078) = (26999+34313) = (26999+34809) =
R		(28382+32401) = (28382+32402) = (28382+32929) = (28382+32475) =
R		(28382+34076) = (28382+34078) = (28382+34313) = (28382+34809) =
R		(30241+32401) = (30241+32402) = (30241+32929) = (30241+32475) =
R		(30241+34076) = (30241+34078) = (30241+34313) = (30241+34809) =
R		(30631+32401) = (30631+32402) = (30631+32929) = (30631+32475) =
R		(30631+34076) = (30631+34078) = (30631+34313) = (30631+34809) =
R		(30635+32401) = (30635+32402) = (30635+32929) = (30635+32475) =
R		(30635+34076) = (30635+34078) = (30635+34313) = (30635+34809) =
R		(32401+25205+26999+28495) = (32402+25205+26999+28495) =
R		(32929+25205+26999+28495) = (32475+25205+26999+28495) =
R		(34076+25205+26999+28495) = (34078+25205+26999+28495) =
R		(34313+25205+26999+28495) = (34809+25205+26999+28495) =
R		(32401+26999+28382+28495) = (32402+26999+28382+28495) =
R		(32929+26999+28382+28495) = (32475+26999+28382+28495) =
R		(34076+26999+28382+28495) = (34078+26999+28382+28495) =
R		(34313+26999+28382+28495) = (34809+26999+28382+28495)
R	0761	Mod : (25205+36609) = (25205+36772) = (25205+36562) = (26111+36609) =
R		(26111+36772) = (26111+36562) = (26485+36609) = (26485+36772) =
R		(26485+36562) = (26999+36609) = (26999+36772) = (26999+36562) =
R		(28382+36609) = (28382+36772) = (28382+36562) = (30241+36609) =
R		(30241+36772) = (30241+36562) = (30631+36609) = (30631+36772) =
R		(30631+36562) = (30635+36609) = (30635+36772) = (30635+36562) =
R		(36609+25205+26999+28495) = (36772+25205+26999+28495) =
R		(36562+25205+26999+28495) = (36609+26999+28382+28495) =
R		(36772+26999+28382+28495) = (36562+26999+28382+28495)
R	0763	Mod : (22249+24035+32600) = (22249+24160+32600) =
R		(22249+32600+31283+34862) = (22249+24035+32600+34862+31283) =
R		(22249+24160+32600+31283+34862) = (22249+24189+32600+31283+34862) =
R		(22249+24035+32600+31283+34861) = (22249+24035+32600+31283+34864) =
R		(22249+24160+32600+31283+34861) = (22249+24160+32600+31283+34864) =
R		(22249+24189+32600+31283+34861) = (22249+24189+32600+31283+34864)
	0764	Mod : 24351 = (24351+27330+28486) = (27330+28486) =
		(24351+25901+27330+28486)
	0765	Mod : 27330 = (24351+27330) = (24351+25901+27330) = (A3A+27330)
R	0767	Mod : (22249+24035+31283) = (22249+24035+31283+34862+37809)
R	0768	Mod : (22249+24035+31283+32600) = (22249+24035+31283+32600+34862+37809)
	0770	MP : (K0385+K5043) = (K1170+K5043) = (K0385+K1170+K5043) =
		(K0385+K2211+K5043)
	0771	MP : K5043 = (K2211+K5043) = (K5043+K0385+K7738)
	0776	Mod : 31283 = (28479+31283) = (22013+24044+31283) = (25951+32239+21283) =
		(22013+24044+28479+31283)

	CODE	DESIGNATION
R	0777	Mod : (20069+20071) = (20069+20816) = (20067+20069+20071) = (20069+20071+20816) = (20067+20069+20816+27063) = (20067+20069+20071+31283) = (20067+20069+20071+33100+33516) = (20067+20069+20071+33100+34997) = (20067+20069+20071+31283+33100+34856) = (20067+20069+20071+31283+33100+34898) = (20067+20069+20071+31283+33100+34997) = (20067+20069+20071+31283+34862+37809) = (20067+20069+20071+31283+34862+33100+34898) = (20067+20069+20071+31283+34862+33100+34997) = (20067+20069+20071+31283+34862+33100+34856) = (20067+20069+20071+31283+33100+34898+34862+37809) = (20067+20069+20071+31283+33100+34997+34862+37809) = (20067+20069+20071+31283+33100+34856+34862+37809)
R	0778	Mod : (20071+21708) = (20067+20069+20071+21708) = (20067+20069+20071+31424) = (20067+20069+20816+21708+27063) = (20067+20069+20071+21708+31283) = (20067+20069+20071+31424+32514) = (20067+20069+20071+21708+31283+33100+34856) = (20067+20069+20071+21708+31283+34862+37809)
R	0779	Mod : (20067+20069+20071+30354+31283) = (20067+20069+20071+31283+33100) = (20067+20069+20071+31283+33300) = (20067+20069+20071+31283+33516) = (20067+20069+20071+30354+31283+33300) = (20067+20069+20071+31283+33100+33516) = (20067+20069+20071+21708+31283+33100+34463) = (20067+20069+20071+30354+31283+34862+37809) = (20067+20069+20071+31283+33100+34862+37809) = (20067+20069+20071+31283+33300+34862+37809) = (20067+20069+20071+31283+33516+34862+37809) = (20067+20069+20071+30354+31283+33300+34862+37809) = (20067+20069+20071+31283+33100+33516+34862+37809) = (20067+20069+20071+21708+31283+33100+34463+34862+37809)
R	0780	Mod : (22249+24035) = (22249+24160) = (22249+24189) = (22249+24035+31283+34862) = (22249+24160+31283+34862) = (22249+24189+31283+34862) = (22249+24035+31283+34861) = (22249+24035+31283+34864) = (22249+24160+31283+34861) = (22249+24160+31283+34864) = (22249+24189+31283+34861) = (22249+24189+31283+34864)
R	0781	Mod : 22249 = (22249+25295+25381+27522+28360+28499+28500)
R	0782	Mod : 31283 = (26540+31283+34294) = (26540+31283+34987) = (31283+34862+37809) = (26540+31283+34294+34862+37809) = (26540+31283+34987+34862+37809)
R	0783	Mod : (26540+31283) = (26540+31283+34862+37809)
	0786	Mod : 24035 = 24160 = 24211 = (24035+31896+32332) = (24035+31897+32333)
R	0787	Mod : (30020+31283) = (30020+31283+34862+37809)
R	0789	Mod : 31283 = (31283+34862+37809)
	0790	Mod : STD = (31897+32333) = (31896+32332)
R	0793	Mod : 31283 = (28479+31283) = (22013+24044+31283) = (25951+32239+21283) = (31283+34862+37809) = (28479+31283+34862+37809) = (22013+24044+28479+31283) = (22013+24044+31283+34862+37809) = (25951+31283+32239+34862+37809) = (22013+24044+28479+31283+34862+37809)
	0794	Mod : (24035+32600) = (24160+32600) = (24211+32600) = (24035+31896+32332+32600) = (24035+31897+32333+32600)
	0795	Mod : 24035 = 24160 = 24211 = (24035+24211) = (24035+31896+32332) = (24035+31897+32333)
R	0796	STD = Mod : 31896 = 31897 = (31896+32332) = (31897+32333) = (31897+32401+35651) = (31896+32332+35119) = (31897+32401+34809+37588) = (31897+32401+34809+36772+37588)

	CODE	DESIGNATION
R	0797	Mod : 31283 = (25590+31283+37892) = (25590+31283+37892+34862+37809)
R	0798	Mod : 20057 = 20059 = 30067 = 35236 = (20057+20059) = (20059+20084+38025)
R		= (20057+20059+38025+20084)
	0799	Mod : (20062+32088) = (20062+32090) = (23398+32088) = (23398+32090)
	0800	Mod : 30368 = (28925+34282+30368)
	0801	Mod : (26358+30368) = (26358+28925+30368+24282)
R	0802	Mod : (20057+20082) = (20059+20084) = (20057+20059+20084) =
R		(20057+20059+20082+20084) = (20057+20059+20082) =
R		(20057+20059+20082+20084+38025)
	0803	STD = Mod : 25345 = 25346 = (23742+25345) = (23742+25346) =
		(23742+25345+25346) = (23742+25345+28925+34282)
	0804	Mod :24035 = 24160 = (24189+24211) = (24035+28925+34282) =
		(24160+28925+34282) = (24189+24211+28925+34282)
R	0805	Mod : 20059 = 30067 = 35236 = (20059+20084+38025) =
R		(20059+20084+30066+30067+38025)
	0806	Mod : 24035 = 24160 = 24189 = (24035+28925+34282) = (24160+28925+34282) =
		(24189+28925+34282)
	0807	Mod : (24035 = 24160 = 24211 = (24035+28925+34282) = (24160+28925+34282) =
		(24211+28925+34282)
	0808	Mod : (24035+30368) = (24160+30368) = (24211+30368) =
		(24035+30368+28925+34282) = (24160+30368+28925+34282) =
		(24211+30368+28925+34282)
	0809	Mod : (23742+24035+26497) = (23742+24160+26497) = (23742+24211+26497) =
		(23742+24035+26497+28925+34282) = (23742+24211+26497+28925+34282)
R	0810	Mod : (20057+20059) = (20057+20059+20084+38025)
	0811	Mod : (24035+26497) = (24160+26497) = (24211+26497) =
		(24035+26497+28925+34282) = (24160+26497+28925+34282) =
		(24211+26497+28925+34282)
	0812	Mod : 32619 = 33239 = (32619+33239) = (24404+33239) = (24405+33239) =
		(25530+33239) = (27640+33239)
	0813	Mod : (20067+20069+30354) = (20067+20069+33100) = (20067+20069+33300) =
		(20067+20069+33516) = (20067+20069+30354+33300) =
		(20067+20069+33100+33516) = (20067+20069+33100+34463)
	0814	Mod : (20067+20069+20071+21708+33100) =
		(20059+20067+20069+20071+21708+33100)
	0815	Mod : (20059+20067+20069+20071+30354) = (20059+20067+20069+20071+33100)
		= (20059+20067+20069+20071+33300) = (20059+20067+20069+20071+33516) =
		(20057+20067+20069+20071+33100) =
		(20059+20067+20069+20071+30354+33300) =
		(20059+20067+20069+20071+33100+33516)
	0818	Mod : (32088+32558) = (32090+32558) = (32088+32090+32499+32558)
R	0820	Mod : (20057+20059+20082) = (20057+20059+20082+20084+38025)
R	0821	Mod : 20059 = 30067 = 35236 = (20059+20084+38025) =
R		(20059+20084+30066+30067+38025)
	0822	STD = Mod : 28308 = 28811 + 34604
	0823	STD = Mod : 28308 = 28811 = 34604 = (28244+28308)
R	0824	Mod : (20057+20059) = (20057+20059+20084) = (20057+20059+20082) =
R		(20057+20059+20084+38025) = (20057+20059+20082+20084+36856) =
R		(20057+20059+20082+20084+38025)
	0826	Mod : (26526) = (26526+27046) = (26526+28244+30170) =
		(26526+28244+28308+30170) = (26526+28244+28308+28811+30170) =
		(26526+28244+28308+28811+30170+34604)

	CODE	DESIGNATION
	0830	Mod : (23885+26358) = (24075+26358) = (25205+26358) = (26111+26358) = (26358+26485) = (26358+26999) = (26358+27646) = (26358+28382) = (26358+30241) = (26358+30631) = (26358+30635) = (26358+27646+28382) = (25205+26358+26999+28495) = (26358+26999+28495+28382) = (26358+26999+27646+28382+28495) = (26358+26999+27646+28382+28495+30635) = (24075+25205+26358+26999+28382)
R	0832	Mod : 31896 = 31897 = 32475 = 32929 = (31896+32332+32475) =
R		(31897+32333+32929) = (31896+32332+35119) = (31897+32401+34076+37588)
R	0833	Mod : (24035+32600+34076) = (24035+31897+32600+34076) =
R		(24035+31896+32222+32600) = (24035+31897+32600+33036) =
R		(24035+32402+32600+32997) = (24035+32475+32600+32997) =
R		(24211+32475+32600+32997) = (24035+31896+32402+32600+32997) =
R		(24035+31897+32401+32600+34076) =
R		(24035+31896+32222+32402+32600+32997) = (24035+31896+32600+34573) =
R		(24035+31897+32600+35526) = (24035+31896+32222+32600+34573) =
R		(24035+31896+32402+32600+32997+34573) =
R		(24035+31896+32332+32475+32600+32997) =
R		(24035+31897+32333+32600+32929+34076) =
R		(24035+31897+32401+32600+34076+35526+37588)
	0834	Mod : 26877 = 27698 = 27740 = 27753 = 28738 = 28739 = 30163 = 31699 = (22536+27698) = (23227+28739) = (23529+27740) = (23529+27753+33055) = (23529+33055)
	0835	Mod : (26877+32007) = (27698+32007) = (27740+32007) = (27753+32007) = (28738+32007) = (28739+32007) = (30163+32007) = (31699+32007) = (22536+27698+32007) = (23227+28739+32007) = (23529+27740+32007) = (23529+27753+32007+33055)
R	0837	Mod : 24035 = 24160 = (24189+24211) = (24035+25863+28551) =
R		(24160+25863+28551) = (24035+34076+37588) = (24189+24211+25863+28551)
R	0839	Mod : 22013 = 24105 =25525 = (24105+34809+37588)
	0840	Mod : (20059+20067+20069+20071+21708+33100+34463) = (20067+20069+20071+21708+33100+34463)
	0841	Mod : 22536 = 23227 = 23529 = 25564 = 26680 = 28738 = 28739 = 31699 = (26680+28308+28811) = (28308+28738+28811) = (28308+28739+28811) = MSN 163, 164, 168, 169, 179, 193, 221, 222, 230, 294, 299, 301, 338, 348, 349, 362, 363, 424, 429, 437, 444, 449, 476
	0842	Mod : (26680+28308) = (28308+28738) = (28308+28739) = (23227+26680+28308+28811+34604)
R	0843	STD = (34076+37588) = (32992+33299+34573)
R	0844	Mod : (33299+34325/CFM) = (33299+34573/CFM) = (33299+35526/PW) =
R		(33299+34076/PW) = (32992+33299+34325+34573/CFM) =
R		(32992+33299+34325+34573/CFM) = (33299+34076+35526+37588/PW)
	0845	Mod : (22536+23885) = (23227+23885) = (23529+23885) = (22536+25205) = (22536+26999) = (22536+28382) = (22536+30631) = (23227+23885) = (23227+25205) = (23227+26999) = (23227+28382) = (23227+30241) = (23227+30631) = (23529+23885) = (23529+25205) = (23529+26999) = (23529+28382) = (23529+30631) = (23529+26999+28382+28495) = (23227+26999+28382+28495) = (23227+25205+26999+28495) = (22536+26999+28382+28495) = (23529+26270+26999+28382+28495+34514)
	0846	Mod : (20361+27638) = (20522+34693) = (20361+20522+27638+34963)
R	0847	Mod : 31896 = 31897 = 32745 = 32929 = 35119 = (31896+28238) = (31897+28238)
R		= (32475+28238) = (32929+28238) = (31896+32332+32475) =
R		(31897+32333+32929) = (31896+32332+35119) = (31897+34809+37588) =
R		(28238+31896+32332+35119)
R	0848	Mod : (22013+31283) = (25951+31283) = (22013+28479+31283) =
R		(22013+31283+34862+37809) = (25951+31283+34862+37809) =
R		(22013+28479+31283+34862)

	CODE	DESIGNATION
	0849	Mod : (26526+28956) = (20522+34963)
	0850	Mod : 26526 = (21391+26526+33450) = (26526+20522+34963)
	0853	Mod : 22769 = (22769+26526+28956) = (20522+22769+34963)
R R R	0854	Mod : 31283 = (23450+31283) = (20406+23450+31283) = (31283+34862+37809) = (23450+31283+34862+37809) = (20406+23450+31283+34862+37809)
R	0855	Mod : (20406+31283) = (20406+31283+34862+37809)
	0856	Mod : 22769 = (22769+26526+28956) = (20522+22769+34963)
	0857	Mod : 26526 = (22769+26526) = (21391+22769+26526+33450) = (20522+22769+26526+34963)
	0858	Mod : 21391 = (21391+26526)
	0859	Mod : (26526+28956) = (20522+34963)
	0860	Mod : 20259 = (20259+20522+34963)
	0861	Mod : (21391+26526) = (20259+21391+26526)
	0862	Mod : (20259+26526) = (20259+21391+26526+33450) = (20259+20522+26526+34963)
	0863	STD = Mod : (20522+34963)
	0864	Mod : 30368 = (22190+30368) = (30368+33129) = (30368+34664)
R R	0865	mod : (22706+30365+P8175+33907+31283) = (P8175+22706+30365+31283+33907+34862+37809)
	0866	Mod : (21391+26526) = (20361+21391+26526+27638) = (21391+26526+31426+35074)
R	0872	Mod : (25404+31283) = (25404+31283+34862+37809)
R R	0873	Mod : (20067+20069+20071) = (20067+20069+20816+27063) = (20067+20069+20071+32146) = (20067+20069+20071+26402+38087)
R R R	0874	Mod :(20067+20069+20071+31424) = (20067+20069+20071+32514) = (20067+20069+20071+31424+26402+38037) = (20067+20069+20071+26402+31424+32514+38087)
	0875	Mod : (20042+20081+20230) = (20042+20081+27395) = (20042+20081+20230+20818+35120)
R	0876	Mod :(20057+20059+20082) = (20057+20059+20082+20084+38025)
R	0878	Mod :(20059+20084+38025) = (20089+20084+30066+30067+38025)
R	0879	Mod :(20057+20059+20082+20084+38025)
	0880	Mod : (26526+31426) = (22769+26526+31426)
	0881	Mod : (26526+31426) = (20522+26526+31426+34963)
	0882	Mod : 26526 = (20361+26526) = (20361+26526+27638) = (21391+26526+33450) = (20522+26526+34963) = (21391+26526+31426+33450) = (20361+20522+26526+27638+34963) = (21391+26526+31426+33450+35074)
	0883	Mod : 26526 = (22769+26526) = (21391+22769+26526+33450) = (20522+22769+26526+34963) = (21391+22769+26526+31426+33450) = (21391+22769+26526+31426+33450+35074)
	0884	STD = Mod : 26526 = (26526+31426+35074) = (26526+31426+33450)
	0887	Mod : 26526 = (26526+31426+35074) = (26526+31426+33450)
	0888	STD = Mod : (26999+28495)
	0889	Mod : STD = (31896+32332) = (31897+32333) = (26999+28495)
	0890	STD = Mod : 31896 = 31897 = 32475 = 32929 = (26999+28495) = (26999+28495+31896) = (26999+28495+31897) = (26999+28495+32475) = (26999+28495+32929)
	0891	STD = (26999+28495)
	0892	STD = 23885 = (26999+28495)
R R R	0893	Mod : 20057 = 20059 = 30067 = 35236 = (20057+20059) = (20057+20082) = (20059+21161) = (20059+20084+38025) = (20057+20059+20084+38025) = (20059+20084+30066+30067+38025) = (20057+20059+20082+20084+36856)

	CODE	DESIGNATION
	0894	STD = Mod : 33497 = (27620+33497) = (26999+28495)
R	0895	Mod : 20057 = 20059 = 35236 = (20059+22707) = (20057+22707) = (20057+20059)
R		= (20059+22706+22707) = (20057+20059+22707) = (22706+22707+35236) =
R		(20057+20059+22706+22707) = (20059+22707+20084+38025) =
R		(20057+20059+20084+22707+38025) = (20059+20084+22706+22707+38025) =
R		(20057+20059+20084+22706+22707+38025)
	0897	Mod : 31371 = (27522+31371) = (27522+31371+31494)
R	0898	Mod : 30067 = (P2878+20059+22706+22707) = (20059+22706+22707+30067) =
R		(P2878+20059+22706+22707+20084+38025)
R	0899	Mod : (20057+20059+20082+22706+22707) =
R		(20057+20059+20082+20084+22706+22707+38025) =
R		(P2878+P2879+20057+20059+20082+20084+22706+22707+38025)
	0900	Mod : 26363 = 34651 = (26363+30626+35110)
	0901	Mod : (22013+26363) = (22013+34651) = (22013+26363+30626+35110)
	0902	Mod : 24139 = 24340 = (24139+24340) = (24139+30626+35110)
	0903	Mod : 22238 = (22238+30626+35110)
	0904	Mod : 24035 = 24160 = 24189 = (24035+34571+35270)
	0905	Mod : (24160+32600) = (24189+32600) = (24035+32600) =
		(24035+32600+34571+35270)
	0906	Mod : (24035+34571) = (24160+34571) = (24189+34571)
	0907	Mod : (32600+34571) = (24035+32600+34571) = (24189+32600+34571)
	0908	Mod : (32600+34984) = (24035+32600+34984)
R	0909	Mod : 20057 = 20059 = 30067 = 35236 = (20059+22707) = (20057+22707) =
R		(20057+20059) = (20059+22706+22707) = (22706+22707+35236) =
R		(20057+22706+22707) = (22706+22707+30067) = (20059+20084+38025) =
R		(20059+20084+22707+38025) = (20057+20059+22706+22707) =
R		(20057+20059+22707) = (P2878+20059+22706+22707) =
R		(20057+20059+20084+22707+38025) = (20059+20084+22706+22707+38025) =
R		(P2878+P2879+20057+20059+22706+22707) =
R		(20057+20059+20084+22706+22707+38025)
R	0910	Mod : (20057+20082+22706+22707) = (P2879+20057+20082+22706+22707) =
R		(20057+20059+20082+22706+22707) =
R		(P2878+P2879+20057+20059+20082+22706+22707) =
R		(20057+20059+20082+22706+22707+20084+38025)
R	0911	Mod : 20057 = 20059 = 35236 = (20057+20059) = (20059+20084+38025) =
R		(20057+20059+20084+38025)
R	0912	Mod : 30067 = (20059+30067) = (20059+20084+30066+30067+38025)
R	0913	Mod : 26526 = (26526+27046) = (26526+28308) = (26526+28308+28811) =
R		(26526+28308+30368) = (26526+28308+28811+34604) =
R		(25526+28308+30368+31367+35270) =
R		(26526+28308+30368+31367+34634+36720)
R	0914	Mod : (34637+35353) = (26526+28308+30368+34637+35353) =
R		(26526+28308+30368+31367+34634+34637+35353+36720)
R	0915	Mod : (26526+27046+28308+31367+34634)
	0916	Mod : (24215+33909) = (24588+33909) = (25534+33909) = (24215+24588+33909)
	0917	Mod : (22536+25184+26380) = (22311+22536+22876+25184+26380) =
		(22311+22876+23529+25184+26380+27285) =
		(22311+22536+22876+25184+26380+27285)

	CODE	DESIGNATION
	0919	Mod : (22536+25184+27281) = (23529+25184+26875+27281) = (22311+23227+25184+27281) = (22311+23529+25184+27281) = (22311+23227+25184+26207) = (22311+23227+25184+27281+27285) = (22311+23529+25184+26875+27281) = (22311+23529+25184+27281+27285) = (22311+23227+25184+26207+27281) = (22311+23529+25184+26207+26235) = (22311+22536+25184+27281+27285) = (22311+23227+25184+26875+27281+27285) = (22311+23529+25184+26875+27281+27285) = (22311+23529+25184+26207+27281+27285) = (22311+22536+25184+26207+27281+27285) = (22311+23227+25184+26207+27281+27285)
R	0921	Mod : 26526 = (26526+28308) = (26526+27046) = (26526+34634) =
R		(26526+28308+28811) = (26526+28308+30368) = (26526+28308+34634) =
R		(26526+28308+28811+34604) = (26526+28308+30368+31375+35270) =
R		(26256+28308+30368+31375+34634+36720)
	0922	Mod : 28479 = 28702 = 28916 = (28479+31283+34861)
	0923	Mod : 30660 = 31283 = (28479+30660+31283) = (28916+30660+31283) = (28479+30660+31283+34862)
R	0924	Mod : (34637+35353) = (26526+28308+30368+34637+35353) =
R		(26526+28308+30368+31375+34634+34637+35353+36720)
	0925	Mod : 26540 = (26540+31283+34861) = (26540+31283+34862) = (26540+31283+34864)
	0926	Mod : 22013 = 24105 = 26334 = 26335 = (22013+31283+34864)
R	0927	Mod : (30368+31367) = (30368+31367+34634)
	0928	STD = (28479+34864) = (28479+34861) = (28479+34862)
R	0929	Mod : (31367+34634) = (30368+31367+34634+35270)
	0932	STD = 23450 = (20406+23450) = (31283+34862) = (31283+34864) = (31283+34861)
	0933	Mod : 20406 = (20406+31283+34861) = (20406+31283+34862)
R	0935	Mod : (26526+28244+31375+28308+34634) = (26526+28244+31375+28308+30368)
R	0936	Mod : (26526+28244+31426+31375+28308+34634) =
R		(26526+28244+31426+31375+28308+30368)
R	0937	Mod : (26526+27046+28244+28308+31375+31426+34634) =
R		(26526+27046+28244+31426+31375+28308+30368)
R	0938	Mod : (26526+28244+31375+28308+31426+34825+34634) =
R		(26526+28244+31375+28308+31426+34825+30368)
	0939	Mod : 31371 = (27522+31371) = (P0164+30660+31371) = (P0164+27522+30660+31371) = (27522+30660+31371+34861) = (27522+30660+31371+34862) = (27522+30660+31371+34864)
R	0940	Mod : (26526+27046+28244+31426+31375+28308+34825+34634) =
R		(26526+27046+28244+31426+31375+28308+34825+30368)
R	0942	Mod : (26526+27046+28244+28308+31375+31426+35074+34825+30368) =
R		(26526+27046+28244+28308+31375+31426+35074+37825+34634)
	0944	STD = (30977+35100)
	0945	Mod : 22013 = 24105 = (22013+30977) = (24105+30977) = (22013+33879) = (24105+33879) = (24105+30977+35100)
	0946	30977 = (30020+30977)
	0947	Mod : STD = 22013 = 24105 = (22013+30977) = (22013+33879) = (24105+30977) = (24105+33879) = (30977+35100)
R	0949	Mod : (26526+28244+31375+28308+31426+34825+35074+34634) =
R		(26526+28244+31375+28308+31426+34825+35074+30368)
	0953	Mod : 26540 = (25296+26540+34293) = (25296+26540+34986)
	0954	Mod : 25296 = 25477 = (25296+26540+34294) = (25296+26540+34987)
	0955	STD = Mod : (25296+34293) = (25296+34986) = (25296+26540+34293+34294) = (25296+26540+34986+34987)

	CODE	DESIGNATION
	0956	STD = Mod : (25296+34293) = (25296+34986)
R R R	0958	Mod : (26526+27046+28244+28308+31375+34634) = (26526+27046+28244+28308+30368+31375) = (26526+27046+28244+28308+31375+31426+34634+35074)
R	0959	Mod : (26526+28244+31375+28308) = (26526+27046+28244+31375+34634)
R	0960	Mod : (26526+28244+31375+31426+34634+34825)
	0961	STD = Mod : 33497 = (27620+33497) = (21126+35643)
R R	0963	Mod : (34637+35350+35351+35353) = (26526+28244+28308+31375+31426+34637+35074+35350+35351+35353+36720)
R R R R R R R R	0965	Mod : (34637+35350+35351) = (26526+34637+35350+35351) = (26526+28244+34637+35350+35351) = (31426+34637+34825+35350+35351+36720) = (26526+28244+27046+28308+34637+35350+35351) = (26526+28244+28308+31426+34637+35350+35351) = (26526+28244+28308+31426+34637+35074+35350+35351) = (26526+27046+28244+28308+31375+31426+34637+35350+35351) = (26526+28244+28308+31375+31426+34637+34825+35350+35351+36720)
R R R	0969	Mod : 28244 = (26526+28244) = (26526+28308) = (26526+27046+28244) = (26526+28244+28308) = (26526+28244+28308+28811) = (26526+28244+28308+28811+34604) = (26526+28244+28308+31426+35074)
	0970	Mod : (20173+23742) = (23742+26274) = (20173+23742+25650) = (20173+23742+26274)
R	0971	Mod : (28244+34825) = (26526+28244+28308+31375+31426+34825+35074+36720)
R	0972	Mod : (26526+27046+28244+28308) = (26526+27046+28244+28308+31426+35074)
	0973	Mod : (32205+33125+35485+35220) = (32205+33125+30368+35485+35220)
	0974	Mod : STD = 22190 = 33129 = 34664 = (30368+35270)
	0975	Mod : 24035 = 24160 = 24211 = (24035+30368+35270)
	0976	Mod : 22013 = 24105 = 28160 = (22013+30368+35270) = (24105+30368+35270) = (28160+30368+35270)
	0977	Mod : 22013 = 24105 = 26334 = 26335 = (22013+30368+35270) = (24105+30368+35270) = (26335+30368+35270) = (22013+30368+31040+35270) = (24105+30368+31040+35270) = (26335+30368+31040+35270)
	0978	Mod : STD = 31040 = (30368+35270) = (30368+31040+35270)
	0979	Mod : 22013 = 24105 = 26334 = 26335 = (22013+30368+35270) = (24105+30368+35270) = (26335+30368+35270)
	0981	Mod : (20024+22013) = (20024+22013+30368+35270)
	0982	Mod : (20024+22013+30422) = (20024+22013+25453+30422) = (20024+22013+30368+30422+35270) = (20024+22013+25453+30368+30422+35270)
	0983	Mod : (20024+22013) = (20024+22013+22802) = (20024+20586+22013+22802) = (20024+22013+30368+35270)
	0984	Mod : 20024 = (20024+22802) = (20024+20586+22802) = (20024+30368+35270)
	0987	Mod : (20024+22013+25453) = (20024+22013+30422) = (20024+22013+25453+30368+30422+35270)
	0990	Mod : (34637+35350) = (26526+34637+35350) = (26526+28244+28308+31426+35350+34637) = (26526+28244+28308+31426+34637+35074+35350) = (26526+27046+28244+28308+31375+31426+34637+35350)
	0992	Mod : 22562 = 35864 = (22562+35864) = (22562+25888+27609)
	0993	Mod : 25888 = (22562+25888) = (25072+25888) = (25888+35864) = (22562+25072+25888)
	0994	Mod : 22562 = (21237+22562) = (21237+35864) = (21237+22562+35864) = (21237+22562+25888+27609)

	CODE	DESIGNATION
	0995	Mod : 25888 = (21237+25888) = (22562+25888) = (25072+25888) = (22562+25072+25888) = (21237+25888+35864) = (21237+22562+25072+25888)
	0998	STD = 25072 = 25888 = (22562+25072) = (22562+25888) = (25888+27609) = (25888+35864) = (22562+25072+25888)
R	1000	STD = (31283+34861) = (31283+34862) = (31283+34864)
R R	1001	Mod : 35220 = (31283+35220) = (31283+34086+35220) = (31283+34862+35220) = (31283+34864+35220) = (31283+34862+37809+35220)
	1002	Mod : STD = (33100+34856) = (33100+34898) = (33100+34997)
	1003	Mod : 26358 = (26358+26999+28495) = (26358+26999+27917) = (26358+26999+28495+30368+35270)
	1010	Mod : STD = (26999+28495) = (26999+28495+30368+35270)
	1011	Mod : 23885 = 25205 = 26999 = 28382 = 30241 = 30631 = (23885+26111) = (25205+26999+28495) = (26999+28382+28495) = (26270+26999+28382+28495+34514) = (26999+28495+30368+35270)
	1012	Mod : (25205+25529) = (25205+26270) = (25529+26999) = (25529+28382) = (25529+30241) = (26117+26999) = (26270+26999) = (26270+28382) = (23885+26111+26270) = (23885+25529+26111) = (25529+26999+28382+28495) = (26117+26999+28382+28495) = (26117+26270+26999+28382+28495+30368+35270) = (26117+26999+28382+28495+30368+35270) = (26270+26999+28382+28495+30368+35270) = (26270+26999+28382+28495) = 25529+26999+30368+35270)
	1013	Mod : STD = (20139+22129) = (30368+35270)
R	1014	Mod 32220 = (25404+35220) = (25404+31283+35220)
	1015	Mod : 22536 = 23227 = 23529 = 25564 = 31699 = (22536+30368+35270) = (23227+30368+35270) = (23529+30368+35270) = MSN : 163 = 164 = 168 = 169 = 179 = 193 = 221 = 222 = 230 = 294 = 299 = 301 = 338 = 348 = 349 = 362 = 363 = 424 = 429 = 437 = 444 = 449 = 476
	1016	Mod : STD = 20151 = 23092 = 31112 = (31495+35270)
	1017	Mod : (31367+34634) = (28308+31367+34634) = (26526+31367+34634) = (26526+28308+31367+34634) = (26526+28308+30368+31367+34634+35270)
	1018	Mod : (31375+34634) = (26526+31375+34634)
	1021	Mod : (26526+27046+28308+30368+31375) = (26526+27046+28308+31375+34634)
	1023	Mod : (22562+27993) = (27993+35864) = (22562+27993+35864)
	1024	Mod : (27993+35864) = (22562+27993)
R	1029	Mod : (30368+31283) = (30368+31283+34862+37809)
R R R R R R R	1030	Mod : 26999 = 26111 = 30631 = 26485 = 23885 = 24075 = 28382 = 30241 = (26999+28382+28495) = (22013+23219+23672+24075) = (22013+23219+23672+26999) = (23672+24105+25294+24075) = (23672+24105+25294+26999) = (22013+23219+23672+28382) = (22013+23219+23672+26111) = (23672+24105+25294+26999+28382+28495) = (22013+23219+23672+24785+26999+28382+28495)
	1031	Mod : STD = (33100+34856) = (33100+34898) = (33100+34997)
R R	1032	Mod : 22013 = 24105 = 25108 = 27917 = 28218 = 31070 = (22013+24785+27917) = (24105+25294+27917) = (24105+30020+31070) = (25108+28218+30400)
R R	1033	Mod : (22706+20406+30365+P8175+33907+31283) = (P8175+20406+22706+30365+31283+33907+34862+37809)
	1034	Mod : M:IAEall = 24105 = (24105+IAEall) = (30368+35270) = (24105+30368+35270) = (24105+30368+35270+IAEall)
R R	1035	Mod : (P8175+22706+30365+33907+35220+35485) = (P8175+22706+30365+31283+33907+35220+35485)
R R	1036	Mod : (P8175+20406+22706+30365+33907+35220+35485) = (P8175+20406+22706+30365+31283+33907+35220+35485)

	CODE	DESIGNATION
R	1037	Mod : 26999 = 27646 = 28382 = 30241 = 30635 = (26999+28495+28382) =
R		(26999+28749+34864)
	1039	Mod : (22707+24105) = (22707+24105+30368+35270)
	1040	Mod : 22561 = (20067+22561) = (20069+22561) = (20067+20069+22561) = (20067+20069+22561+33100+34856) = (20067+20069+22561+33100+34898) = (20067+20069+22561+33100+34997)
	1041	Mod : (20067+20069) = (20067+20069+33100+34997) = (20067+20069+33100+34856) = (20067+20069+33100+34808)
	1042	Mod : (20057+20067+20069+20071) = (20059+20067+20069+20071) = (20057+20067+20069+20816+27063) = (20059+20067+20069+20816+27063) = (20057+20059+20067+20069+20071) = (20059+20067+20069+33100+20071+34898) = (20059+20067+20069+33100+20071+34856) = (20057+20059+20069+20067+33100+20071+34997)
	1043	Mod : (20057+20067+20069+20071) = (20059+20067+20069+20071) = (20057+20067+20069+20816+27063) = (20059+20067+20069+20816+27063) = (20057+20059+20067+20069+20071) = (20059+20067+20069+20071+33100+34898) = (20059+20067+20069+20071+33100+34856) = (20057+20059+20067+20069+20071+33100+34997)
R	1044	Mod : (26999+28916) = (28382+28916) = (26999+28479) = (26999+28702) =
R		(28916+30241) = (26999+28382+28479) = (28382+28916) =
R		(26999+28382+28495+28916) = (26999+27646+28382+28495+28702) =
R		(26999+27646+28382+28479+28495) =
R		(26999+27646+28382+28479+28495+30365)
	1045	Mod : (20067+20069+20071) = (20067+20069+20816+27063) = (20067+20069+20071+33100+34856) = (20067+20069+20071+33100+34898) = (20067+20069+20071+33100+34997)
	1047	Mod : (21678+33100+34856) = (21678+33100+34898) = (31678+33100+34997)
	1048	Mod : (21678+21708) = (21678+21708+33100+34856)
	1049	Mod : (35485+35220+31283) = (23450+31283+35485+35220) = (20406+23450+31283+35485+35220)
	1051	(CFM Eng : 56-5-B1/B2/B3/B4/B5/B6/B7) = (30368+35270+56-5-B1/B2/B3/B4/B5/B6/B7)
	1052	(22707+CFM all) = (22707+30368+35270+CFM all)
	1054	Mod : 24035 = 24084 = 24160 = 24189 = (24035+24084) = (24035+24160) = (24035+24189) = (24035+24084+24160) = (24035+24084+24189) = (24035+24160+24189) = (24035+24084+24160+24189) = (24035+24084+30368+35270)
	1056	IAE all = (30368+35270+IAE all)
	1058	(25409+CFM all) = (25409+30368+35270+CFM all)
R	1059	Mod : 28658 = (28658+33497) = (28658+27658+33497)
	1061	Mod : 35220 = (31283+35220) = (22013+24044+35220) = (25951+32239+35220) = (22013+24044+31283+35220)
	1062	Mod : (22013+35220) = (25951+35220) = (22013+31283+35220) = (25951+31283+35220)
R	1064	Mod : 26999 = 27646 = 30631= 28382 = 30241 = (27646+30241) =
R		(26274+27646+30955) = (26999+28382+28495) = (26358+26999+30980) =
R		(26358+27646+30980) = (26358+28382+30980) = (26358+30241+30980) =
R		(26358+30631+30980) = (26999+27531+35638) = (27531+27646+35638) =
R		(26274+27646+28382+30955) = (26999+27646+28382+28495) =
R		(26999+27531+27646+35638) = (27531+27646+28382+35638) =
R		(26274+26358+27646+30955+30980) = (26358+26999+28382+28495+30980) =
R		(26274+26358+27646+28382+30955+30980) =
R		(26358+26999+27646+28382+28495+30980) =
R		(26358+27531+27646+28382+30980+35638) =
R		(26358+26999+27531+27646+30980+35638)

	CODE	DESIGNATION
	1065	Mod : 27229 = 28180 = 28777 = 31090 = 31558 = 31668
	1066	Mod : STD (30368+35270) = (22562+25072) = (25888+27609) = (22562+25072+30368+35270) = (25888+27609+30368+35270)
R	1067	Mod : (26999+27531) = (27531+27646) = (26999+27531+27646) =
R		(27531+27646+28382) = (26274+27531+27646+28382) =
R		(26358+26999+27531+27646+30980) = (26358+27531+27646+28382+30980)
	1068	Mod : 26999 = 27646 = 30631= 28382 = 30241 = (26999+27646) = (27646+28382) = (27646+30241) = (26274+27646+30955) = (26999+28382+28495) = (26358+26999+30980) = (26358+27646+30980) = (26358+28382+30980) = (26358+30241+30980) = (26358+30631+30980) = (26999+27531+35638) = (27531+27646+35638) = (26274+27646+28382+30955) = (26358+27646+30241+30980) = (26999+27646+28382+28495) = (26999+27531+27646+35638) = (27531+27646+28382+35638) = (26274+26358+27646+30955+30980) = (26358+26999+28382+28495+30980) = (26274+26358+27646+28382+30955+30980) = (26358+26999+27646+28382+28495+30980) = (26358+27531+27646+28382+30980+35638) = (26358+26999+27531+27646+30980+35638)
	1069	Mod : 26358 = (26358+30955) = (26358+26999+28495) = (26274+26358+26999+27646+28382+28495+30955) = (26358+26999+27531+27646+28382+28495+35638)
R	1073	Mod : 25184 = 27285 = (22311+25184) = (22311+27285) = (25184+26875) =
R		(22311+25184+26875) = (22311+25184+27285) = (22311+25184+26875+27285) =
R		(22311+22791+25184+30389) = (22311+25184+26380+26875) =
R		(25184+26380+26875+27285) = (22311+22876+25184+26380+26875) =
R		(22091+25184+26875+27285+27608) = (22311+25184+26670+27285+30389)
	1074	Mod : (31896+32222) = (31897+32160) = (31897+34076) = (32402+32997) = (32475+32997) = (32401+34076) = (32929+34076)
R	1076	Mod : (25184+35240) = (27285+35240) = (22311+27285+35240) =
R		(25184+26875+35240) = (22791+30389+35240) = (22311+25184+35240) =
R		(22311+25184+26875+35240) = (22311+25184+27285+35240) =
R		(22311+25184+26380+26875+35240) = (25184+26380+26875+27285+35240) =
R		(22311+22791+25184+30389+35240) = (22311+25184+26875+27285+35240) =
R		(22311+25184+26380+26875+27285+35240) =
R		(22311+22876+25184+26380+26875+35240) =
R		(22311+25184+26670+27285+30389+35240) =
R		(22311+22876+25184+26380+26875+27285+35240)
R	1077	Mod : (26670+35240) = (25184+26670+35240) = (22311+25184+26670+35240) =
R		(22311+25184+26670+27285+35240) = (22791+26670+30389+35240) =
R		(22311+22791+25184+26670+30389+35240)
R	1078	MSN : 0557 = 0597 = 0620 = 0631 = 0820 = 0908 = 1758 = 1790 = 1850 = 1893 = 1912 = 1926 = 1962
R	1079	Mod : (25184+27281) = (25184+27281+27285) = (22311+25184+26207) =
R		(25184+26875+27281) = (25184+26207+26875+27281) =
R		(22311+25184+26207+27285) = (22311+25184+26875+27281) =
R		(22311+25184+26875+27285) = (22311+25184+26207+27281+27285) =
R		(22311+25184+26875+27281+27285) =
R		(22311+25184+26380+26875+27281+27285)
R	1080	Mod : (27281+35240) = (25184+27281+35240) = (22311+25184+27281+35240) =
R		(25184+27281+27285+35240) = (25184+26875+27281+35240) =
R		(22311+25184+27281+35240) = (22311+25184+26207+35240) =
R		(25184+26207+26875+27281+35240) = (22311+25184+26875+27281+35240) =
R		(22311+25184+26207+27285+35240) = (22311+25184+27281+27285+35240) =
R		(22311+25184+26207+27281+27285+35240) =
R		(22311+25184+26875+27281+27285+35240) =
R		(22311+25184+26380+26875+27281+27285+35240)

	CODE	DESIGNATION
	1082	Mod : 34637 = (21391+34637) = (21391+26526+34637) = (21391+26526+31426+34637) = (21391+26526+31426+34637+35074)
	1083	Mod : 34637 = (21391+34637) = (21391+26526+34637)
	1084	Mod : (22769+34637) = (21391+22769+34637) = (21391+22769+26526+34637) = (21391+22769+26526+31426+34637) = (21391+22769+26526+31426+34637+35074)
	1085	Mod : (22769+34637) = (21391+22769+34637) = (21391+22769+26526+34637)
	1086	Mod : 34637 = (26526+34637) = (26526+31426+34637) = (26526+31426+34637+35074)
	1087	Mod : 34637 = (21391+34637) = (21391+26526+34637)
R R	1088	Mod : 22876 = 27558 = (22311+22876) = (22311+22876+25184) = (22311+22876+25184+27285) = (22311+25184+26670+27285+27558)
	1089	Mod : (22769+34637) = (22769+26526+34637)
	1090	Mod : 34637 = (21391+34637) = (20259+21391+34637) = (21391+26526+34637) = (20259+21391+26526+34637)
	1091	Mod : 34637 = (26526+34637) = (26526+28244+34637)
	1092	Mod : (28308+34637) = (28308+28738+34637) = (28308+28739+34637)
	1093	Mod : 34637 = (28738+34637) = (28739+34637)
R R R	1094	Mod : (22876+35240) = (27558+35240) = (22311+22876+35240) = (22311+22876+25184+35240) = (22311+22876+25184+27285+35240) = (22311+25184+26670+27285+27558+35240)
	1095	Mod : (34637+35350+35353) = (26526+28244+28308+31426+34637+35350+35353)
	1097	Mod : 30368 = (22562+25072+30368) = (25888+27609+30368)
	1099	Mod : (25888+30368)
	1100	Mod : (24035+35220) = (24160+35220) = (24189+35220)
	1101	Mod : (26017+35220) =(22634+26017+35220)
	1102	Mod : (22634+26017+35220)
	1103	Mod : (32088+33777) = (32090+33777) = (32088+35137) = (32090+35137)
R R R R R R R R R R	1104	Mod : (25184+35240) = (27285+35240) = (22311+27285+35240) = (25184+27285+35240) = (25184+26875+35240) = (22791+30389+35240) = (22311+25184+35240) = (22311+25184+27285+35240) = (22311+25184+26875+35240) = (22311+22791+25184+30389+35240) = (22311+25184+26380+26875+35240) = (25184+26380+26875+27285+35240) = (22311+25184+26670+27285+30389+35240) = (22311+22876+25184+26380+26875+35240) = (22311+25184+26380+26875+27285+35240) = (22311+22876+25184+26380+26875+27285+35240)
R R R	1105	Mod : (22876+35240) = (27558+35240) = (22311+22876+35240) = (22311+22876+25184+35240) = (22311+22876+25184+27285+35240) = (22311+25184+26670+27285+27558+35240)
R R R	1106	Mod : (26670+35240) = (25184+26670+35240) = (22311+25184+26670+35240) = (22791+26670+30389+35240) = (22311+25184+26670+27285+35240) = (22311+22791+25184+26670+30389+35240)
	1107	Mod : (24035+35220) = (24084+35220) = (24160+35220) = (24035+24084+35220) = (24035+24160+35220) = (24084+24160+35220) = (24035+24084+24160+35220)

	CODE	DESIGNATION
R	1108	Mod : (27281+35240) = (26207+35240) = (25184+26207+35240) = (25184+27281+35240) = (22311+25184+27281+35240) = (22311+25184+26207+35240) = (22311+25184+27281+27285+35240) = (22311+25184+26875+27281+35240) = (22311+25184+26207+27285+35240) = (25184+26207+26875+27281+35240) = (22311+25184+26207+27281+35240) = (22311+25184+26207+27281+27285+35240) = (22311+25184+26875+27281+27285+35240) = (25184+26207+26875+27281+27285+35240) = (22311+25184+26380+26875+27281+27285+35240) = (22311+22876+25184+26380+26875+27281+27285+35240)
R	1109	Mod : (25184+26207) = (25184+27281) = (22311+25184+26207) = (22311+25184+26875+27281) = (22311+25184+27281+27285) = (22311+25184+26207+27285) = (25184+26207+26875+27281) = (22311+25184+26207+27281+27285) = (22311+25184+26875+27281+27285) = (25184+26207+26875+27281+27285) = (22311+25184+26380+26875+27281+27285) = (22311+22876+25184+26380+26875+27281+27285)
R	1110	Mod : 25184 = 27285 = (22311+25184) = (22311+27285) = (25184+26875) = (25184+27285) = (22311+25184+26875) = (22311+25184+27285) = (22311+22791+25184+30389) = (22311+25184+26380+26875) = (25184+26380+26875+27285) = (22311+22791+25184+30389) = (22311+22876+25184+26380+26875) = (22311+25184+26380+26875+27285) = (22091+25184+26875+27285+27608) = (22311+25184+26670+27285+30389)
	1111	Mod : 31896 = 31897 = 32475 = 32929 = (31896+32332+32475) = (31897+32333+32929) = (26999+28495+31896) = (26999+28495+31897) = (26999+28495+32475) = (26999+28495+32929) = (31896+32332+35119) = (26999+28495+31896+32332+35119)
	1113	Mod : (26999+31896) = (26999+31897) = (28382+31897) = (26999+32929) = (26999+32475) = (26999+28382+28495+31896) = (26999+31896+32332+32475) = (26999+31897+32333+32929) = (26999+28495+28382+32475) = (26999+28495+28382+31897) = (26999+28495+28382+31897+32333+32929) = (26999+28495+28382+31896+32332+32475) = (28382+31475) = (26999+28382+28495+32929) = (25205+32929) = (30241+31896) = (26999+31896+32332+35119) = (26999+28382+28495+31896+32332+35119)
	1114	Mod : (30631+31896) = (30631+31897) = (26485+31896) = (26485+31897) = (30631+32929) = (26485+32929) = (30631+32475) = (30631+31896+32332+32475) = (26485+31896+32332+32475) = (30631+31897+32333+32929) = (26485+31897+32333+32929) = (26485+31896+32332+35119) = (30631+31896+32332+35119)
R	1115	Mod : (22311+25184+26670) = (22791+26670+30389) = (22311+25184+26670+27285) = (22311+22791+25184+26670+30389)
R	1119	Mod : 22914 = 34383 = (20175+20704) = (20175+34383) = (20175+21441) = (21441+22183) = (21441+22192) = (25440+26275) = (20175+21441+22192) = (20175+21441+22914) = (20175+25440+26275) = (25440+26275+26560+35555) = (25440+26275+26560+28293+35555)
R	1122	Mod: (34637+35352) = (34637+35212) = (21391+26526+34637+35352) = (21391+26526+31426+34637+35352) = (21391+26526+31426+34637+35074+35352)
R	1123	Mod : (22536+32007) = (23227+32007) = (23529+32007) = (25564+32007) = (32007+MSN 168 = 179 = 221 = 222 = 294 = 299 = 301 = 348 = 349 = 362 = 363 = 424 = 444)
R	1124	Mod : 22536 = 23227 = 23529 = 25564 = 31699 = MSN 164 = 169 = 193 = 221 = 222 = 294 = 299 = 301 = 348 = 349 = 362 = 424 = 444
R	1125	Mod : 22536 = 23227 = 23529 = 25564 = 31699 = MSN 164 = 168 = 169 = 179 = 193 = 221 = 222 = 294 = 299 = 301 = 348 = 349 = 362 = 424 = 444

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R	1126	Mod : 22536 = 23227 = 23529 = (22311+22536) = (22311+23227) = (22311+23529)
R		= (22311+22876+23529+25184+26380+26875) =
R		(22311+23529+25184+26875+27285) = (23227+25184+26875+27281+27285) =
R		(22311+23529+25184+26380+26875+27281+27285) =
R		(22311+22876+23529+25184+26380+26875+27281+27285) =
R		(23227+25184+26875+27281) = (22311+22536+22791+25184+26670+30389) =
R		(22311+27285) =(22536+22791+26670+30389) = (23227+25184+26875+27281)
	1127	Mod : (31896+32042) = (31897+32042) = (32042+34076+35651) =
		(31896+32042+32332+35119)
	1128	Mod : (31896+22249+32600) = (31897+22249+32600) = (32475+22249+32600) =
		(22249+32600+32929) = (22249+24035+31896+32600) =
		(22249+24035+31897+32600) = (31896+32332+32475+22249+32600) =
		(22249+31897+32333+32600+32929) = (22249+32600+31896+32332+35119) =
		(22249+24035+32600+31896+32332+35119)
R	1130	Mod : (23227+25184) = (23227+27285) = (22311+22536+25184) =
R		(22311+23227+25184) = (22311+23529+25184) = (22311+23529+27285) =
R		(23227+25184+26875) = (23529+25184+26875) = (23529+25184+27285) =
R		(22311+22536+25184+26875) = (22311+22536+25184+27285) =
R		(22311+23227+25184+26875) = (22311+23227+25184+27285) =
R		(22311+23529+25184+26875) = (22311+23529+25184+27285) =
R		(22536+22791+26670+30389) = (23227+25184+26875+27281) =
R		(23227+25184+26875+27285) = (22311+22791+23529+25184+30389) =
R		(22311+23227+25184+26875+27285) = (22311+23529+25184+26380+26875)
R		=(22311+23529+25184+26875+27285) = (23227+25184+26875+27281+27285) =
R		(22311+22536+22791+25184+26670+30389) =
R		(22311+22876+23529+25184+26380+26875) =
R		(22311+26529+25184+26380+26875+27285) =
R		(22311+23227+25184+26670+27285+30389) =
R		(22311+22876+23529+25184+26380+26875+27285) =
R		(22311+23529+25184+26380+26875+27281+27285) =
R		(22311+23529+23853+25184+26670+27285+34204) =
R		(22311+22876+23529+25184+26380+26875+27281+27285)
R	1131	Mod : (22536+28308) = (23227+28308) = (23529+28308) = (27740+28308) =
R		(23227+28308+28811+34604) = (22536+28308+28811+34604)
R	1132	Mod : (22536+35485) = (23227+35485) = (23529+35485) = (27740+35485) =
R		(25564+35485) = (22536+30368+35485) = (23227+30368+35485) =
R		(23529+30368+35485) = (27740+30368+35485) = (25564+30368+35485)
	1134	Mod : (31896+32600) = (31897+32600) = (32475+32600) = (32600+32929) =
		(31896+32332+32475+32600) = (31897+32333+32929+32600) =
		(24035+31896+32600) = (24035+31897+32600) = (24035+31896+32402+32600) =
		(24035+31897+32401+32600) = (31896+32332+32600+35119) =
		(24035+31896+32332+32600+35119)
	1135	Mod : (24035+31896+32600) = (24035+31897+32600) =
		(24035+31896+32402+32600) = (24035+31897+32401+32600) =
		(24035+31896+32332+32600+35119)
	1148	Mod : 22473 = 26589 = 35391 = (22567+26589) = (22567+35391)
R	1149	Mod : (22536+30368) = (23227+30368) = (23529+30368) = (27740+30368) =
R		(25564+30368)
	1150	Mod : 22230 = 22432 = 22976 = 26195 = (22485+22976) = (22567+26195) = ANA
R	1151	Mod : 22536 = 23227 = 23529 = 25564 = 31699 = MSN : 164 = 168 = 169 = 179
R		= 193 = 221 = 222 = 230 = 294 = 299 = 301 = 348 = 349 = 362 = 424 = 429 =
R		437 = 444 = 476
R	1152	Mod : (24035+24197+31283) = (24035+24197+31283+34862+37809)
R	1153	Mod : (22249+31283) = (22249+24035+24197+31283)
R	1154	Mod : (24035+31283) = (24160+31283) = (24189+31283) =
R		(24035+31283+34862+37809) = (24160+31283+34862+37809) =
R		(24189+31283+34862+37809)

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R	1155	Mod : (22249+24035+31283) = (22249+24160+31283) = (22249+24186+31283) = (22249+24035+31283+34862+37809) = (22249+24160+31283+34862+37809) = (22249+24189+31283+34862+37809)
	1156	Mod : (34637+35353) = (26526+34637+35353)
	1158	Mod : (24035+24084+33909) = (24035+24084+33909+35220)
R	1159	Mod : (22249+32600+31283) = (22249+24035+31283+32600) = (22249+24160+31283+32600) = (22249+24189+31283+32600) = (22249+32600+31283+34862+37809) = (22249+24035+32600+31283+34862+37809) = (22249+24160+32600+31283+34862+37809) = (22249+24189+32600+31283+34862+37809)
R	1160	STD = Mod : (24035+24197) = (31283+34861) = (31283+34864) = (31283+34862) = (24035+24197+31283+34861) = (24035+24197+31283+34864) = (24035+24197+31283+34862)
R	1161	Mod : 22249 = (22249+24035+24197) = (22249+31283+34861) = (22249+31283+34862) = (22249+31283+34864) = (22249+24035+24197+31283+34861) = (22249+24035+24197+31283+34862) = (22249+24035+24197+31283+34864)
	1162	Mod: 35220 =(26017+35220)
R	1163	Mod : 24035 = 24160 = 24189 = (24035+31283+34862) = (24035+31283+34861) = (24035+31283+34864) = (24160+31283+34862) = (24160+31283+34861) = (24160+31283+34864) = (24189+31283+34862) = (24189+31283+34861) = (24189+31283+34864)
R	1164	Mod : (24035+32600) = (24160+32600) = (24189+32600) = (24160+32600+31283+34861) = (24160+32600+31283+34862) = (24160+32600+31283+34864) = (24035+32600+31283+34861) = (24035+32600+31283+34862) = (24035+32600+31283+34864) = (24189+32600+31283+34861) = (24189+32600+31283+34862) = (24189+32600+31283+34864)
	1168	Mod : STD = (STD+L) = 22802 = 25453 = 28378 = 30422 = 34456 = (22802+L) = (25453+L) = (30422+L) = (34456+L) = (22802+25453) = (25453+30422) = (25453+30422+L)
	1169	Mod : STD = 25453 = 28378 = 30422 = 34456 = (25453+30422)
	1170	Mod : (20024+30368) = (20024+30368+22802)
	1173	Mod : STD = 25072 = 27609 = (22562+25072) = (25072+27609) = (25888+27609) = (22562+25072+27609)
	1174	Mod : 22562 = 35864 = (22562+30368+35270) = (30368+35270+35864) = (22562+25888+27609)
	1175	Mod : 25888 = (25888+30368+35270) = (22562+25072+25888) = (25888+30368+35270+35864)
	1176	Mod : (24871+27993) = (22562+24871+25072+27993)
	1177	Mod : (22536+32007) = (23227+32007) = (23529+32007) = (25564+32007) = (31699+32007) = (22562+24871+25072+25000+27993) = (32007+MSN 168 = 179 = 221 = 222 = 294 = 299 = 301 = 348 = 349 = 362 = 363 = 424 = 444)
	1178	Mod : (22562+24871+26608+27993) = (22562+24871+25000+27993)
	1181	Mod : 28916 = 28479 = 28702 = (26270+28479+34514) = (26999+28479+28495) = (26999+28495+28916) = (26999+28495+28702)
R	1183	Mod : 25205 = 26999 = 28382 = 30241 = 30631 = (23885+26111) = (25205+26999+28495) = (26999+28382+28495) = (26999+31283+34864)
	1184	Mod : 22536 = 23227 = 23529 = 27740 = (22536+27740) = (23227+27740) = (23227+28738) = (23227+28739) = (23529+27740) = (28738+28739) = (22536+34987) = (23227+28738+28739) = (23529+26540+34294) = (23529+28738+28739) = (22536+26540+34987) = (23227+26540+34987) = (23529+26540+34987) = (23227+28739+34987) = (23227+26540+28738+34987) = (23227+26540+28739+34987) = (23529+26540+27740+34987) = (23227+26540+28738+28739+34987)

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1185	Mod : STD = Mod: (26999+28495) = (26999+27917)
1188	Mod : (25205+28916) = (26111+28916) = (26999+28916) = (28382+28916) = (28916+30241) = (28916+30635) = (28916+30631) = (25205+28479) = (26111+28479) = (26999+28479) = (28382+28479) = (30241+28479) = (30635+28479) = (30631+28479) = (26999+28702) = (28382+28702) = (25205+31283) = (23885+26111+28916) = (26999+31283+34861) = (26999+31283+34862) = (25205+26999+28495+28916) = (26999+28382+28475+28495) = (26999+28382+28495+28702) = (26999+28382+28495+28916)
1189	Mod : (25205+25529) = (25205+26270) = (25529+26999) = (25529+28382) = (25529+30241) = (26117+26999) = (26270+26999) = (26270+28382) = (23885+26111+26270) = (23885+25529+26111) = (25529+26999+28382+28495) = (26117+26999+28382+28495) = (26117+26270+26999+28382+28495+30368+35270) = (26117+26999+28382+28495+30368+35270) = (26270+26999+28382+28495+30368+35270) = (26270+26999+28382+28495) = (25529+26999+30368+35270) = (23885+26111+26270+26999)
1190	Mod : (26270+26999+30368) = (25529+26999+30368) = (26117+26999+30368) = (25529+26999+28382+28495+30368) = (26270+26999+28382+28495+30368) = (26117+26999+28382+28495+30368) = (25205+26270+26999+28382+30368)
1193	Mod : (24035+32600+26497) = (24160+32600+26497) = (24211+32600+26497) = (24035+26497+28925+32600+34282)
1195	Mod : 35220 = (26017+35220)
1197	Mod : K0860 = K4355 = (K0860+33100+34856) = (K0860+33100+34898)
1199	Mod : 26093 = 26243 = 26716 = 26717 = 26799 = 26968 = 27780 = 27831 = 27832 = 28416 = (26999+28495) = (26999+28495+31896) = (26999+28495+32475) = (26999+28495+28916)
1201	Mod : 25205 = 26111 = 26999 = 28382 = 30241 = 30635 = 30631 = 26485 = (26999+28382+28495) = (25205+26999+28495) = (26999+31897+32333) = (26999+31896+32332) = (26999+28382+28495+31897+32333)
1202	STD = Mod : 26111 = (26999+28218) = (28218+28382) = (28218+30241) = (28218+30631) = (28218+30635) = (28218+28495) = (26001+26999+28218) = (26001+28218+28382)
1203	Mod : 25205 = (26001+26999) = (26001+28382) = (26001+30241) = (26001+30631) = (26001+30635) = (26001+28495) = (25205+26001+28218)
1204	Mod : 23885 = 26999 = 28382 = 25205 = 30241 = 30631 = (23885+26111) = (25205+26999+28495) = (26999+28382+28495) = (26999+27531+28382+28495+35638)
1205	Mod : 32475 = 32401 = 32402 = 32929 = (31896+32402) = (31897+32401) = (31896+32332+32475) = (31897+32333+32929) = (31897+32929)
1207	Mod : (31896+20701) = (31897+20701) = (32929+20701) = (32475+20701) = (31896+32332+32475+20701) = (20701+31897+32333+32929) = (20701+31896+32332+35119)
1208	Mod : (27522+34869) = (27522+31286+34869)
1209	Mod : 27522 = (P0164+27522) = (27522+31371) = (P0164+27522+30660) = (P0164+30660+31371) = (P0164+27522+31371) = (27522+31371+31728) = (P0164+27522+30660+31371) = (27522+30660+31371+34861) = (27522+30660+31371+34862) = (27522+30660+31371+34864) = (P0164+27522+31371+31728) = (P0164+27522+30660+31371+31728)
1210	Mod : 27522 = (P0164+27522) = (27522+31371) = (P0164+30660+31371) = (P0164+27522+30660) = (P0164+27522+31371) = (P0164+31371+31728) = (27522+31371+31728) = (27522+30660+34861) = (27522+30660+34862) = (27522+30660+34864) = (P0164+27522+30660+31371) = (P0164+27522+30660+31371+31728)
1211	Mod : (30660+31371) = (27522+30660+31371) = (27522+30660+31371+34862)
1212	Mod : 27522 = (P0164+27522) = (P0164+27522+30660) = (27522+31371+31728) = (P0164+27522+31371+31728) = (P0164+27522+30660+31371+31728)

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1213	Mod : 31371 = (27522+31371) = (P0164+30660+31371) = (P0164+27522+31371) = (P0164+27522+30660+31371) = (27522+30660+31371+34861) = (27522+30660+31371+34862) = (27522+30660+31371+34864)
1214	Mod : 27522 = (P0164+27522) = (27522+31371) = (P0164+27522+30660) = (P0164+27522+31371) = (27522+31371+31728) = (30660+31371+P0164) = (P0164+27522+31371+31728) = (P0164+27522+30660+31371) = (P0164+27522+30660+31371+31728)
1215	Mod : (P0164+27522+31215) = (P0164+27522+31215+31371+31728) = (P0164+27522+30660+31215+31371+31728)
1216	Mod : (27522+31215+31371) = (P0164+27522+31215+31371) = (P0164+27522+30660+31215+31371) = (27522+30660+31215+31371+34862)
1217	Mod : (27522+31215+31371) = (P0164+27522+31215) = (P0164+27522+31215+31371+31728) = (P0164+27522+31215+31371) = (P0164+27522+30660+31215+31371) = (27522+31215+31371+30660+34861) = (27522+31215+31371+30660+34862) = (27522+31215+31371+30660+34864) = (P0164+27522+30660+31215+31371+31728)
1218	Mod : (26999+25863+35165) = (26999+25863+28551+34195+35165)
1219	Mod : (24211+32475+32997) = (24035+24197+32475+32997)
1220	Mod : (25863+34076) = (25863+32222) = (25863+32997) = (25863+32160) = (25863+34573) = (25863+28551+34076+34195) = (25863+28551+32222+34195) = (25863+28551+32997+34195) = (25863+28551+32160+34195) = (25863+28551+34195+34573)
1221	Mod : (24035+25863) = (24160+25863) = (24189+24211+25863) = (24035+25863+28551+34195) = (24160+25863+28551+34195) = (24189+24211+25863+28551+34195)
1222	Mod : (24189+25863) = (24189+25863+28551+34195)
1223	Mod : (24211+25863) = (24211+25863+28551+34195)
1226	Mod : (25345+25863) = (25346+25863) = (25345+25863+28551+34195) = (25346+25863+28551+34195) = (25346+25863+28551+34195)
1227	Mod : (24211+25863) = (24211+25345+25863) = (24211+25345+25863+28551+34195) = (24211+25863+28551+34195)
1228	Mod : (25863+28925) = (25863+28551+28925+34195)
1229	Mod : (24035+25863+28925) = (24035+25863+28551+28925+34195)
1230	STD = Mod : (26540+34294) = (26540+34987) = (26540+34987+31283+34861) = (26540+34987+31283+34862) = (26540+34987+31283+34864)
1232	Mod : (22013+30626) = (22013+26363+30626)
1233	Mod : (24105+30626) = (24139+30626)
1234	Mod : STD = (30368+35270) = (30368+30626+35110+35270)
1235	Mod : (26526+28308+30368+31367) = (26526+28308+31367+34634+30368)
R 1236	Mod : 25529 = 26117 = 26270 = 26345 = (25529+26345+26378)
R 1237	Mod : (25529+28916) = (25529+28479) = (26117+28479) = (26117+28702) = (26270+28479) = (26117+28916) = (26270+28916) = (26345+28916) = (25529+26345+26378+28916)
R 1241	Mod : 23888 = 25829 = 26438 = 27624 = 28258 = 30470 = 32015 = 34330 = 34331 = 34332 = 34333 = 34334 = 35436 = (27624+28258) = (27624+30470) = MSN 912 = MSN 916 = MSN 1007
R 1242	Mod :27624 = 33345 = 34330 =34334
R 1243	Mod : 28258 = 30470 = 34332 = 34333 = 35436 = (27624+28258) = (27624+30470) = (27624+28809+28258)
R 1244	Mod : 22431 = 27643 = 26520 = 21744 = 25246 = (22567+27643) = (22567+26520) = (22567+25246)
R 1245	Mod : 21744 = 22431 = 27643 = 26520 = 25246 = (22567+26520) = (22567+27643) = (21459+21744) = (22567+25246)

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	1247	Mod : 34637 = (26526+34637) = (26526+28308+30368+34637) = (26526+28308+30368+31367+34637) = (26526+27046+28308+30368+31367+34637) = (26526+28308+30368+31367+34634+36720+34637)
	1249	Mod : 34637 = (26526+34637) = (26526+28308+30368+34637) = (26526+27046+28308+30368+31375+34637) = (26256+28308+30368+31375+34634+34637+36720)
R R R	1251	Mod : (25529+28479+32600) = (26270+28479+32600) = (26117+28479+32600) = (25529+28916+32600) = (26270+28916+32600) = (26117+28916+32600) = (26345+28916+32600) = (26345+28479+32600)
	1255	Mod : 34637 = (26526+34637) = (26526+28244+28308+4637) = (26526+28244+28308+31426+34637) = (26526+28244+28308+31426+34637+35074) = (26526+28244+28308+31375+31426+34637+34825) = (26526+28244+28308+31375+31426+34637+34825+36720)
R R R R R R R R	1258	Mod : (25529+26999+32600) = (25529+26111+32600) = (26117+26111+32600) = (26270+26111+32600) = (26345+26111+32600) = (26485+25529+32600) = (26485+26117+32600) = (26485+26270+32600) = (26485+26345+32600) = (30241+25529+32600) = (30241+26117+32600) = (30241+26270+32600) = (30241+26345+32600) = (30635+25529+32600) = (30635+26117+32600) = (30635+26270+32600) = (30635+26345+32600) = (25529+26999+32600+31283+34864)
R R R R R	1260	Mod : (26270+26999+28916+32600) = (26270+26999+28479+32600) = (26117+26999+28479+32600) = (25529+26999+28916+32600) = (25529+26999+28479+32600) = (25529+26999+28382+28479+28495+32600) = (26117+26999+28382+28479+28495+32600) = (26270+26999+28382+28479+28495+32600)
R R R R	1261	Mod : 31896 = 31897 = 32475 = 32929 = (28308+31896) = (28308+31897) = (28308+32475) = (28308+32929) = (28308+31896+32475) = (28308+31897+32929) = (23308+31896+32332+32475) = (31896+32332+35119) = (28308+31896+32332+35119) = (28308+28811+32929+34604)
R R	1262	Mod : (28308+28369) = (23450+28308+28369) = (20406+23450+28308+28369) = (28308+28369+28811+34604)
R R R R	1263	Mod : 31896 = 31897 = 32475 = 32929 = (28308+31896) = (28308+31897) = (28308+32475) = (28308+32929) = (28308+31896+32475) = (28308+31897+32329) = (31896+32332+35119) = (28308+31896+32332+32475) = (28308+31896+32332+35119) = (28308+28811+32929+34604)
	1264	Mod : 34637 = (31367+34637) = (30368+31367+34634+34637) = (30368+31367+34634+34637+36720)
R R R R R R	1265	Mod : (P7092+28369+31896) = (P7092+28369+31897) = (P7092+28369+32222) = (P7092+28369+32401) = (P7092+28369+32402) = (P7092+28369+32475) = (P7092+28369+32929) = (P7092+28369+31896+32402) = (P7092+28369+31897+32401) = (P7092+28369+31896+32222) = (P7092+28369+31897+32401+32929) = (P7092+28369+31896+32332+35119)
R R R	1266	Mod : (22536+26540) = (23227+26540) = (23529+26540) = (23227+26540+28738) = (23227+26540+28739) = (23529+26540+27740) = (23227+26540+27740) = (23227+26540+28738+28739)
R	1267	Mod : (20047+24105+32208) = (20047+24105+32208+US)
R R R	1268	Mod : (26526+28308+30368+31375) = (26526+28308+31375+34634) = (26526+28308+30368+31375+34634+35270)
R	1269	Mod : (27522+35227) = (27522+34869+35227)
R R R	1270	Mod : (27522+30660+31215+31371+35227) = (27522+30660+31215+31371+35865) = (P0164+27522+30660+31215+31371+35865)
R R R R	1271	Mod : 27522 = (P0164+30660+31371) = (P0164+27522+30660+31371) = (27522+30660+31371+34861) = (27522+30660+31371+34862) = (27522+30660+31371+34864)
R	1274	Mod : (27320+27620) = (27320+27620+37285) = (23742+27620+37285)

CODE	DESIGNATION
1275	Mod : (20024+30422) = (20024+25453+30422) = (20024+22802+25453+30422) = (20024+22802+25453+30422+L)
1276	Mod : (2004+22013+30368+30422+P7092) = (20024+22013+25453+30368+30422+P7092)
1277	Mod : (P7092+20024+20586+22013+30368+30422) = (P7092+20024+20586+22013+25453+30368+30422) = (P7092+20024+22013+25453+30368+30422+37565)
1278	Mod : (20024+22013+30422) = (20024+22013+25453+30422) = (20024+22013+22802+30422) = (20024+22013+22802+25453+30422) = (20024+22013+25453+30368+30422+35270) = (20024+20586+22013+22802+25453+30422)
1279	Mod : (20024+32650) = (20024+34035) = (20024+32650+32651+34035)
1280	Mod : 31286 = (31286+20170) = (20036+20037+31286) = (20036+20037+20170+31286)
1281	Mod : 20057+20059+20082+20084+38025
1282	Mod : (26526+27046+28308+30368+31367) = (26526+27046+28308+30368+31367+34634)
1283	Mod : 26526+27046+28244+28308+31426+34825
1285	Mod : (31426+34825) = (26526+31426+34825) = (28244+31426+34825) = (26526+28244+31426+34825) = (26526+28244+28308+31426+34825) = (26526+28244+28308+31375+31426+38425+36720) = (26526+28244+28308+30368+31375+31426+38425+36720)
1286	STD = Mod : (22013+24044) = (25951+32239)
1287	Mod : 28479 = 28702 = 28916 = (31283+34862) = (31283+34861) = (22013+24044+28479) = (22013+24044+28916) = (28951+32239+28479) = (28951+28702+32239) = (25951+28916+32239) = (28479+31283+34862)
1288	Mod : 23742 = (23742+26358) = (23742+26358+30980)
1289	Mod : (36998+23742) = (23742+26358+36998) = (23742+26358+30980+36998)
1290	Mod : 35240 + (163 = 164 = 168 = 169 = 179 = 193 = 221 = 222 = 230 = 294 = 299 = 301 = 338 = 348 = 349 = 362 = 363 = 424 = 429 = 437 = 444 = 449 = 476)
1291	Mod : (20042+20081) = (20042+20081+20818+35120)
1292	Mod : (31266+36136) = (31266+33254+36136)
1293	Mod : (31266+36043+36136) = (31266+33254+36043+36136)
1294	Mod : (31266+33254+36043) = (27170+31266+33254) = (25577+31266+33254)
1295	Mod : (22013+31265+33254) = (22013+26539+33254) = (22013+26539+26858)
1296	Mod : (K2211+22013+22681) = (K2211+22013+25839) = (31265+K2211+22013)
1297	Mod : (26703+31266+33254) = (31265+33254+36043) = (31266+33254+36043) = (25577+31266+33254) = (27170+31266+33254)
1298	Mod : (26539+26858) = (26858+31265) = (26858+31266) = (26539+33254) = (31265+33254) = (31266+33254)
1299	Mod : (20457+20510) = (20458+20510) = (20510+21144) = (20510+22681) = (20510+25125) = (20510+25386) = (20510+25839) = (20510+26155) = (20510+26539) = (20510+20818+21144+35120)
1300	MP : K0385 = K1170 = (K0385+K1170) = (K0385+20818+35120)
1301	Mod : (22562+30368) = (30368+35864) = (22562+25888+27609+30368) = (35864+25888+27609+30368)
1302	Mod : 27640 = (22562+25888+27640)
1303	STD = Mod : 25072 = (22562+25072) = (22562+25888) = (35864+25072) = (35864+25888)
1304	STD = Mod : (22562+25072) = (22562+25888) = (35864+25072) = (35864+25888)
1305	Mod : 22562 = 35864 = (22562+25888+27609) = (25888+27609+35864)
1306	Mod : 27993 = (25072+27993) = (22562+25072+27993) = (27993+22562+25888) = (27993+25888+35864) = (25072+27993+35864)

CODE	DESIGNATION
1307	Mod : 24871 = (24871+25072) = (22562+24871+25072) = (22562+24871+25888)
1308	Mod : (22562+27993) = (27993+35864) = (22562+27993+35864) = (22562+25888+27609+27993) = (25888+27609+27993+35864)
1309	Mod : (24405+27993) = (22562+24405+25072+27993) = (22562+24405+25888+27993)
1310	Mod : (24871+27777) =(22562+24871+25072+27777) = (22562+24871+25888+27777)
1311	Mod : (24871+27777+27993) = (22562+24871+25072+27777+27993) = (22562+24871+25888+27777+27993) = (24871+25888+27777+27993+35864)
1312	Mod : (22562+24871+27777) = (22562+24871+25888+27609+27777)
1313	Mod : (22562+24871+27777+27993) = (24871+27777+27993+35864) = (22562+24871+27777+27993+35864) = (22562+24871+25888+27609+27777+27993)
1314	Mod : 27993 = (22562+25072+27993) = (27993+22562+25888) = (27993+25888+35864) = (25072+27993+35864)
1315	Mod : 24871 = (22562+24871+25072) = (22562+24871+25888) = (24871+25888+35864)
1316	Mod : (24871+25000) = (24871+26608) = (24871+25000+25072) = (24871+25072+26608) = (22562+24871+25000+25072) = (22562+24871+25072+26608) = (22562+24871+25000+25888) = (22562+24871+25888+26609)
1317	Mod : (24871+27777+27993) = (24871+26608+27777+27993) = (22562+24871+25072+26608+27777+27993) = (22562+24871+25888+26608+27777+27993) = (24871+25888+26609+27777+27993+35864)
1318	Mod : (22562+24871+25000) = (22562+24871+26608) = (22562+24871+25000+25888+27609)
1319	Mod : (24871+25000+27777) = (24871+26608+27777) = (22562+24871+25072+27777) = (22562+24871+25072+26608+27777) = (24871+25072+26608+27777) = (22562+24871+25888+26608+27777)
1320	Mod : (22562+24871+27777) = (22562+24871+25000+27777) = (22562+24871+26608+27777) = (22562+24871+25888+26608+27609+27777)
1321	Mod : (22562+24871+27777+27993) = (22562+24871+26608+27777+27993) = (24871+26608+27777+27993+35864) = (22562+24871+26608+27777+27993+35864) = (22562+24871+25888+26608+27609+27777+27993)
1322	Mod : (20586+36725) = (20586+30368+36725) = (20586+22707+30368+36725)
1323	Mod : (31266+36136) = (30206+31265) = (31266+33254+36136)

R

N°	ISSUE DATE	
00	JUL 86	
01	NOV 86	
02	FEB 87	
03	OCT 87	
04	JAN 88	
05	MAR 88	
06	MAY 88	
07	JUL 88	
08	OCT 88	
09	JAN 89	
10	APR 89	
11	SEP 89	
12	MAR 90	
13	SEP 90	
14	NOT DISPATCHED	
15	AUG 91	
16	MAR 92	
17	DEC 92	
18	MAR 93	
19	SEP 93	
20	DEC 93	
21	JUL 94	
22	OCT 95	
23	JAN 97	
24	NOV 97	
25	APR 98	
26	SEP 98	
27	FEB 99	

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N°	ISSUE DATE	
28	JUL 99	
29	FEB 00	
30	JUN 00	
31	NOV 00	
32	MAY 01	
33	NOV 01	
34	JUL 02	
35	DEC 02	
36	OCT 03	
37	MAR 04	
38	DEC 04	
39	FEB 06	
40	DEC 06	
41	SEP 07	

N°	TITLE	STATUS	LOCATION
To be filled by the operator, if needed.			

R	AA	Airworthiness Authorities
R	AB	Abort
R	ABCU	Alternate Braking Control Unit
	ABN	Abnormal
R	A/BRK	Autobrake
R	ABV	Above
	AC	Alternating Current
	A/C	Aircraft
	ACARS	ARINC Communication Addressing and Reporting System
R	ACCEL	Acceleration
R	ACCU	Accumulator
	ACP	Audio Control Panel
R	ACSC	Air Conditioning System Controller
R	ACT	Additional Center Tank
	ADF	Automatic Direction Finder
	ADIRS	Air Data Inertial Reference System
	ADIRU	Air Data Inertial Reference Unit
	ADM	Air Data Module
	ADR	Air Data Reference
	ADV	Advisory
	AEVC	Avionic Equipment Ventilation Controller
	AFS	Auto Flight System
	AIDS	Aircraft Integrated Data System
	AIL	Aileron
	AIME	Autonomous Integrity Monitoring Extrapolation
	AIU	Audio Interface Unit
	ALT	Altitude
	ALTN	Alternate
	AMU	Audio Management Unit
	ANT	Antenna
	AOC	Airline Operational Control
	A/P	Autopilot
	APPR	Approach
	APPU	Assymetry Position Pick off Unit
	APU	Auxiliary Power Unit
	ARN	Aircraft Registration Number
	ARPT	Airport
	A/S	Airspeed
	ASAP	As Soon As Possible
	ASI	Air Speed Indicator
	ASP	Audio Selector Panel
	A/SKID	Anti-skid
	ATC	Air Traffic Control
	ATE	Automatic Test Equipment
R	ATIS	Airbus Technical Information System

	A/THR	Auto Thrust Function
	ATS	Auto Thrust System
	ATSU	Air Traffic Service Unit
	ATT	Attitude
R	AVNCS	Avionics
	AWY	Airway
R	B	Blue
	BARO	Barometric
	BAT	Battery
	BCL	Battery Charge Limiter
	BCDS	Bite Centralized Data System
	BITE	Built-in Test Equipment
	BIU	Bite Interface Unit
	BFE	Buyer Furnished Equipment
	BMC	Bleed Air Monitoring Computer
	BNR	Binary
	BRG	Bearing
	BRK	Brake
	BRT	Bright
	BSCU	Braking Steering Control Unit
	BTC	Bus Tie Contactor
	BTL	Bottle
	C	Centigrade
R	CAB	Cabin
	CAPT	Captain, Capture
	CAS	Calibrated Airspeed
R	CAT	Category
	C/B	Circuit Breaker
	CBMS	Circuit Breaker Monitoring System
	CDL	Configuration Deviation List
R	CDLS	Cockpit Door Locking System
R	CDSS	Cockpit Door Surveillance System
	CDU	Control Display Unit
	CFDIU	Centralized Fault Data Interface Unit
	CFDS	Centralized Fault Display System
	CG	Center of Gravity
	CHG	Change
R	CHK	Check
	CIDS	Cabin Intercommunication Data System
R	CKPT	Cockpit
	C/L	Checklist
	CLB	Climb

	CLR	Clear
R	CLSD	Closed
	CMPTR	Computer
	CM 1(2)	Crewmember 1 (left seat) or 2 (right seat)
	CO	Company
R	COND	Conditioning
R	CONF	Configuration
	CONT	Continuous
	CO RTE	Company Route
	CPCU	Cabin Pressure Controller Unit
	CRC	Continuous Repetitive Chime
	CRG	Cargo
	CRS	Course
	CRT	Cathode Ray Tube
	CRZ	Cruise
	CSCU	Cargo Smoke Control Unit
	CSD	Constant Speed Drive
	CSM/G	Constant Speed Motor/Generator
	CSTR	Constraint
R	CTL	Control
	CTR	Center
	CTL PNL	Control Panel
	CVR	Cockpit Voice Recorder
	DA	Drift Angle
	DAR	Digital AIDS Recorder
	DC	Direct Current
	DCDU	Datalink Control and Display Unit
	DDRMI	Digital Distance and Radio Magnetic Indicator
R	DECEL	Deceleration
R	DEG	Degree
	DES	Descent
	DEST	Destination
R	DET	Detection, Detector
	DFA	Deplayed Flap Approach
	DFDR	Digital Flight Data Recorder
	DH	Decision Height
	DIR	Direction
	DIR TO	Direct To
	DISC	Disconnect
R	DISH	Discharge
	DIST	Distance
	DITS	Digital Information Transfer System
	DIV	Diverter
	DMC	Display Management Computer

	DME	Distance Measuring Equipment
	DMU	Data Management Unit
R	DN	Down
	DSDL	Dedicated Serial Data Link
	DSPL	Display
	DTG	Distance To Go
	DU	Display Unit
	E	East
	ECAM	Electronic Centralized Aircraft Monitoring
R	ECAS	Emergency Cockpit Alerting System
	ECB	Electronic Control Box (APU)
	ECM	Engine Condition Monitoring
	ECON	Economic
	ECP	ECAM Control Panel
	ECS	Environmental Control System
	ECU	Engine Control Unit
	EDP	Engine-Driven Pump
	EEC	Electronic Engine Computer
	EFCS	Electronic Flight Control System
	EFIS	Electronic Flight Instrument System
	EFOB	Estimated Fuel On Board
R	EGPWS	Enhanced Ground Proximity Warning System
	EIU	Engine Interface Unit
	EIS	Electronic Instruments System
	ELAC	Elevator Aileron Computer
	ELEC	Electrics
R	ELT	Emergency Locator Transmitter
	ELV	Elevation
	EMER	Emergency
	EMER GEN	Emergency Generator
	ENG	Engine
	EO	Engine-Out
	EPR	Engine Pressure Ratio
R	EROPS	Extended Range Operation
	ESS	Essential
	EST	Estimated
	ETA	Estimated Time of Arrival
	ETE	Estimated Time Enroute
R	ETOPS	Extended Twin Operation
	ETP	Equal Time Point
	EVMU	Engine Vibration Monitoring Unit
	E/WD	Engine/Warning Display
	EXT PWR	External Power
	EXTN	Extension

R	F	Fahrenheit, Flap retraction speed
	FAC	Flight Augmentation Computer
	FADEC	Full Authority Digital Engine Control System
	FAF	Final Approach Fix
	FAR	Federal Aviation Regulations
	FAV	Fan Air Valve
	F/C	Flight Crew
	FCDC	Flight Control Data Concentrator
R	FCOM	Flight Crew Operating Manual
	FCU	Flight Control Unit
	FD	Flight Director
	FDIU	Flight Data Interface Unit
	FDU	Fire Detection Unit
	FF	Fuel Flow
	FGC	Flight Guidance Computer
	FIDS	Fault Isolation and Detection System
	FL	Flight Level
R	FLP, F	Flap
	FLT	Flight
	FLT CTL	Flight Control
R	FLX TO	Flexible Takeoff
R	FM	Flight Management
	FMA	Flight Mode Annunciator
R	FMGC	Flight Management Guidance Computer
R	FMGS	Flight Management Guidance System
	FMS	Flight Management System
	F/O	First Officer
	FOB	Fuel On Board
	F-PLN	Flight Plan
	FPA	Flight Path Angle
	FPPU	Feedback Position Pick-off Unit
	FPV	Flight Path Vector
	FQI/FQU	Fuel Quantity Indication/Unit
	FREQ	Frequency
	FRT	Front
	FRV	Fuel Return Valve
	FT	Foot, Feet
	FT/MN	Feet per Minute
	FU	Fuel Used
	FWD	Forward
	FWC	Flight Warning Computer
	FWS	Flight Warning System

R	G	Green
	GA	Go-Around
R	GAPCU	Ground and Auxiliary Power Control Unit
	GCU	Generator Control Unit
	GEN	Generator
	GLC	Generator Line Contactor
	GMT	Greenwich Mean Time
	GND	Ground
	GPCU	Ground Power Control Unit
	GPS	Global Positioning System
	GPWS	Ground Proximity Warning System
	GRND	Ground
	GRP	Geographic Reference Point
	GRVTY	Gravity
	GS	Ground Speed
	G/S	Glideslope
	GW	Gross Weight
	H	Hour, Hot
	HC	Harness Connector
	HCU	Hydraulic Control Unit
	HDG	Heading
	HDG/S	Heading Selected
	HDL	Handle
R	HF	High Frequency
	HI	High
	HLD	Hold
	HMU	Hydrau-Mechanical Unit
	HMS	Heat Management System
	HP	High Pressure
	HPA	Hecto Pascal
	HPV	High Pressure Valve
	HUD	Head Up Display
	HYD	Hydraulic
	HZ	Hertz
	IAF	Initial Approach Fix
	IAS	Indicated Airspeed
	IDENT	Identification
	IDG	Integrated Drive Generator
R	IFE	In Flight Entertainment
	IFR	Instrument Flight Rules
	IGN	Ignition
	ILS	Instrument Landing System
	IMM	Immediate

	INB	Inbound
	INBO	Inboard
	INCREM	Increment
	INIT	Initialization
	INOP	Inoperative
	INR	Inner
	INST	Instrument
	INTCP	Intercept
R	INV	Inverter
	I/O	Inputs/Outputs
	I/P	Input or Intercept Profile
	IP	Intermediate Pressure
	IPC	Intermediate Pressure Check valve
	IPPU	Instrumentation Position Pick-Off Unit
	IRS	Inertial Reference System
	ISA	International Standard Atmosphere
	ISDU	Initial System Display Unit
	ISOL	Isolation
R	ISPSS	In Seat Power Supply System
	KG	Kilogram
	KT	Knot
	L	Left
	LAF	Load Alleviation Function
	LAT	Latitude
	LAT REV	Lateral Revision
	LAV	Lavatory
	LCN	Load Classification Number
	LDG	Landing
R	LF	Low Frequency
	L/G	Landing Gear
	LGCIU	Landing Gear Control Interface Unit
	LGPIU	Landing Gear Position Indicator Unit
	LH	Left-Hand
	LIM	Limitation
	LIS	Localizer Inertial Smoothing
	LK	Lock
	LL	Latitude/Longitude
	LLS	Left-Line Select key
	LOC	Localizer
	LONG	Longitude
	LP	Low Pressure
	LRRA	Low Range Radio Altimeter
	LRU	Line Replaceable Unit

	LSK	Line Select Key
	LT	Light
	LVL	Level
	LVL/CH	Level Change
	LW	Landing Weight
	M	Magenta, Mach, Meter
R	MABH	Minimum Approach Break-off Height
	MAC	Mean Aerodynamic Chord
	MAG	Magnetic
	MAG DEC	Magnetic Declination
	MAG VAR	Magnetic Variation
	MAINT	Maintenance
	MAN	Manual
	MAX CLB	Maximum Climb
	MAX DES	Maximum Descent
	MAX END	Maximum Endurance
	MB	Millibar
R	MC	Master Caution
	MCT	Maximum Continuous Thrust
	MCDU	Multipurpose Control and Display Unit
	MCU	Modular Concept Unit
	MDA	Minimum Descent Altitude
	MDDU	Multifunction Disk Drive Unit
	MECH	Mechanic
R	MED	Medium
	MEL	Minimum Equipment List
	MFA	Memorized Fault Annunciator
	MIN	Minimum, Minute
	MKR	Marker
R	MLA	Maneuver Load Alleviation
	MLS	Microwave Landing System
	MLW	Maximum Landing Weight
	MMEL	Master Minimum Equipment List
	MMO	Maximum Operating Mach
R	MMR	Multi Mode Receiver
	MN	Mach Number
	MRIU	Maintenance and Recording Interface Unit
	MSA	Minimum Safe Altitude
	MSG	Message
	MSL	Mean Sea Level
	MSU	Mode Selector Unit
	MTBF	Mean Time Between Failure
	MTOW	Maximum Takeoff Weight
	MZFW	Maximum Zero Fuel Weight

	N	Normal, North
R	N/A	Not Applicable
	NACA	National Advisory Committee for Aeronautics
	NAV	Navigation
	NAVAID	Navigation Aid (VOR/DME)
	NCD	Non Computed Data
	ND	Navigation Display
	NDB	Non Directional Beacon
R	NORM	Normal
	NM	Nautical Mile
	NW	Nosewheel
R	NWS	Nosewheel Steering
	OAT	Outside Air Temperature
	OBRM	On Board Replaceable Module
	OFF/R	Off Reset
	OFST	Offset
	O/P	Output
	OPP	Opposite
R	OPS	Operations
	OPT	Optimum
	OUTB	Outbound
	OUTR	Outer
	OVBD	Overboard
	OVHD	Overhead
	OVHT	Overheat
	OVRD	Override
	OVSPD	Overspeed
R	OXY	Oxygen
R	PA	Passenger Address
	P-ALT	Profile Altitude
R	PAX	Passenger
	PB, pb	Pushbutton
	P-CLB	Profile Climb
	PCU	Power Control Unit
	P-DES	Profile Descent
	PDU	Pilot Display Unit
	PERF	Performance
R	PES	Passenger Entertainment System
	PFD	Primary Flight Display
	PHC	Probes Heat Computer
	P-MACH	Profile Mach
R	P/N	Part Number

R	PNL	Panel
	POB	Pressure Off Brake
	POS	Position
	PPOS	Present Position
	PPU	Position Pick-off Unit
	PR	Pressure
	PRED	Prediction
	PROC	Procedure
	PROC T	Procedure Turn
	PROF	Profile
	PROG	Progress
	PROTEC	Protection
	P-SPEED	Profile Speed
	PSU	Passenger Service Unit
	PT	Point
	PTR	Printer
R	PTT	Push To Talk
	PTU	Power Transfer Unit (Hydraulic)
	PVI	Paravisual Indicator
	PWR	Power
R	PWS	Predictive Windshear System
	QAR	Quick Access Recorder
	QFE	Field Elevation Atmosphere Pressure
	QFU	Runway Heading
	QNE	Sea Level Standard Atmosphere Pressure (1013 hPa)
	QNH	Sea Level Atmosphere Pressure
	QT	Quart (US)
	QTY	Quantity
	R	Right, Red
	RA	Radio Altitude
	RACC	Rotor Active Clearance Control
	RAIM	Receiver Autonomous Integrity Monitoring
	RAT	Ram Air Turbine
R	RATC	Remote ATC Box
	RCDR	Recorder
	RCL	Recall
	RCVR	Receiver
	REAC	Reactive
R	REG	Regulation
	REL	Release
	REV	Reverse
	RH	Right-Hand
	R/I	Radio/Inertial

	RLSK	Right Line Select Key
	RMI	Radio Magnetic Indicator
	RMP	Radio Management Panel
	RNG	Range
	RNP	Required Navigation Performance
	RPM	Revolution Per Minute
	RPTG	Repeating
	RQRD	Required
	RSV	Reserves
	RTE	Route
R	RTL	Rudder Travel Limit
	RTOW	Regulatory Takeoff Weight
R	RUD	Rudder
	RVSM	Reduced Vertical Separation Minimum
	RWY	Runway
	S	Slats Retraction Speed, South
R	SAT	Static Air Temperature
	SC	Single Chime
	S/C	Step Climb
	SD	System Display
	S/D	Step Descent
	SDAC	System Data Acquisition Concentrator
	SDCU	Smoke Detection Control Unit
	SEC	Spoiler Elevator Computer
	SEL	Selector
R	S/F	Slats/Flaps
	SFCC	Slat/Flap Control Computer
	SFE	Seller-Furnished Equipment
	SID	Standard Instrument Departure
	SIM	Simulation
	SLT	Slat
R	S/N	Serial Number
	SPD	Speed
	SPD LIM	Speed Limit
	SPLR	Spoiler
	SRS	Speed Reference System
	STAR	Standard Terminal Arrival Route
R	STAT	Static
	STAT INV	Static Inverter
R	STBY	Standby
R	STD	Standard
	STEER	Steering
	STRG	Steering

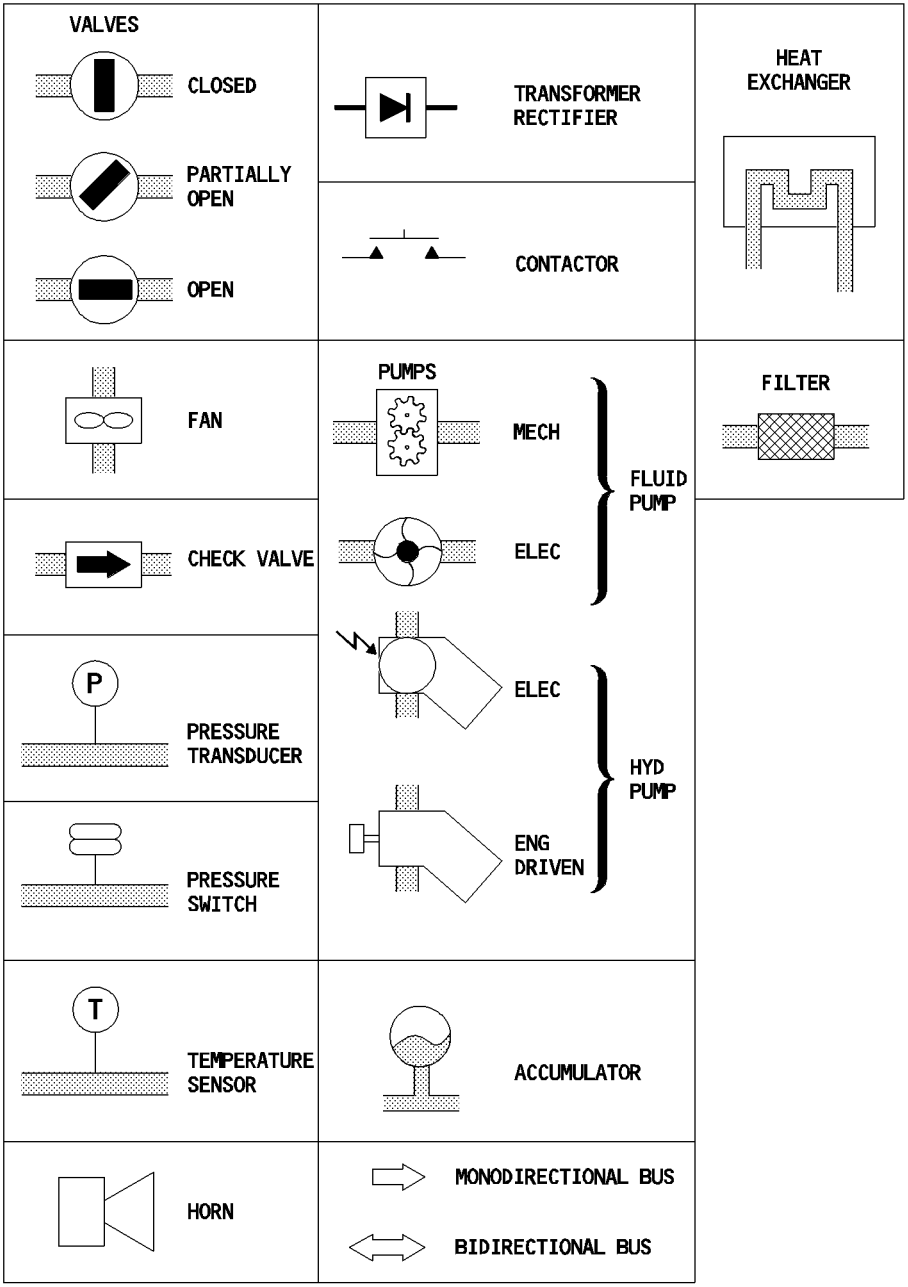
	STS	Status
	SW	Switch
	SWTG	Switching
	SYNC	Synchronize
	SYS	System
	T	Tons, Temperature, True, Turn, Total
	TACT	Tactical
	TAS	True Air Speed
	TAT	Total Air Temperature
	TAU	Time to intercept
R	TBC	To Be Confirmed
	TBD	To Be Determined
	T/C	Top of Climb
	TCAS	Traffic Collision Alert System or Threat-Analysis/Collision Avoidance System
	T/D	Top of Descent
	TEMP	Temperature
	TFTS	Terrestrial Flight Telephone System
	TGT	Target
	THR	Thrust
	THS	Trimmable Horizontal Stabilizer
	TK	Tank
	TK	Track angle
	TKE	Track angle Error
	TLA	Throttle Lever Angle
	TMR	Timer
	T.O., T/O	Takeoff
	TOGA	Takeoff - Go-Around
	TOGW	Takeoff Gross Weight
	TOW	Takeoff Weight
	T-P	Turn Point
	TPIS	Tire Pressure Indicating System
	T-R	Transmitter-Receiver
	TRANS	Transition
	TRK	Track
	TROPO	Tropopause
	TRU	Transformer Rectifier Unit
R	TRV	Travel
	TTG	Time To Go
	TVMC	Minimum Control Speed Temperature
	UFD	Unit Fault Data
	ULB	Underwater Locator Beacon
	UNLK	Unlock
R	UP	Up, Upper

	UTC	Universal Coordinated Time
	V	Volt
R	V1	Decision Speed
	V2	Takeoff Safety Speed
	VBV	Variable Bypass Valve
	VC	Calibrated airspeed
	VEL	Velocity
	VFE	Maximum Speed for each Flap Configuration
	VFEN	VFE Next
	VFTO	Final Takeoff Speed
	VHF	Very High Frequency
	VHV	Very High Voltage
	VIB	Vibration
	VLE	Maximum Landing Gear Extended Speed
	VLS	Lowest Selectable Speed
	VLV	Valve
	VM	Maneuvering Speed
	VMAX	Maximum Allowable Speed
	VMCA	Minimum Control Speed in the Air
	VMCG	Minimum Control Speed on Ground
	VMCL	Minimum Control Speed at Landing
	VMIN	Minimum Operating Speed
	VMO	Maximum Operating Speed
	VMU	Minimum Unstick Speed
	VOR	VHF Omnidirectional Range
	VOR-D	VOR-DME
	VR	Rotation Speed
	VREF	Landing Reference Speed
	V/S	Vertical Speed
	VSI	Vertical Speed Indicator
	VSV	Variable Stator Vane
	VU	Visual Unit
	W	White, West, Weight
	WARN	Warning
	WBC	Weight and Balance Computer
	WBS	Weight and Balance System
	WGD	Windshield Guidance Display
	WHC	Window Heat Computer
	WNDW	Window
	WPT	Waypoint
	WSHLD	Windshield
	WT	Weight

	WTB	Wing Tip Brake
	WXR	Weather Radar
R	XBLD	Crossbleed
	XCVR	Transceiver
	XFR	Transfer
	XMTR	Transmitter
	XPDR	Transponder
	XTK	Crosstrack Error
	Y	Yellow
R	Z	Altitude
	ZFCG	Zero Fuel Center of Gravity
	ZFW	Zero Fuel Weight
	A>B	A is greater than B
	A≥B	A is greater than or equal to B
	A<B	A is less than B
	A≤B	A is less than or equal to B

	METRIC → US	US → METRIC
LENGTH	1 millimeter (mm) = 0.0394 inch (in) 1 meter (m) = 3.281 feet (ft) 1 meter (m) = 1.094 yard (yd) 1 kilometer (km) = 0.540 nautical mile (nm)	1 inch (in) = 25.4 millimeter (mm) 1 foot (ft) = 0.3048 meter (m) 1 yard (yd) = 0.914 meter (m) 1 nautical mile (nm) = 1.852 kilometer (km)
SPEED	1 meter/second (m/s) = 3.281 feet/second (ft/s) 1 kilometer/hour (km/h) = 0.540 knot (kt)	1 foot/second (ft/s) = 0.3048 meter/second (m/s) 1 knot (kt) = 1.852 kilometer/hour (km/h)
WEIGHT	1 gram (g) = 0.353 ounce (oz) 1 kilogram (kg) = 2.2046 pounds (lb) 1 ton (t) = 2 204.6 pounds (lb)	1 ouce (oz) = 28.35 grams (g) 1 pound (lb) = 0.4536 kilogram (kg) 1 pound (lb) = 0.0004536 ton (t)
FORCE	1 Newton (N) = 0.2248 pounds (lb) 1 deca Newton (daN) = 2.248 pounds (lb)	1 pound (lb) = 4.448 Newtons (N) 1 pound (lb) = 0.4448 deca Newton (daN)
PRESSURE	1 BAR = 14.505 pounds per square inch (psi) 1hpa = 0.0145 psi	1 pound per square inch (psi) = 0.689 bar 1 psi = 68.92 millibars (hPa)
VOLUME	1 liter (l) = 0.2642 U.S. Gallons 1 cubic meter (m^3) = 264.2 U.S. Gallons	1 US Gallon = 3.785 liters (l) 1 US Gallon = 0.03785 cubic meter (m^3)
MOMENTUM	1 meter × deca Newton (m. daN) = 88.50 pound × inch (lb. in)	1 pound × inch (lb. in) = 0.0113 meter × deca Newton (mdaN)
TEMPERATURE	t (°C) = 5/9 (t (°F) - 32)	t (°F) = t (°C) × 1.8 + 32

R



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THIS TABLE GIVES, FOR EACH AIRCRAFT INCLUDED IN THE MANUAL, THE CROSS REFERENCE BETWEEN :

- THE MANUFACTURING SERIAL NUMBER (MSN) WHICH APPEARS IN THE LIST OF EFFECTIVE PAGES

- THE REGISTRATION NUMBER OF THE AIRCRAFT AS KNOWN BY AIRBUS INDUSTRIE.

MSN	REGISTRATION
2052	VP-BWA
2069	VP-BDM
2072	VP-BDN
2091	VP-BDO
2093	VP-BWG
2106	VP-BDK
2116	VP-BWD
2133	VP-BWE
2144	VP-BWF
2151	VP-BWH
2163	VP-BWI
2179	VP-BWJ
2222	VP-BWK
2233	VP-BWM
2243	VP-BWL
2330	VP-BWN
2337	VP-BWO
2342	VP-BWP
2875	VP-BQP
2903	VP-BQR
2912	VP-BQS
2920	VP-BQV
2947	VP-BQW
2957	VP-BQX
2965	VP-BQT
3052	VP-BRY
3063	VP-BRX
3157	VP-BRZ
3191	VP-BRW
3267	VP-BUM
3281	VP-BUK
3298	VP-BUN
3334	VP-BUP
3336	VP-BUO
3373	VP-BQU
3410	VP-BKX
3511	VP-BKY
3545	VP-BKC
3574	
3631	

V CH SEC	---PAGE--	SEQ-	--REV--	----VALIDATION CRITERIA----- ----------REASONS OF CHANGE----------
1 25 11	001	200	REV041	CODE 1103
				- INCORPORATION OF MOD 33777
				- INCORPORATION OF MOD 35137
1 31 10	005	301	REV041	CODE 0592
				- INCORPORATION OF MOD 37445
1 31 40	024	100	REV041	37444
				- INCORPORATION OF MOD 37444
1 34 25	003	110	REV038	CODE 0135
				- INCORPORATION OF MOD 27620
				- INCORPORATION OF MOD 34429
1 70 90	006	210	REV041	30368+34665/56-5-B
				- INCORPORATION OF MOD 34665

M V CH SEC	---PAGE--	SEQ-	--REV--	----VALIDATION CRITERIA-----	-----EFFECTIVITY-----
1 00 00	001	001	REV024	CONTENTS	ALL
1 00 10	001	001	REV040		ALL
1 00 10	002	001	REV034		
1 00 10	003	001	REV024		ALL
1 00 10	004	001	REV024		
1 00 10	005	001	REV024		ALL
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1 00 20	003	001	REV041	LIST OF CODES	ALL
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1 00 20	027	001	REV041	LIST OF CODES	ALL
1 00 20	028	001	REV041	LIST OF CODES	
1 00 20	029	001	REV041	LIST OF CODES	ALL
1 00 20	030	001	REV041	LIST OF CODES	
1 00 20	031	001	REV041	LIST OF CODES	ALL
1 00 20	032	001	REV041	LIST OF CODES	

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	1	00	20	034	001	REV041	LIST OF CODES	
	1	00	20	035	001	REV041	LIST OF CODES	ALL
	1	00	20	036	001	REV041	LIST OF CODES	
	1	00	20	037	001	REV041	LIST OF CODES	ALL
	1	00	20	038	001	REV041	LIST OF CODES	
	1	00	20	039	001	REV041	LIST OF CODES	ALL
	1	00	20	040	001	REV041	LIST OF CODES	
	1	00	20	041	001	REV041	LIST OF CODES	ALL
	1	00	20	042	001	REV041	LIST OF CODES	
	1	00	20	043	001	REV041	LIST OF CODES	ALL
	1	00	20	044	001	REV041	LIST OF CODES	
	1	00	20	045	001	REV041	LIST OF CODES	ALL
	1	00	20	046	001	REV041	LIST OF CODES	
	1	00	30	001	001	REV027	LIST OF NORMAL REVISIONS	ALL
	1	00	30	002	001	REV041	LIST OF NORMAL REVISIONS	
	1	00	35	001	001	REV024	RECORD OF TEMPORARY REV.	ALL
	1	00	36	001	001	REV041	LIST OF EFFECTIVE TR	ALL
	1	00	40	001	001	REV036	ABBREVIATIONS	ALL
	1	00	40	002	001	REV036	ABBREVIATIONS	
	1	00	40	003	001	REV036	ABBREVIATIONS	ALL
	1	00	40	004	001	REV036	ABBREVIATIONS	
	1	00	40	005	001	REV036	ABBREVIATIONS	ALL
	1	00	40	006	001	REV036	ABBREVIATIONS	
	1	00	40	007	001	REV036	ABBREVIATIONS	ALL
	1	00	40	008	001	REV036	ABBREVIATIONS	
	1	00	40	009	001	REV036	ABBREVIATIONS	ALL
	1	00	40	010	001	REV036	ABBREVIATIONS	
	1	00	40	011	001	REV036	ABBREVIATIONS	ALL
	1	00	40	012	001	REV036	ABBREVIATIONS	
	1	00	40	013	001	REV039	STD	ALL
	1	00	40	014	001	REV036	STD	
	1	00	50	001	001	REV023	UNITS CONVERSION TABLE	ALL
	1	00	60	001	001	REV023	SYMBOLS	ALL
R	1	00	70	CRT	001	REV041	CROSS REFERENCE TABLE	ALL
	1	00	75	HL	001	REV041	HIGHLIGHTS	ALL
R	1	00	80	LEP	001	REV041	LIST OF EFFECTIVE PAGES	ALL

LIST OF EFFECTIVE PAGES (LEP) -

M	V	CH	SEC	---PAGE--	SEQ-	--REV--	----VALIDATION CRITERIA-----	-----EFFECTIVITY-----
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1		00	85	LOM	001	REV041	LIST OF MODIFICATIONS	ALL
1		20	00	001	001	REV023		ALL
1		20	10	001	105	REV034	20047	2106-2163 2233 2875 2920-2947 3052-3157 3373-3631
1		20	10	001	200	REV035	CODE 0353	2330-2342 2903-2912 2957-2965 3191-3267 3334
1		20	10	001	205	REV035	CODE 0354	2052-2093 2179-2222 2243 3281-3298 3336
1		20	20	001	001	REV031	STD=M:20139+22129	2106-2163 2233 2875
1		20	20	002	001	REV035		2920-2947 3052-3157 3373-3631
1		20	20	001	100	REV031	M:24105	2052-2093 2179-2222
1		20	20	002	001	REV035		2243 3281-3298 3336
1		20	20	001	103	REV033	22013	2330-2342 2903-2912
1		20	20	002	001	REV035		2957-2965 3191-3267 3334
1		20	20	003	100	REV030	M:20268=(20139+20268+22129)	2106-2163 2233 2875
1		20	20	004	001	REV032		2920-2947 3052-3157 3373-3631
1		20	20	003	203	REV030	M:20268+22013	2330-2342 2903-2912
1		20	20	004	100	REV032	M:22013	2957-2965 3191-3267 3334
1		20	20	003	206	REV030	M:20268+24105	2052-2093 2179-2222
1		20	20	004	103	REV032	M:24105	2243 3281-3298 3336
1		21	00	001	001	REV030		ALL
1		21	10	001	001	REV023	STD=(30626+35110)	2052-2243
1		21	10	002	001	REV023	STD=(30626+35110)	
1		21	10	001	001	REV023	STD=(30626+35110)	2330-2342
1		21	10	002	100	REV023	M:22013=(22013+30626+35110)	
1		21	10	001	110	REV037	M:30626	2875-3631
1		21	10	002	202	REV041	CODE 0508	
1		21	10	003	001	REV023	STD=(30626+35110)	2052-2243
1		21	10	004	105	REV028	CODE 0900	
1		21	10	003	001	REV023	STD=(30626+35110)	2330-2342
1		21	10	004	200	REV028	CODE 0901	
1		21	10	003	110	REV033	30626	2875 2920-2947
1		21	10	004	115	REV036	M:30626=(30626+26363)	3052-3157 3281-3298 3336-3631

M	V	CH	SEC	---PAGE--	SEQ-	--REV--	----VALIDATION CRITERIA-----	-----EFFECTIVITY-----
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1	21	10		003	110	REV033	30626	2903-2912 2957-2965
1	21	10		004	215	REV039	CODE 1232	3191-3267 3334
1	21	10		005	100	REV033	CODE 0902	2052-2243
1	21	10		006	105	REV028	CODE 0900	
1	21	10		005	100	REV033	CODE 0902	2330-2342
1	21	10		006	200	REV028	CODE 0901	
1	21	10		005	205	REV036	CODE 1233	2875 2920-2947
1	21	10		006	115	REV036	M: 30626	3052-3157 3281-3298 3336-3631
1	21	10		005	205	REV036	CODE 1233	2903-2912 2957-2965
1	21	10		006	210	REV039	22013+30626	3191-3267 3334
1	21	10		007	001	REV023	STD=(30626+35110)	2052-2342
1	21	10		008	001	REV024	STD=(30626+35110)	
1	21	10		007	201	REV041	30626+P9801	2875-3631
1	21	10		008	110	REV033	30626	
1	21	10		009	100	REV034	CODE 0900	2052-2243
1	21	10		010	001	REV033		
1	21	10		009	100	REV034	CODE 0900	2330-2342
1	21	10		010	100	REV033	22013=34651	
1	21	10		009	105	REV039	30626	2875-3631
1	21	10		010	101	REV041	P9801=22013+P9801	
1	21	10		011	105	REV032	CODE 0299	2052-2243
1	21	10		012	001	REV033		
1	21	10		011	105	REV032	CODE 0299	2875 2920-2947
1	21	10		012	100	REV041	P9801	3052-3157 3281-3298 3336-3631
1	21	10		011	305	REV031	CODE 0073	2330-2342
1	21	10		012	001	REV033		
1	21	10		011	305	REV031	CODE 0073	2903-2912 2957-2965
1	21	10		012	100	REV041	P9801	3191-3267 3334
1	21	10		013	100	REV041	M:30368	2052-2342
1	21	10		014	100	REV041	M:30368=(30368+30626+35110)	
1	21	10		013	100	REV041	M:30368	2875-3631
1	21	10		014	200	REV041	M:30368+30626	
1	21	10		015	001	REV041	STD=(30626+35110)	2052-2342
1	21	10		016	001	REV023		
1	21	10		015	110	REV041	30626	2875-3631
1	21	10		016	001	REV023		
1	21	10		017	100	REV036	M:30368	2052-2342
1	21	10		018	001	REV033	STD=(30626+35110)	

M	V	CH	SEC	---PAGE--	SEQ-	--REV--	----VALIDATION CRITERIA-----	-----EFFECTIVITY-----
M	V	CH	SEC	---PAGE--	SEQ-	--REV--	----VALIDATION CRITERIA-----	-----EFFECTIVITY-----
1	21	10	017		100	REV036	M:30368	2875-3631
1	21	10	018		100	REV036	M:30626	
1	21	10	019		001	REV023		ALL
1	21	20	001		001	REV032	STD=34673+35495	2052-2342
1	21	20	002		100	REV023	M:23344	
1	21	20	001		101	REV039	34673	2875-3631
1	21	20	002		100	REV023	M:23344	
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1	21	20	004		001	REV023		ALL
1	21	20	005		001	REV037	STD=(26251+32221)	ALL
1	21	20	006		001	REV037	STD=(26251+32221)	
1	21	20	007		001	REV035		ALL
1	21	20	008		100	REV041	23344	
1	21	20	009		001	REV035		ALL
1	21	20	010		100	REV036	M:30368	
1	21	20	011		001	REV028		ALL
1	21	20	012		100	REV036	M:30368	
1	21	20	013		110	REV041	M:30368	2052-2965
1	21	20	014		100	REV037	M:23124	
1	21	20	013		110	REV041	M:30368	3052-3631
1	21	20	014		210	REV040	23124+35220	
1	21	30	001		100	REV040	CODE 0310	ALL
1	21	30	002		001	REV023	STD=M:28221=28240	
1	21	30	003		001	REV026	STD OR M:22190=33129=34664	ALL
1	21	30	004		001	REV026	STD OR M:22190=33129=34664	
1	21	30	005		001	REV026	STD OR M:22190=33129=34664	ALL
1	21	30	006		001	REV023	STD OR M:22190=33129=34664	
1	21	30	007		001	REV023	STD OR M:22190=33129=34664	ALL
1	21	30	008		001	REV023	STD OR M:22190=33129=34664	
1	21	30	009		001	REV023		ALL
1	21	30	010		001	REV023	STD OR M:22190=33129=34664	
1	21	30	011		110	REV041	CODE 0864	ALL
1	21	30	012		105	REV041	30368	
1	21	30	013		001	REV030	STD OR M:22190=33129=34664	ALL
1	21	40	001		200	REV023	CODE 0802	ALL
1	21	40	002		203	REV023	(20059+20084)=(30066+30067)	

M	V	CH	SEC	---PAGE--	SEQ-	--REV--	----VALIDATION CRITERIA-----	-----EFFECTIVITY-----
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1	21	40	003		203	REV023	(20059+20084)=(30066+30067)	ALL
1	21	40	004		203	REV025	(20059+20084)=(30066+30067)	
1	21	40	005		200	REV032	(20059+20084)=(30066+30067)	ALL
1	21	40	006		209	REV026	CODE 0084	
1	21	40	007		240	REV026	CODE 0035	ALL
1	21	40	008		200	REV023	CODE 0092	
1	21	50	001		100	REV025	M:21678=(21678+30626+35110)	2052-2342
1	21	50	001		210	REV036	M:21678+30626	2875-3631
1	22	00	001		001	REV039		ALL
1	22	00	002		202	REV041	CODE 0051	
1	22	10	001		001	REV032		ALL
1	22	10	002		100	REV041	CODE 0724	
1	22	10	003		001	REV041		ALL
1	22	10	004		100	REV037	26358	
1	22	10	005		100	REV041	CODE 1288	ALL
1	22	10	006		001	REV023		
1	22	10	007		001	REV028		ALL
1	22	10	008		001	REV024		
1	22	10	009		001	REV024		2052-2342
1	22	10	010		100	REV034	27256	
1	22	10	009		001	REV024		2875-3631
1	22	10	010		120	REV040	CODE 0266	
1	22	10	011		110	REV041	27256	2052-2342
1	22	10	012		100	REV038	M:27256	
1	22	10	011		120	REV041	CODE 0266	2875-3631
1	22	10	012		105	REV036	CODE 0597	
1	22	10	013		001	REV023	STD=36772+37588	ALL
1	22	10	014		001	REV025	CODE 0796	
1	22	10	015		001	REV025	STD=34809+37588	ALL
1	22	10	016		100	REV041	27256	
1	22	10	017		330	REV039	CODE 0269	ALL
1	22	10	018		100	REV030	M:23742	
1	22	10	019		100	REV023	M:23742	ALL
1	22	10	020		100	REV023	M:23742	
1	22	10	021		001	REV025	CODE 0803	ALL
1	22	10	022		100	REV037	23742	
1	22	10	023		200	REV037	CODE 0014	ALL
1	22	20	001		001	REV023		ALL
1	22	20	002		220	REV039	CODE 0058	

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1	22	20		004	200	REV038	CODE 0072	
1	22	20		005	205	REV035	CODE 0078	ALL
1	22	20		006	210	REV035	CODE 0082	
1	22	20		007	210	REV041	CODE 0749	ALL
1	22	20		008	220	REV035	CODE 0112	
1	22	20		009	210	REV039	CODE 0128	2903-2912 2957-2965
1	22	20		010	001	REV023	CODE 1202	3191-3336
1	22	20		009	210	REV039	CODE 0128	2875 2920-2947
1	22	20		010	100	REV032	CODE 1203	3052-3157 3373-3631
1	22	20		009	300	REV039	CODE 0115	2052-2093 2179-2222
1	22	20		010	001	REV023	CODE 1202	2243-2342
1	22	20		009	300	REV039	CODE 0115	2106-2163 2233
1	22	20		010	100	REV032	CODE 1203	
1	22	20		011	102	REV041	CODE 0756	ALL
1	22	20		012	105	REV040	CODE 0724	
1	22	20		013	105	REV038	CODE 1204	ALL
1	22	20		014	120	REV033	CODE 0139	
1	22	20		015	100	REV026	M:24064=24065=24066=24067	ALL
1	22	20		016	001	REV023		
1	22	20		017	001	REV041	CODE 0726	ALL
1	22	20		018	001	REV025		
1	22	20		019	100	REV033	CODE 0734	ALL
1	22	20		020	001	REV041		
1	22	20		021	001	REV027		ALL
1	22	20		022	100	REV033	CODE 0146	
1	22	20		023	120	REV033	CODE 0146	ALL
1	22	20		024	100	REV034	24064=24065=24066=24067	
1	22	20		025	120	REV033	CODE 0148	ALL
1	22	20		026	001	REV041		
1	22	20		026A	100	REV041	CODE 0278	ALL
1	22	20		026B	110	REV039	CODE 0154	ALL
1	22	20		027	110	REV041	CODE 0287	ALL
1	22	20		027A	110	REV041	CODE 0287	ALL
1	22	20		028	001	REV034		ALL
1	22	20		029	100	REV030	CODE 0804	ALL
1	22	20		030	100	REV034	CODE 0160	

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1	22	30		002	100	REV026	M:24035=24160=24211	
1	22	30		003	001	REV031	EQ 200	ALL
1	22	30		004	215	REV026	CODE 0012	
1	22	30		005	100	REV025	CODE 0806	ALL
1	22	30		006	100	REV029	26497=(26497+28925+32282)	
1	22	30		007	001	REV025	STD=37252+37588=37311+32998	ALL
1	22	30		008	206	REV040	CODE 0152	
1	22	30		009	001	REV040		ALL
1	22	30		010	001	REV032		
1	22	30		011	100	REV039	CODE 0167	ALL
1	22	30		012	001	REV039		
1	22	30		013	001	REV039		ALL
1	22	30		014	100	REV033	CODE 0167	
1	22	30		015	100	REV033	24035=24160=24211	ALL
1	22	30		016	001	REV025		
1	22	30		017	001	REV025		ALL
1	22	30		018	100	REV027	M:24035=24160=24211	
1	22	30		019	001	REV025		ALL
1	22	30		020	001	REV025		
1	22	30		021	100	REV035	32600	ALL
1	22	30		022	100	REV026	CODE 0807	
1	22	30		023	100	REV035	32600	ALL
1	22	30		024	001	REV023	EQ 200	
1	22	30		025	001	REV030		ALL
1	22	30		026	100	REV035	32600	
1	22	30		027	200	REV036	CODE 0808	ALL
1	22	30		028	203	REV036	CODE 0808	
1	22	30		029	001	REV025		ALL
1	22	30		030	100	REV041	CODE 0168	
1	22	30		030A	001	REV041	STD=32401+37588	ALL
1	22	30		031	100	REV025	M:24064=24065=24066=24067	ALL
1	22	30		032	110	REV035	32600=26497+32600	
1	22	30		033	100	REV034	24035=24160=24211	ALL
1	22	30		034	400	REV041	CODE 0438	
1	22	30		035	200	REV040	CODE 0109	ALL
1	22	30		036	100	REV025	M:24035=24160=24211	
1	22	30		037	300	REV026	CODE 0809	ALL
1	22	30		038	210	REV028	CODE 0236	

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1	22	30		040	100	REV025	M:24035=24160=24211	
1	22	30		040A	110	REV035	CODE 0450	ALL
1	22	30		040B	310	REV041	CODE 0439	ALL
1	22	30		041	310	REV035	CODE 1193	ALL
1	22	30		042	300	REV041	CODE 1193	
1	22	30		043	310	REV037	CODE 1193	ALL
1	22	30		044	310	REV037	CODE 1193	
1	22	30		045	100	REV039	M:26497	ALL
1	22	30		045A	100	REV041	32600	ALL
1	22	30		046	001	REV037		ALL
1	22	30		047	320	REV037	CODE 1128	ALL
1	22	30		048	100	REV025	M:24035=24160=24211	
1	22	30		049	001	REV040		ALL
1	22	30		050	001	REV030		
1	22	30		051	100	REV036	CODE 0182	ALL
1	22	30		052	110	REV035	CODE 0167	
1	22	30		052A	001	REV036		ALL
1	22	30		053	100	REV036	M:26017	ALL
1	22	30		054	200	REV027	CODE 0183	
1	22	30		055	001	REV033		ALL
1	22	30		056	203	REV034	CODE 0185	
1	22	30		056A	100	REV035	25863=(25863+28551+34195)	ALL
1	22	30		057	310	REV040	CODE 0833	2052-2222 2875-3631
1	22	30		058	001	REV025		
1	22	30		057	350	REV038	CODE 1135	2233-2342
1	22	30		058	001	REV025		
1	22	30		059	001	REV023		ALL
1	22	30		060	001	REV039		
1	22	30		061	001	REV028		2233-2342
1	22	30		062	200	REV031	CODE 1221	
1	22	30		061	001	REV028		2052-2222 2875-3631
1	22	30		062	203	REV041	CODE 0189	
1	22	30		063	100	REV031	M:24035=24160=24189	ALL
1	22	30		064	100	REV023	M:24035=24160=24211	
1	22	30		065	100	REV034	24035=24160=24211	ALL
1	22	30		066	100	REV033	CODE 0192	

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1 22 30	068	100	REV034	CODE 0839	
1 22 30	069	210	REV039	CODE 0907	ALL
1 22 30	070	106	REV032	M:24035=24160=(24189+24211)	
1 22 30	071	110	REV035	CODE 0603	ALL
1 22 30	072	100	REV023	M:24035=24160=24211	
1 22 30	073	100	REV032	M:24035=24160=24211	ALL
1 22 30	074	100	REV023	M:24035=24160=24211	
1 22 30	075	100	REV023	CODE 0026	ALL
1 22 30	076	120	REV033	CODE 0195	
1 22 40	001	001	REV025		ALL
1 22 40	002	001	REV025		
1 22 40	003	001	REV026		2106-2163 2233
1 22 40	004	001	REV039		2330-3267 3334 3373-3631
1 22 40	003	110	REV026	M:24105	2052-2093 2179-2222
1 22 40	004	001	REV039		2243 3281-3298 3336
1 22 40	005	120	REV035	24215=24588=25534 CFM/PW	ALL
1 22 40	006	100	REV041	22249	
1 22 45	001	100	REV041	CODE 0017	ALL
1 22 45	002	100	REV041	CODE 0017	
1 22 45	003	100	REV041	CODE 0219	ALL
1 22 45	004	100	REV041	CODE 0017	
1 22 45	005	100	REV041	CODE 0017	ALL
1 22 45	006	100	REV041	CODE 0017	
1 22 45	007	100	REV041	CODE 0017	ALL
1 22 45	008	100	REV041	CODE 0017	
1 22 46	001	100	REV041	CODE 0256	ALL
1 22 46	002	100	REV041	CODE 0024	
1 22 60	001	312	REV041	CODE 1159	ALL
1 22 60	002	200	REV038	CODE 1188	
1 22 75	001	100	REV023		ALL
1 23 00	001	100	REV039	CODE 1241	ALL
1 23 00	002	001	REV041		
1 23 10	001	001	REV023		ALL
1 23 10	002	805	REV038	31286+UR	
1 23 10	003	001	REV026		ALL
1 23 10	004	001	REV026		
1 23 10	005	100	REV023	M:20137	ALL

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1	23	20		002	001	REV023		
1	23	20		003	100	REV033	31286	2052-2342
1	23	20		004	001	REV028	CODE 1002	
1	23	20		003	100	REV033	31286	2875-3631
1	23	20		004	100	REV036	33100=33300=33100+SAS	
1	23	20		005	120	REV040	32526	ALL
1	23	20		006	105	REV040	CODE 0196	
1	23	20		007	001	REV023		ALL
1	23	20		008	001	REV023		
1	23	20		009	001	REV026		ALL
1	23	20		010	001	REV028		
1	23	20		011	001	REV023		ALL
1	23	20		012	001	REV026		
1	23	20		013	001	REV023		2052-2243 2875
1	23	20		014	001	REV026		2920-2947 3052-3157 3281-3298 3336-3631
1	23	20		013	100	REV023	M:22013	2330-2342 2903-2912
1	23	20		014	001	REV026		2957-2965 3191-3267 3334
1	23	20		015	001	REV039	STD=(K4453+K7741)	2106-2163 2233
1	23	20		016	001	REV039		
1	23	20		015	001	REV039	STD=(K4453+K7741)	2052-2093 2179-2222
1	23	20		016	100	REV039	22013=24105=K5070	2243 2875 2920-2947 3052-3157 3281-3298 3336-3631
1	23	20		015	109	REV039	M:22013	2330-2342 2903-2912
1	23	20		016	100	REV039	22013=24105=K5070	2957-2965 3191-3267 3334
1	23	20		017	103	REV029	M:26621=(21437+26621)	ALL
1	23	20		018	001	REV024		
1	23	20		019	001	REV032	CODE 1031	2052-2342
1	23	20		020	002	REV024		
1	23	20		019	115	REV036	M:33100=33300	2875-3631
1	23	20		020	002	REV024		
1	23	30		001	205	REV028	CODE:0698	ALL
1	23	30		002	001	REV034	STD	
1	23	35		001	105	REV031	CODE 1243	ALL
1	23	50		001	120	REV036	CODE 0923	ALL
1	23	60		001	100	REV023	M:21858	ALL

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1 24 10	001	001	REV023		ALL
1 24 10	002	001	REV023		
1 24 10	003	100	REV033	27140	ALL
1 24 10	004	001	REV040	STD	
1 24 10	004A	100	REV040	22013=24105=28160	ALL
1 24 10	005	001	REV023		ALL
1 24 10	006	100	REV036	M:30368	
1 24 10	007	100	REV036	M:30368	ALL
1 24 10	008	001	REV023		
1 24 10	009	150	REV036	M:30368	2052-2243 2875
1 24 10	010	100	REV036	30368	2920-2947 3052-3063
1 24 10	009	150	REV036	M:30368	3157 3281-3298
1 24 10	010	205	REV041	30368+37317	3336-3631
1 24 10	009	200	REV036	M: 30051+30368	2330-2342 2903-2912
1 24 10	010	100	REV036	30368	2957-2965
1 24 10	009	200	REV036	M: 30051+30368	3191-3267 3334
1 24 10	010	205	REV041	30368+37317	
1 24 10	011	100	REV036	M:30368	ALL
1 24 10	012	100	REV036	M:30368	
1 24 10	013	150	REV036	30368	ALL
1 24 10	014	100	REV023	M:22013=24105=28160	
1 24 10	015	001	REV023		ALL
1 24 10	016	001	REV023		
1 24 10	017	100	REV036	M:30368	ALL
1 24 10	018	001	REV023		
1 24 10	019	100	REV025	M:22013=24105=28160	ALL
1 24 20	001	200	REV028	M:21230+27498	ALL
1 24 20	002	200	REV023	M:21230+21213	
1 24 20	003	001	REV023		2052-2243 2875
1 24 20	004	205	REV034	27498+31891	2920-2947 3052-3063
1 24 20	003	001	REV023		2330-2342 2903-2912
1 24 20	004	300	REV034	27498+30051+31891	2957-2965
1 24 20	003	001	REV023		3157 3281-3298
1 24 20	004	305	REV041	27498+31891+37317	3336-3631
1 24 20	003	001	REV023		3191-3267 3334
1 24 20	004	400	REV041	27498+30051+31891+37317	
1 24 20	005	001	REV023		ALL
1 24 20	006	100	REV025	M:22013=24105=28160	

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1	24	20		009	100	REV036	M:30368	ALL
1	24	20		010	001	REV023		
1	24	20		011	100	REV036	M:30368	ALL
1	24	20		012	100	REV036	M:30368	
1	24	20		013	001	REV023		ALL
1	24	20		014	001	REV023		
1	24	20		015	001	REV032		ALL
1	24	20		016	001	REV023	STD=(IAE ALL+25409):25409	
1	24	20		017	001	REV041		ALL
1	24	20		018	100	REV036	25999	
1	25	00		001	105	REV036	M:32088:32090	2052-2342 2903-2912 2957-2965 3191-3373 3511-3631
1	25	00		001	200	REV036	CODE 0165	2875 2920-2947 3052-3157 3410
1	25	10		001	001	REV039		ALL
1	25	10		002	001	REV034		
1	25	10		003	100	REV034	20047:20255:23577	ALL
1	25	10		004	001	REV039		
1	25	10		005	001	REV033		ALL
1	25	10		006	100	REV023	M:22941	
1	25	10		007	001	REV028		ALL
1	25	10		008	001	REV023		
1	25	10		009	001	REV023		ALL
1	25	10		010	001	REV023		
1	25	10		011	110	REV029	M:27320:27320+27620+33497	ALL
1	25	10		012	110	REV029	M:27320	
1	25	10		013	200	REV029	M:22112+27256	2052-2243 2875
1	25	10		014	206	REV031	20024+23839	2920-2947 3052-3157 3281-3298 3336-3631
1	25	10		013	200	REV029	M:22112+27256	2330-2342 2903-2912
1	25	10		014	210	REV031	CODE 0166	2957-2965 3191-3267 3334
1	25	10		015	001	REV023		2052-2243 2875-3631
1	25	10		016	001	REV023		
1	25	10		015	001	REV023		2330-2342
1	25	10		016	100	REV023	M:20048	
1	25	11		001	100	REV041	32088:32090	2052-3511 3631
1	25	11		002	100	REV035	32088:32090	

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	1	25	11	003	100	REV041	32088=32090	ALL
	1	25	11	004	100	REV035	M:32088=32090	
	1	25	11	005	105	REV035	32088=32090	ALL
	1	25	11	006	100	REV035	M:32088=32090	
	1	25	11	007	100	REV035	M:32087	2875 2920-2947
	1	25	11	008	200	REV040	M:32087+35000	3052-3157 3410
	1	25	11	009	105	REV040	M:32087=36414	2875 2920-2947 3052-3157 3410
	1	25	15	001	001	REV032	STD=27229+27230=27229+27540	ALL
	1	25	20	001	001	REV035		ALL
	1	26	00	001	100	REV036	CODE 0322	ALL
	1	26	10	001	100	REV034	CODE 0542	ALL
	1	26	20	001	005	REV024	CFM ALL	ALL
	1	26	20	002	001	REV026		
	1	26	20	003	100	REV033	23839	ALL
	1	26	20	004	001	REV023		
	1	26	20	005	100	REV026	M:23839	ALL
	1	26	20	006	001	REV023		
	1	26	20	007	001	REV024		ALL
	1	26	20	008	001	REV040	STD	
	1	26	20	009	001	REV039		ALL
	1	26	20	010	001	REV023		
	1	26	30	001	001	REV030		ALL
	1	26	30	002	001	REV023		
	1	26	30	003	001	REV023		ALL
	1	26	40	001	001	REV030	CODE 1031	2052-2342
	1	26	40	002	102	REV035	CODE 1040	
	1	26	40	001	105	REV034	CODE 0541	2875-3631
	1	26	40	002	400	REV036	CODE:0616	
	1	26	50	001	201	REV030	CODE 1041	2052-2243
	1	26	50	002	300	REV023	CODE 0873	
	1	26	50	001	300	REV036	CODE 0813	2875 2920-2947
	1	26	50	002	300	REV023	CODE 0873	3052-3157 3281-3298 3336-3631
	1	26	50	001	301	REV039	CODE 1042	2330-2342
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1	26	50		004	200	REV037	CODE 0777	
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1	26	60		001	100	REV030	CODE 1047	2052-2342
1	26	60		001	205	REV036	CODE:0626	2875-3631
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1	27	10		001	001	REV034		ALL
1	27	10		002	001	REV023		
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1	27	10		004	001	REV023		
1	27	10		005	100	REV024	M:22013=24105=26334=26335	ALL
1	27	10		006	001	REV036		
1	27	10		007	100	REV036	M:21964	ALL
1	27	10		008	001	REV023		
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1	27	10		010	001	REV030		2957-2965 3191-3267 3334
1	27	10		009	105	REV028	M:24105 OR 26334 OR 26335	2052-2243 2875
1	27	10		010	001	REV030		2920-2947 3052-3157 3281-3298 3336-3631
1	27	10		011	204	REV027	CODE 0050	2106-2163 2233 2875
1	27	10		012	001	REV039		2920-2947 3052-3157 3373-3631
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1	27	10		014	100	REV024	M:22013=24105=26334=26335	
1	27	10		015	001	REV023		2106-2163 2233
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1 27 20 001	001	REV041		2875 2920-2947
1 27 20 002	105	REV041	CODE 0946	3052-3157 3373-3631
1 27 20 003	100	REV028	M:27276	2052-2243 2875
1 27 20 004	105	REV035	M:31395=(24105+31395)	2920-2947 3052-3157 3281-3298 3336-3631
1 27 20 003	100	REV028	M:27276	2330-2342 2903-2912
1 27 20 004	205	REV035	M:22013+31395	2957-2965 3191-3267 3334
1 27 20 005	001	REV041	CODE 0947	2052-2342 2903-2912
1 27 20 006	001	REV040		2957-2965 3191-3336
1 27 20 005	100	REV041	CODE 0647	2875 2920-2947
1 27 20 006	001	REV040		3052-3157 3373-3631
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1 27 20 008	001	REV040		
1 27 30 001	001	REV023	STD	2106-2163 2233 2875
1 27 30 002	001	REV041		2920-2947 3052-3157 3373-3631
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1 27 30 004	001	REV023	STD	
1 27 30 005	001	REV032	STD	ALL
1 27 30 006	001	REV023	STD	
1 27 30 007	001	REV023	STD	2052-2243
1 27 30 007	100	REV036	M:30977	2330-3631
1 27 40 001	001	REV036	STD	2106-2163 2233
1 27 40 002	001	REV035	STD	2330-3267 3334 3373-3631
1 27 40 001	001	REV036	STD	2052-2093 2179-2222
1 27 40 002	100	REV036	M:24105=30020	2243 3281-3298 3336
1 27 40 003	200	REV037	CODE 0588	ALL
1 27 40 004	100	REV023	25477=25296=25296+25477	
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1 27 40 009	200	REV036	M:30368+31040	2875-3631
1 27 40 010	200	REV036	M:30368+31040	
1 27 40 011	110	REV036	M:30368	ALL
1 27 40 012	200	REV037	CODE 0783	
1 27 40 013	201	REV041	CODE 0001	ALL
1 27 40 014	001	REV036		
1 27 50 001	001	REV023	STD=M:24105	2052-2243 2875
1 27 50 002	001	REV023	STD=M:24105	2920-2947 3052-3157 3281-3298 3336-3631
1 27 50 001	100	REV023	M:22013	2330-2342 2903-2912
1 27 50 002	100	REV023	M:22013	2957-2965 3191-3267 3334
1 27 50 003	001	REV035		2052-2243 2875
1 27 50 004	001	REV039	STD=M.24105	2920-2947 3052-3157 3281-3298 3336-3631
1 27 50 003	001	REV035		2330-2342 2903-2912
1 27 50 004	100	REV039	M.22013	2957-2965 3191-3267 3334
1 27 50 005	005	REV023	CFM ALL	2106-2163 2233 2875
1 27 50 006	100	REV036	M:30368	2920-2947 3052-3157 3373-3631
1 27 50 005	050	REV023	IAE/PW=24105	2052-2093 2179-2222
1 27 50 006	100	REV036	M:30368	2243 3281-3298 3336
1 27 50 005	100	REV023	M.22013	2330-2342 2903-2912
1 27 50 006	100	REV036	M:30368	2957-2965 3191-3267 3334
1 27 50 007	100	REV036	M:30368	3157
1 27 50 008	001	REV041	STD	
1 27 50 007	100	REV036	M:30368	2052-3063 3191-3631
1 27 50 008	100	REV040	P6146	
1 27 60 001	001	REV023		ALL
1 28 00 001	001	REV036		ALL
1 28 10 001	203	REV025	CODE 0158	2052-2243 2875
1 28 10 002	100	REV025	M.20024	2920-2947 3052-3157
1 28 10 001	300	REV033	20024+20167+22013	2330-2342 2903-2912
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1 28 10 004	100	REV024	M:20024	2920-2947 3052-3157 3281-3298 3336-3631
1 28 10 003	200	REV025	M.20024+22013	2330-2342 2903-2912
1 28 10 004	200	REV024	M:20024+22013	2957-2965 3191-3267 3334
1 28 10 005	220	REV036	M:20024+30368	2052-2243 2875
1 28 10 006	105	REV023	CODE 0106/CFM ALL	2920-2947 3052-3157 3281-3298 3336-3631
1 28 10 005	315	REV036	M:20024+22013+30368	2330-2342 2903-2912
1 28 10 006	305	REV023	M:20024+20167+22013/CFM ALL	2957-2965 3191-3267 3334
1 28 10 007	106	REV024	M:20024	2052-2243 2875
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1 28 10 008	100	REV024	M:22013	2957-2965 3191-3267 3334
1 28 10 009	001	REV024		ALL
1 28 20 001	100	REV024	M:20024	2052-2243 2875
1 28 20 002	100	REV024	M:20024	2920-2947 3052-3157 3281-3298 3336-3631
1 28 20 001	203	REV024	M:20024+22013	2330-2342 2903-2912
1 28 20 002	100	REV024	M:20024	2957-2965 3191-3267 3334
1 28 20 003	100	REV023	CODE 0163	ALL
1 28 20 004	001	REV023		
1 28 20 005	001	REV023		ALL
1 28 20 006	001	REV023	CODE 1168	
1 28 20 007	001	REV023	CODE 1169	3157
1 28 20 008	220	REV036	M:20024+30368	
1 28 20 007	001	REV023	CODE 1169	2052-2243 2875
1 28 20 008	311	REV036	CODE 0729	2920-2947 3052-3063 3281-3298 3336-3631
1 28 20 007	001	REV023	CODE 1169	2330-2342 2903-2912
1 28 20 008	425	REV037	CODE 593	2957-2965 3191-3267 3334
1 28 20 009	220	REV036	M:20024+30368	2052-2243 2875
1 28 20 010	225	REV036	M:20024+30368	2920-2947 3052-3157 3281-3298 3336-3631

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1	28	20		013	100	REV039	M:20024	2052-2243 2875 2920-2947 3052-3157 3281-3298 3336-3631
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1	29	10		002	100	REV023	M:22013=24105=26334=26335	
1	29	10		003	001	REV023		ALL
1	29	10		004	001	REV023		
1	29	10		005	100	REV033	CODE 0306	2052-2342
1	29	10		006	100	REV023	M:22013=24105=26334=26335	
1	29	10		005	100	REV033	CODE 0306	2875-3631
1	29	10		006	110	REV033	M:26925	
1	29	20		001	001	REV030		ALL
1	29	20		002	001	REV025		
1	29	20		003	001	REV027	STD=M:21679=(21591+21679)	ALL
1	29	20		004	100	REV036	M:30368	
1	29	20		005	001	REV023		ALL
1	29	20		006	001	REV023		
1	29	20		007	001	REV030	STD=M:23795=(23119+23795)	2052-2093 2179-2222
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1 30 00 001	001	REV036		ALL
1 30 10 001	001	REV028	CODE 0132	ALL
1 30 20 001	010	REV034	CFM/PW	ALL
1 30 20 002	001	REV026		
1 30 20 003	100	REV034	22875:28558	ALL
1 30 30 001	110	REV034	20327/CFM/PW	ALL
1 30 30 002	200	REV036	CODE 0643	
1 30 30 003	100	REV034	22875:28558	ALL
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1 30 50 002	001	REV036		
1 30 50 003	100	REV036	31283:31283+34862+37809	ALL
1 30 60 001	001	REV032		ALL
1 30 60 002	001	REV034		
1 30 60 003	001	REV023		ALL
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1 30 80 001	100	REV023	M:21678	ALL
1 31 00 001	001	REV023		ALL
1 31 00 002	001	REV033		
1 31 00 003	001	REV026		ALL
1 31 05 001	001	REV036		ALL
1 31 05 002	100	REV041	30368	
1 31 05 003	100	REV041	30368	ALL
1 31 05 004	001	REV036		
1 31 05 005	100	REV036	MOD 30368	ALL
1 31 05 006	001	REV026		
1 31 10 001	001	REV023		3157
1 31 10 002	001	REV035		
1 31 10 001	100	REV039	M:P7092	2052-3063 3191-3631
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1 31 10 003	001	REV023		ALL
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	1	31	15	003	001	REV023		ALL
	1	31	15	004	105	REV033	CODE 0662	
	1	31	15	005	001	REV039	STD	2052-2965
	1	31	15	005	105	REV039	35220=33910	3052-3631
	1	31	20	001	100	REV026	M:25409=26018=(25409+26018)	ALL
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	1	31	20	003	100	REV039	M:30368	ALL
	1	31	20	004	001	REV024		
	1	31	20	005	200	REV041	CODE 0405	3157
	1	31	20	006	001	REV023		
	1	31	20	005	300	REV041	CODE 1265	2052-3063 3191-3631
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	1	31	25	003	120	REV036	30368/CFM/PW	ALL
	1	31	25	004	100	REV036	M: 30368	
	1	31	25	005	110	REV036	30368/CFM/PW	ALL
	1	31	25	006	110	REV036	30368/CFM/PW	
	1	31	25	007	110	REV036	30368/CFM/PW	ALL
	1	31	27	001	100	REV033	25590	ALL
	1	31	27	002	100	REV033	25590	
	1	31	27	003	100	REV033	25590	ALL
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	1	31	30	005	001	REV023		ALL
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	1	31	40	004	005	REV039	CODE 0843 CFM/PW	
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	1	31	40	004	205	REV039	CODE 0844	

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	1	31	40	010	100	REV039	CODE 1263	
	1	31	40	011	100	REV036	M:30368	ALL
	1	31	40	012	300	REV028	M:20406+28308+28369	
	1	31	40	013	100	REV036	CODE 0800	ALL
	1	31	40	014	110	REV033	M:30368	
	1	31	40	015	100	REV036	30368	ALL
	1	31	40	016	100	REV036	CODE 0800	
	1	31	40	017	001	REV023	EQ 200	ALL
	1	31	40	018	001	REV026	EQ 200	
	1	31	40	019	001	REV024	EQ 200	ALL
	1	31	40	020	200	REV036	CODE 0801	
	1	31	40	021	200	REV036	M:26358+30368	ALL
	1	31	40	022	310	REV036	CODE 0623	
	1	31	40	023	100	REV026	M : 24035=24160=24189	2052-3545
	1	31	40	024	001	REV024		
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N	1	31	40	024	100	REV041	37444	
	1	31	40	025	001	REV023		2052-2965
	1	31	40	026	300	REV036	CODE 0630	
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	1	31	40	027	100	REV038	26018=(26018+30368)	ALL
	1	31	40	028	205	REV036	CODE 0525	
	1	31	40	029	305	REV041	CODE 0632	ALL
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	1	31	45	004	100	REV037	26358	
	1	31	45	005	110	REV038	CODE 0667	ALL
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	1	31	45	008	001	REV024		
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1	31	45		017	405	REV037	CODE 1235	ALL
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1	31	45		018A	201	REV041	CODE 0927	ALL
1	31	45		019	300	REV038	CODE 1190	ALL
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1	31	45		021	300	REV038	CODE 0369	2052-2965
1	31	45		022	300	REV038	CODE 0367	
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1	31	45		022	300	REV038	CODE 0367	
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1	31	50		002	100	REV036	M:26358	
1	31	50		003	100	REV030	M:26526	ALL
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1	31	55		001	100	REV030	M:27330	ALL
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1	31	55		003	110	REV026	CODE 0765	ALL
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1	31	65		001	001	REV023		ALL
1	31	65		002	001	REV023		
1	31	65		003	001	REV023		ALL
1	31	65		004	001	REV023		
1	31	67		001	001	REV023		ALL
1	31	68		001	001	REV023		ALL
1	31	70		001	205	REV041	25590+31283	ALL

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1	31	75	001		100	REV041	21678	ALL
1	32	00	001		001	REV036		ALL
1	32	10	001		001	REV026	STD=M:20139+22129	ALL
1	32	10	002		001	REV023		
1	32	10	003		001	REV023	STD=M:20139+22129	ALL
1	32	10	004		001	REV023		
1	32	10	005		001	REV023	STD=M:20139+22129	ALL
1	32	10	006		001	REV023		
1	32	10	007		001	REV023	STD=M:20139+22129	ALL
1	32	10	008		001	REV027		
1	32	10	009		001	REV023		ALL
1	32	10	010		001	REV040	CODE 0557	
1	32	10	011		001	REV023		ALL
1	32	10	012		001	REV029		
1	32	10	013		001	REV023		ALL
1	32	10	014		001	REV023		
1	32	10	015		100	REV030	M:22013=24105=28160	ALL
1	32	10	016		001	REV030	STD=M:20139+22129	
1	32	10	017		001	REV023		ALL
1	32	10	018		001	REV025		
1	32	10	019		100	REV029	M:28482	ALL
1	32	10	020		001	REV023		
1	32	10	021		105	REV036	M: 30368	ALL
1	32	10	022		001	REV023		
1	32	10	023		001	REV040	STD=(20139+22129)	ALL
1	32	20	001		105	REV036	CODE 0015	2052-2342
1	32	20	002		002	REV027		
1	32	20	001		200	REV037	CODE 0016	2875-3631
1	32	20	002		100	REV036	26925	
1	32	20	003		001	REV023		2052-2342
1	32	20	004		105	REV036	M: 30368	
1	32	20	003		001	REV023		2875-3631
1	32	20	004		200	REV036	M: 26925+30368	
1	32	20	005		103	REV036	28479=28702=28916	ALL
1	32	30	001		100	REV024	M:23208=24077=(23208+24077)	2052-2342
1	32	30	002		001	REV025	STD=M:(20139+22129)	
1	32	30	001		110	REV038	26925=(23208+24077+26925)	2875-3631
1	32	30	002		110	REV038	26925	

M	V	CH	SEC	---PAGE--	SEQ-	--REV--	----VALIDATION CRITERIA-----	-----EFFECTIVITY-----
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1	32	30	004		100	REV030	M:30062	
1	32	30	003		105	REV037	CODE 0033	2875-3631
1	32	30	004		110	REV033	26925 = (26925+30062)	
1	32	30	005		100	REV028	M:30062	2052-2342
1	32	30	006		001	REV023	STD=M:(20139+22129)	
1	32	30	005		110	REV033	26925 = (26925+30062)	2875-3631
1	32	30	006		110	REV036	26925	
1	32	30	007		001	REV023		2052-2342
1	32	30	008		100	REV041	CODE 0530	
1	32	30	007		110	REV033	26925	2875-3631
1	32	30	008		100	REV041	CODE 0530	
1	32	30	009		100	REV028	M:30062	2052-2342
1	32	30	010		100	REV036	M:30368	
1	32	30	009		100	REV028	M:30062	2875-3631
1	32	30	010		205	REV036	M:(26925+30368)=(26925+30368	
1	32	30	011		001	REV036	CODE 0332	2052-2342
1	32	30	012		001	REV036		
1	32	30	011		001	REV036	CODE 0332	2875-3631
1	32	30	012		205	REV036	CODE 0441 (éQUI à DEFINIR)	
1	32	30	013		110	REV036	CODE 0776	2052-2342
1	32	30	014		001	REV036	STD	
1	32	30	013		110	REV036	CODE 0776	2875-2965
1	32	30	014		100	REV036	M: 26925 = (26925+P6911)	
1	32	30	013		115	REV039	CODE 0239	3052-3631
1	32	30	014		205	REV039	26925+35220	
1	32	50	001		001	REV025		2052-2342
1	32	50	001		100	REV036	M: 26925	2875-3631
1	33	00	001		001	REV032		ALL
1	33	10	001		001	REV023		ALL
1	33	10	002		100	REV034	23642	
1	33	10	003		100	REV023	M:24851	ALL
1	33	10	004		103	REV024	M:24851=(20818+24851+35120)	
1	33	10	005		100	REV023	M:23642	ALL
1	33	10	006		001	REV034		
1	33	10	007		100	REV034	23642	ALL
1	33	20	001		001	REV023		ALL
1	33	20	002		200	REV025	M.20042+20081	

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1	33	20	004		100	REV023	M:20081	
1	33	30	001		100	REV035	CODE 0118	2106-2163 2233
1	33	30	002		001	REV032	STD = MOD 21610 = CTN	
1	33	30	001		100	REV035	CODE 0118	2052-2093 2179-2222
1	33	30	002		103	REV033	24105 OR (CTN + 24105)	2243
1	33	30	001		108	REV033	CODE 0088	2330-2342
1	33	30	002		100	REV034	22013	
1	33	30	001		110	REV034	CODE 0494	2903-2912 2957-2965
1	33	30	002		100	REV034	22013	3191-3267 3334
1	33	30	001		200	REV034	CODE 0497	2875 2920-2947
1	33	30	002		001	REV032	STD = MOD 21610 = CTN	3052-3157 3373-3631
1	33	30	001		200	REV034	CODE 0497	3281-3298 3336
1	33	30	002		103	REV033	24105 OR (CTN + 24105)	
1	33	30	003		100	REV031	CODE 0091	2052-2342
1	33	30	004		100	REV025	CODE 0169	
1	33	30	003		110	REV031	CODE 0498	2875-3631
1	33	30	004		221	REV025	CODE 0324	
1	33	40	001		001	REV025	CODE 0325	2875-3631
1	33	40	002		205	REV037	20081+K4337	
1	33	40	001		120	REV033	CODE 0771	2052-2342
1	33	40	002		205	REV037	20081+K4337	
1	33	50	001		100	REV034	24851	2052-3063
1	33	50	002		001	REV023		
1	33	50	001		200	REV041	24851+37329=24851+37330	3157-3631
1	33	50	002		001	REV023		
1	34	00	001		110	REV038	CODE 0554	2052-2144 2875-3631
1	34	00	002		100	REV039	CODE 0679	
1	34	00	001		207	REV038	CODE 0319	2151-2342
1	34	00	002		100	REV039	CODE 0679	
1	34	10	001		100	REV023	CODE 1030	2052-2965 3191
1	34	10	002		001	REV024		
1	34	10	001		203	REV023	CODE 0585	3052-3157 3267-3631
1	34	10	002		001	REV024		
1	34	10	003		205	REV037	CODE 0830	ALL
1	34	10	004		001	REV025	CODE:0474	
1	34	10	005		001	REV041		ALL
1	34	10	006		001	REV031		
1	34	10	007		001	REV023		ALL
1	34	10	008		001	REV033		

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	1	34	10	009	305	REV039	CODE 1049	3157
	1	34	10	009	600	REV041	CODE 1033	2875-2965
	1	34	10	009	700	REV041	CODE 1036	3052-3063 3191-3631
	1	34	15	001	110	REV041	CODE:0036	ALL
	1	34	15	002	120	REV026	CODE:0036	
	1	34	15	003	205	REV037	CODE 1044	ALL
	1	34	20	001	001	REV038	STD=33497=27620+33497	2052-2965 3063-3191
	1	34	20	002	001	REV033	CODE 0961	
	1	34	20	001	100	REV041	CODE 1059	3052 3267-3631
	1	34	20	002	001	REV033	CODE 0961	
	1	34	20	003	100	REV024	M:20316=(20316+27620+33497)	ALL
N	1	34	25	003	110	REV038	CODE 0135	3574-3631
	1	34	30	001	001	REV027		ALL
	1	34	30	002	001	REV023		
	1	34	30	003	310	REV037	CODE 0609	2052-2151
	1	34	30	004	001	REV023	CODE 0540	
	1	34	30	003	310	REV037	CODE 0609	2163-3631
	1	34	30	004	103	REV024	CODE 0543	
	1	34	30	005	001	REV023	CODE 0545	2052-2151
	1	34	30	006	001	REV023	CODE 0169	
	1	34	30	005	100	REV031	CODE 0543	2163-3631
	1	34	30	006	001	REV023	CODE 0169	
	1	34	30	007	001	REV031	STD	ALL
	1	34	30	008	001	REV031		
	1	34	30	009	001	REV032		ALL
	1	34	40	001	202	REV036	CODE 1029	ALL
	1	34	40	002	001	REV023		
	1	34	50	001	217	REV041	CODE 1077	ALL
	1	34	50	002	207	REV041	CODE 1106	
	1	34	50	003	100	REV036	M:32007	2151-2243
	1	34	50	003	205	REV038	32007+34783	2330-2342
	1	34	60	001	100	REV028	CODE 0248	2052-2243
	1	34	60	002	100	REV031	CODE 0206	
	1	34	60	001	115	REV039	CODE 0201	2330-3631
	1	34	60	002	120	REV037	CODE 0201	

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1	34	60		003	105	REV038	CODE 0211	ALL
1	34	60		004	105	REV038	CODE 0211	
1	34	60		005	100	REV038	CODE 0013	2052-2342
1	34	70		001	310	REV035	MOD: 21391+26526+31426	ALL
1	34	70		002	210	REV035	MOD: 26526+21391	
1	34	70		003	200	REV041	21391+26526	ALL
1	34	70		004	400	REV041	21391+22769+26526+31426	
1	34	70		005	300	REV041	CODE 0567	ALL
1	34	70		006	200	REV041	26526+31426	
1	34	70		007	100	REV041	CODE 0858	2052-2342
1	34	70		008	610	REV041	CODE 0936	
1	34	70		007	100	REV041	CODE 0858	2875-3631
1	34	70		008	710	REV041	CODE 0938	
1	34	70		009	100	REV030	M:26526	ALL
1	34	70		010	210	REV035	MOD: 26526+31426	
1	34	70		011	100	REV030	M:26526:(22769+26526)	ALL
1	34	70		012	200	REV031	CODE 0861	
1	34	70		013	105	REV032	MOD 28244 OR (26526 + 28244)	2052-2342
1	34	70		014	101	REV027	CODE 0104	
1	34	70		013	105	REV032	MOD 28244 OR (26526 + 28244)	2875-2965
1	34	70		014	308	REV041	22769+26526+34825	
1	34	70		013	105	REV032	MOD 28244 OR (26526 + 28244)	3052-3631
1	34	70		014	405	REV041	22769+26526+34825+35220	
1	34	80		001	100	REV033	CODE 0841	2052-2342
1	34	80		002	100	REV023	CODE 0095	
1	34	80		001	210	REV038	22536+34207	2875-3631
1	34	80		002	100	REV023	CODE 0095	
1	34	80		003	100	REV023	CODE 0095	ALL
1	34	80		004	100	REV031	CODE 0095	
1	34	80		005	150	REV040	CODE:0834	2052-2144 2875-3631
1	34	80		006	150	REV039	CODE 0218	
1	34	80		005	210	REV040	CODE:0835	2151-2342
1	34	80		006	150	REV039	CODE 0218	
1	34	80		007	315	REV037	CODE 0161	ALL
1	34	80		008	200	REV031	CODE 1131	
1	34	80		009	100	REV023	CODE 0095	ALL
1	34	80		010	110	REV040	CODE 0009	
1	34	80		011	205	REV041	CODE 1149	2052-2965
1	34	80		012	150	REV038	CODE 0218	

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1		34	80	013	100	REV024	CODE 0095	ALL
1		34	97	001	206	REV035	CODE 0610	2052-2965 3063-3191
1		34	97	001	301	REV041	CODE 0607	3052 3267-3631
1		35	00	001	001	REV023		ALL
1		35	10	001	001	REV024		ALL
1		35	20	001	001	REV036		2052-2342
1		35	20	002	100	REV034	CODE 0676	
1		35	20	001	100	REV036	31459	2875-3631
1		35	20	002	100	REV034	CODE 0676	
1		35	20	003	001	REV023		ALL
1		35	20	004	001	REV034		
1		35	20	005	001	REV031		ALL
1		35	20	006	001	REV036		
1		35	20	007	001	REV032		2052-2965
1		35	20	008	100	REV036	M: 31495	
1		35	20	007	001	REV032		3052-3631
1		35	20	008	102	REV041	36725	
1		35	30	001	110	REV041	26923=27255=27572	ALL
1		35	30	002	001	REV023		
1		35	30	003	001	REV038		ALL
1		35	40	001	112	REV023	CODE 0686	ALL
1		35	40	002	112	REV023	CODE 0688	
1		35	50	001	001	REV031	STD=M:25110	ALL
1		36	00	001	001	REV023		ALL
1		36	10	001	001	REV023		ALL
1		36	10	002	001	REV023		
1		36	10	003	001	REV023		2106-2163 2233
1		36	10	004	110	REV036	M:30368	2330-3191
1		36	10	003	001	REV023		2052-2093 2179-2222
1		36	10	004	160	REV036	CODE 0426	2243
1		36	10	003	100	REV039	M:35550	3267 3334 3373-3631
1		36	10	004	110	REV036	M:30368	
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1		36	10	004	160	REV036	CODE 0426	

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1 36 10 006	001	REV023	CODE 0998	
1 36 10 007	100	REV037	M:30368	ALL
1 36 10 008	001	REV023		
1 36 10 009	001	REV023		ALL
1 36 10 010	001	REV023		
1 36 20 001	001	REV023		ALL
1 36 20 002	001	REV023		
1 36 20 003	100	REV036	M:30368	ALL
1 36 20 004	100	REV036	M:24805	
1 36 20 005	100	REV036	M:30368	ALL
1 36 20 006	100	REV023	M:24805	
1 36 20 007	001	REV023		2052-3191
1 36 20 007	200	REV039	M:35220+35550	3267-3631
1 36 30 001	100	REV023	M:21678	ALL
1 38 00 001	001	REV023		ALL
1 38 10 001	001	REV023		2330-2342 2903-2912
1 38 10 002	105	REV036	M:26250	2957-2965 3191-3267 3334
1 38 10 001	001	REV023		2052-2243 2875
1 38 10 002	200	REV036	M:21003+26250	2920-2947 3052-3157 3281-3298 3336-3631
1 38 10 003	001	REV023		ALL
1 38 10 004	100	REV034	20109	
1 38 10 005	205	REV036	M:20109+26250	ALL
1 38 20 001	100	REV034	MOD 20109	ALL
1 45 00 001	001	REV030		ALL
1 45 10 001	001	REV023		ALL
1 45 10 002	100	REV028	M:27522	
1 45 10 003	100	REV032	23119:22013	ALL
1 45 10 004	100	REV038	M:30622	
1 45 10 005	001	REV023		ALL
1 45 20 001	100	REV028	M:27522	ALL
1 45 20 002	001	REV023		
1 45 20 003	103	REV032	MOD 24287	ALL
1 45 20 004	001	REV032		
1 45 20 005	001	REV023		ALL
1 45 20 006	001	REV023		

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1	45	25	001		100	REV030	M:25293	ALL
1	45	30	001		001	REV023		ALL
1	45	40	001		001	REV023		ALL
1	46	00	001		205	REV040	CODE 1208	2875-2947 3052-3063
1	46	00	001		210	REV040	27522+31286	2069-2072 2093-2106 2151-2342
1	46	00	001		302	REV041	CODE 0521	2052 2091 2116-2144 2957-2965 3157-3631
1	46	10	001		100	REV028	M:27522	2069-2072 2093-2106
1	46	10	002		100	REV028	M:27522	2151-2342
1	46	10	001		205	REV039	27522+34869	2875-2947 3052-3063
1	46	10	002		205	REV039	27522+34869	
1	46	10	001		210	REV041	CODE 0522	2052 2091 2116-2144
1	46	10	002		210	REV041	CODE 0522	2957-2965 3157-3631
1	46	20	001		110	REV033		2069-2072 2093-2106
1	46	20	002		203	REV035	CODE 0391	2151-2947 3052-3063
1	46	20	001		302	REV040	CODE 0523	2052 2091 2116-2144
1	46	20	002		402	REV040	CODE 0524	2957-2965 3157-3631
1	46	20	003		203	REV035	CODE 1211	2069-2072 2093-2106
1	46	20	004		203	REV035	CODE 0391	2151-2947 3052-3063
1	46	20	003		402	REV040	CODE 0524	2052 2091 2116-2144
1	46	20	004		402	REV040	CODE 0524	2957-2965 3157-3631
1	46	20	005		402	REV037	27522+30660+31371+31215	2069-2072 2093-2106
1	46	20	006		400	REV039	27522+30660+31215+31371	2151-2947 3052-3063
1	46	20	005		500	REV040	CODE 1270	2052 2091 2116-2144
1	46	20	006		500	REV040	CODE 1270	2957-2965 3157-3631
1	46	20	007		200	REV037	M: 31215+31286=(27522+31215+	2069-2072 2093-2106
1	46	20	008		204	REV039	CODE 0613	2151-2947 3052-3063
1	46	20	007		200	REV037	M: 31215+31286=(27522+31215+	2052 2091 2116-2144
1	46	20	008		500	REV041	CODE 0527	2957-2965 3157-3631
1	46	30	001		100	REV028	M:27522	ALL
1	46	30	002		100	REV033	27522	
1	46	30	003		100	REV029	M:27522	ALL
1	46	40	001		100	REV041	35865=34869+35865	2052 2091 2116-2144
1	46	40	002		102	REV041	35865	2957-2965 3157-3631
1	46	40	001		105	REV039	34869	2875-2947 3052-3063

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1 46 40 004	102	REV041	35865	2957-2965 3157-3631
1 46 55 001	100	REV040	35227=35865	2052 2091 2116-2144
1 46 55 002	102	REV041	35865	2957-2965 3157-3631
1 46 55 003	102	REV041	35865	2052 2091 2116-2144
1 46 55 004	102	REV041	35865	2957-2965 3157-3631
1 46 55 005	102	REV041	35865	2052 2091 2116-2144
1 46 55 006	100	REV040	35227=35865	2957-2965 3157-3631
1 46 55 007	102	REV041	35865	2052 2091 2116-2144
1 46 55 008	102	REV041	35865	2957-2965 3157-3631
1 46 55 009	102	REV041	35865	2052 2091 2116-2144
1 46 55 010	102	REV041	35865	2957-2965 3157-3631
1 46 55 011	102	REV041	35865	2052 2091 2116-2144
1 46 55 012	102	REV041	35865	2957-2965 3157-3631
1 46 55 013	102	REV041	35865	2052 2091 2116-2144
1 46 55 014	102	REV041	35865	2957-2965 3157-3631
1 46 55 015	102	REV041	35865	2052 2091 2116-2144
1 46 55 016	102	REV041	35865	2957-2965 3157-3631
1 46 55 017	102	REV041	35865	2052 2091 2116-2144
1 46 55 018	102	REV041	35865	2957-2965 3157-3631
1 46 55 019	102	REV041	35865	2052 2091 2116-2144 2957-2965 3157-3631
1 46 60 001	203	REV035	CODE 0391	2069-2072 2093-2106 2151-2947 3052-3063
1 46 60 001	402	REV040	CODE 0524	2052 2091 2116-2144
1 46 60 002	100	REV040	35227=35865	2957-2965 3157-3631
1 46 70 001	100	REV028	M:27522	2069-2072 2093-2106 2151-2342
1 46 70 001	202	REV040	CODE 0528	2052 2091 2116-2144 2957-2965 3157-3631
1 46 70 001	205	REV039	27522+34869	2875-2947 3052-3063
1 49 00 001	001	REV023		ALL
1 49 10 001	102	REV041	CODE 0007	ALL
1 49 10 002	001	REV023		
1 49 10 003	110	REV040	CODE 0993	ALL
1 49 20 001	110	REV035	CODE 0995	ALL
1 49 20 002	110	REV028	CODE 0993	
1 49 20 003	001	REV023		ALL
1 49 20 004	210	REV041	CODE 1099	

M	V	CH	SEC	---PAGE--	SEQ-	--REV--	----VALIDATION CRITERIA-----	-----EFFECTIVITY-----
M	V	CH	SEC	---PAGE--	SEQ-	--REV--	----VALIDATION CRITERIA-----	-----EFFECTIVITY-----
1		49	20	005	110	REV027	CODE 0993	ALL
1		49	20	006	001	REV023	CODE 0555	
1		49	30	001	100	REV032	M:22013 OR 24105 OR 28160	ALL
1		52	00	001	001	REV038	STD =20062+22188	ALL
1		52	10	001	100	REV023	M:20029=20449	2106-2163 2233 2875
1		52	10	002	001	REV023		2920-2947 3052-3157 3373-3631
1		52	10	001	106	REV023	M:24105	2052-2093 2179-2222
1		52	10	002	001	REV023		2243 3281-3298 3336
1		52	10	001	206	REV033	(20029+22013)=(20449+22013)	2330-2342 2903-2912
1		52	10	002	001	REV023		2957-2965 3191-3267 3334
1		52	10	003	001	REV023		ALL
1		52	10	004	100	REV039	M:26088	
1		52	10	005	100	REV035	32088=32090	2106-2163 2233 2875
1		52	10	006	001	REV032		2920-2947 3052-3157 3373-3631
1		52	10	005	100	REV035	32088=32090	2330-2342 2903-2912
1		52	10	006	100	REV026	M:22013	2957-2965 3191-3267 3334
1		52	10	005	100	REV035	32088=32090	2052-2093 2179-2222
1		52	10	006	103	REV032	M:24105	2243 3281-3298 3336
1		52	10	007	001	REV023	STD OR (24105+32208)	2106-2163 2233 2875
1		52	10	008	100	REV038	32088=32090	2920-2947 3052-3157 3373-3631
1		52	10	007	100	REV023	22013=(AFR+22013)	2330-2342 2903-2912
1		52	10	008	100	REV038	32088=32090	2957-2965 3191-3267 3334
1		52	10	007	103	REV023	M:24105=(AFR+24105)	2052-2093 2179-2222
1		52	10	008	100	REV038	32088=32090	2243 3281-3298 3336
1		52	10	009	001	REV023		2106-2163 2233 2875
1		52	10	010	001	REV025		2920-2947 3052-3157 3373-3631
1		52	10	009	001	REV023		2330-2342 2903-2912
1		52	10	010	100	REV023	M:22013	2957-2965 3191-3267 3334
1		52	10	009	001	REV023		2052-2093 2179-2222
1		52	10	010	103	REV025	M:24105	2243 3281-3298 3336
1		52	10	011	001	REV039	STD OR (24105+32208)	2106-2163 2233 2875 2920-2947 3052-3157 3373-3631

M V CH SEC	---PAGE--	SEQ-	--REV--	----VALIDATION CRITERIA-----	-----EFFECTIVITY-----
M V CH SEC	---PAGE--	SEQ-	--REV--	----VALIDATION CRITERIA-----	-----EFFECTIVITY-----
1 52 10	011	100	REV038	22013	2330-2342 2903-2912 2957-2965 3191-3267 3334
1 52 10	011	103	REV039	24105=24105+30020	2052-2093 2179-2222 2243 3281-3298 3336
1 52 20	001	303	REV041	CODE 0487	2106-2163 2233 2875 2920-2947 3052-3157 3373-3631
1 52 20	002	001	REV034	STD OR (24105+32208)	
1 52 20	001	310	REV036	M: (22707+24105+30368)	2052-2093 2179-2222 2243 3281-3298 3336
1 52 20	002	100	REV034	MOD 24105	
1 52 20	001	406	REV041	20029+22013+22707+30368	2330-2342 2903-2912 2957-2965 3191-3267 3334
1 52 20	002	001	REV034	STD OR (24105+32208)	
1 52 40	001	001	REV023		ALL
1 70 00	001	005	REV041	CFM ALL	ALL
1 70 00	002	005	REV023	CFM ALL	
1 70 10	001	020	REV028	CFM 56-5-B	ALL
1 70 20	001	005	REV023	CFM ALL	2052-2342
1 70 20	002	105	REV024	CODE 0903/CFM ALL	
1 70 20	001	005	REV023	CFM ALL	2875-3631
1 70 20	002	120	REV036	M:30626 CFM ALL	
1 70 20	003	001	REV023		ALL
1 70 20	004	001	REV023		
1 70 20	005	120	REV040	M:32619=33239/ALL CFM	ALL
1 70 20	006	100	REV041	32619=33239=32619+33239/CFM	
1 70 30	001	105	REV023	MOD.22112/CFM ALL	ALL
1 70 30	002	005	REV023	CFM=PW	
1 70 30	003	005	REV023	CFM=PW	ALL
1 70 30	004	105	REV023	24035 CFM/PW	
1 70 30	005	065	REV039	CFM ALL	ALL
1 70 30	006	160	REV039	30368 CFM/PW ALL	
1 70 40	001	005	REV023	CFM ALL	ALL
1 70 40	002	005	REV023	CFM ALL	
1 70 40	003	105	REV034	22238/CFM	ALL
1 70 40	004	005	REV023	CFM ALL	
1 70 40	005	103	REV036	CODE 0812 M CFM	2052-2243 2875 2920-2947 3052-3157 3281-3298 3336-3631
1 70 40	006	005	REV023	CFM ALL	
1 70 40	005	103	REV036	CODE 0812 M CFM	2330-2342 2903-2912 2957-2965 3191-3267 3334
1 70 40	006	105	REV023	MOD.22013/CFM ALL	

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	1	70	40	007	005	REV023	CFM ALL	ALL
	1	70	50	001	005	REV023	CFM ALL	ALL
	1	70	60	001	005	REV023	CFM ALL	ALL
	1	70	60	002	005	REV023	CFM ALL	
	1	70	70	001	005	REV023	CFM ALL	ALL
	1	70	70	002	110	REV031	CODE:0018/CFM	
	1	70	70	003	106	REV028	M:25404/CFM ALL	2052-2243 2875 2920-2947 3052-3157 3281-3298 3336-3631
	1	70	70	003	205	REV028	CODE:0040/CFM	2330-2342 2903-2912 2957-2965 3191-3267 3334
	1	70	80	001	150	REV040	33239=36462/CFM ALL	ALL
	1	70	80	002	005	REV031	CFM	
	1	70	80	003	105	REV036	MOD:32619=33239 CFM ALL	ALL
	1	70	80	004	005	REV023	CFM ALL	
	1	70	80	005	107	REV032	CODE 1306/CFM	ALL
	1	70	80	006	005	REV023	CFM ALL	
	1	70	80	007	107	REV031	CODE 1306/CFM	ALL
	1	70	90	001	005	REV023	CFM ALL	ALL
	1	70	90	002	105	REV036	M:32619=33239 CFM ENG: ALL	
	1	70	90	003	005	REV024	CFM ALL	ALL
	1	70	90	004	005	REV023	CFM ALL	
	1	70	90	005	113	REV036	CODE 0420/CFM	2052-3574
	1	70	90	006	125	REV036	30368/56-5-B	
N	1	70	90	005	113	REV036	CODE 0420/CFM	3631
N	1	70	90	006	210	REV041	30368+34665/56-5-B	
	1	70	90	007	005	REV033	CFM ALL	ALL
	1	70	90	008	148	REV033	22707/CFM 56-5-B	
	1	70	90	009	118	REV033	CODE 0061/CFM ALL	2052-2965
	1	70	90	010	110	REV036	M:30368/CFM	
	1	70	90	009	118	REV033	CODE 0061/CFM ALL	3052-3631
	1	70	90	010	116	REV041	CODE 0506/CFM	
	1	70	90	011	005	REV023	CFM ALL	2052-2965
	1	70	90	012	110	REV036	M:30368/CFM	
	1	70	90	011	005	REV023	CFM ALL	3052-3631
	1	70	90	012	115	REV041	CODE 0506/CFM	
	1	70	90	013	110	REV036	M:24035=24160=24189/CFM	2052-2965
	1	70	90	014	146	REV035	26017=22634+26017/CFM 56-5-B	

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1	70	90	013		250	REV039	CODE 1100 CFM ALL	3052-3631
1	70	90	014		260	REV039	CODE 1101/56-5-B	
1	70	90	015		125	REV041	CODE 1014/CFM	3052-3631
1	70	98	001		001	REV028	STD=M:20165	ALL

M V T	REV	MOD SB	MP	TITLE / VALIDITY
.	037	.....	K4337	INDICATING/RECORDING SYSTEM - NEW LOGIC
		.....		CABIN READY MEMO
				ALL
.	036	.....	K5043	COMMUNICATIONS - CIDS - CABIN CONFIGURATION
		.....		FOR NON-SMOKING FLIGHTS
				VP-BWA VP-BDM VP-BDN
				VP-BDO VP-BWG VP-BDK
				VP-BWD VP-BWE VP-BWF
				VP-BWH VP-BWI VP-BWJ
				VP-BWK VP-BWM VP-BWL
				VP-BWN VP-BWO VP-BWP
.	039	.....	K5070	COMMUNICATIONS - CIDS - DUAL DIAL CODE
		.....		ON HANDSET KEYBOARD (A319/A3
				21)
				VP-BQP VP-BQV VP-BQW
				VP-BRY VP-BRX VP-BRZ
				VP-BQU VP-BKX VP-BKY
				VP-BKC MSN 3574 MSN 3631
.	036	.....	P2878	INDICATING RECORDING SYSTEM - SDAC -
		.....		DEFINE A PIN PROGRAM FOR REAR C.C.
				VENTILATION
				VP-BWA VP-BDM VP-BDN
				VP-BDO VP-BWG VP-BDK
				VP-BWD VP-BWE VP-BWF
				VP-BWH VP-BWI VP-BWJ
				VP-BWK VP-BWM VP-BWL
				VP-BWN VP-BWO VP-BWP
				VP-BQP VP-BQR VP-BQS
				VP-BQV VP-BQW VP-BQX
				VP-BQT VP-BRY VP-BRX
				VP-BRW VP-BUM VP-BUK
				VP-BUN VP-BUP VP-BUO
				VP-BQU VP-BKX VP-BKY
				VP-BKC MSN 3574 MSN 3631
.	037B	.....	P3451	LANDING GEAR - WHEELS AND BRAKES - EXTE
		.....		ND PIN PROGRAMMING FOR STD6 BSC
				U
				VP-BWN VP-BWO VP-BWP

M V T	REV	MOD SB	MP	TITLE / VALIDITY
.	041	.....	P6146	INDICATING/RECORDING SYSTEM - FWC - INTRODUCE "F/CTL FLAP LVR NOT ZERO" RED WARNING
	.....			VP-BWA VP-BDM VP-BDN VP-BDO VP-BWG VP-BDK VP-BWD VP-BWE VP-BWF VP-BWH VP-BWI VP-BWJ VP-BWK VP-BWM VP-BWL VP-BWN VP-BWO VP-BWP VP-BQP VP-BQR VP-BQS VP-BQV VP-BQW VP-BQX VP-BQT VP-BRY VP-BRX VP-BRW VP-BUM VP-BUK VP-BUN VP-BUP VP-BUO VP-BQU VP-BKX VP-BKY VP-BKC MSN 3574 MSN 3631
.	039C	.....	P6911	INDICATING/RECORDING SYSTEM : FROM FWC-F1 PIN-PROGRAMMING FOR IMPROVING THE MONITORING ABOUT THE NORMAL BRAKING SYSTEM
	.....			VP-BQP VP-BQR VP-BQS VP-BQV VP-BQW VP-BQX VP-BQT VP-BRY VP-BRX VP-BRW VP-BUM VP-BUK VP-BUN VP-BUP VP-BUO VP-BQU VP-BKX VP-BKY VP-BKC MSN 3574 MSN 3631
.	036	.....	P7092	INDICATING/RECORDING SYSTEM - EIS - ACTIVATE FUEL FLOW/DELTA ISA FUNCTION BY PIN PROGRAMMING ON DMC
	.....			VP-BWA VP-BDM VP-BDN VP-BDO VP-BWG VP-BDK VP-BWD VP-BWE VP-BWF VP-BWH VP-BWI VP-BWJ VP-BWK VP-BWM VP-BWL VP-BWN VP-BWO VP-BWP VP-BQP VP-BQR VP-BQS VP-BQV VP-BQW VP-BQX VP-BQT VP-BRY VP-BRX VP-BRW VP-BUM VP-BUK VP-BUN VP-BUP VP-BUO VP-BQU VP-BKX VP-BKY VP-BKC MSN 3574 MSN 3631

M V T	REV	MOD SB	MP	TITLE / VALIDITY
.	040D	.....	P8175	INDICATING/RECORDING SYSTEMS - SDAC - ACTIVATE IAS DISCREPANCY MONITORING BY PIN PROGRAMMING
	.....			VP-BQP VP-BQR VP-BQS VP-BQV VP-BQW VP-BQX VP-BQT VP-BRY VP-BRX VP-BRW VP-BUM VP-BUK VP-BUN VP-BUP VP-BUO VP-BQU VP-BKX VP-BKY VP-BKC MSN 3574 MSN 3631
.	040C	.....	P9801	AIR CONDITIONNING - COCKPIT AIR HEATING - INSTALL ADDITIONAL "HEATER" ON THE FOOT AIR OUTLET FOR CAPTAIN & F/O
	.....			VP-BQP VP-BQR VP-BQS VP-BQV VP-BQW VP-BQX VP-BQT VP-BRY VP-BRX VP-BRZ VP-BRW VP-BUM VP-BUK VP-BUN VP-BUP VP-BUO VP-BQU VP-BKX VP-BKY VP-BKC MSN 3574 MSN 3631
.	035A	20024	.....	FUEL- INSTALL A CENTRE TANK SYSTEM-
	.....			ALL
.	036	20029	.....	DOORS- BULK CARGO COMPARTMENT- INSTALL AN ADDITIONAL DOOR AT FR 60/62-
	.....			VP-BDK VP-BWD VP-BWE VP-BWF VP-BWH VP-BWI VP-BWM VP-BWN VP-BWO VP-BWP VP-BQP VP-BQR VP-BQS VP-BQV VP-BQW VP-BQX VP-BQT VP-BRY VP-BRX VP-BRZ VP-BRW VP-BUM VP-BUP VP-BQU VP-BKX VP-BKY VP-BKC MSN 3574 MSN 3631
.	038	20036	.....	COMMUNICATIONS - HF SYSTEM - INSTALL SYSTEM PROVISION FOR A SINGLE SYSTEM -
	.....			ALL
.	038	20037	.....	COMMUNICATIONS - HF SYSTEM - INSTALL A FULL PROVISION FOR A SINGLE SYSTEM -
	.....			ALL

M V T	REV	MOD SB	MP	TITLE / VALIDITY
.	035A	20042	.....	LIGHTS - EXTERNAL LIGHTS - INSTALL LOGO LIGHTS ALL
.	036	20047	.....	EQUIPMENT/FURNISHINGS - FLIGHT COMPARTMENT - INSTALL A 4TH OCCUPANT SEAT - ALL
.	037A	20048	.....	AIR CONDITIONING- FLIGHT COMPARTMENT- INSTALL ELECTRICAL FOOT WARMERS- VP-BWN VP-BWO VP-BWP
.	036	20059	.....	AIR CONDITIONING - CARGO COMPARTMENT - VENTILATION - INSTALL SYSTEM IN AFT COMPARTMENT - ALL
.	035A	20067	.....	FIRE PROTECTION - FWD CARGO COMPARTMENT - INSTALL SMOKE DETECTION SYSTEM - ALL
.	035A	20069	.....	FIRE PROTECTION - AFT CARGO COMPARTMENT - INSTALL SMOKE DETECTION SYSTEM - ALL
.	035A	20071	.....	FIRE PROTECTION - CARGO COMPARTMENT FIRE EXTINGUISHING - INSTALL A SINGLE SHOT SYSTEM - ALL
.	035A	20073	.....	INDICATING/RECORDING SYSTEMS - INSTALL AN AIRCRAFT INTEGRATED DATA SYSTEM - ALL
.	035A	20081	.....	LIGHTS - EXTERIOR LIGHTS - INSTALL SYNCHRONIZED STROBE LIGHTS ALL
.	036	20084	.....	AIR CONDITIONING - AFT CARGO COMPARTMENT - INSTALL HEATING SYSTEM ALL

M V T	REV	MOD SB	MP	TITLE VALIDITY
.	035A	20109	.....	WATER/WASTE- INSTALL VACUUM TOILET SYSTEM - ALL
.	036	20137	.....	COMMUNICATIONS - RADIO MANAGEMENT - INSTALL A 3RD RMP - ALL
.	035A	20167	.....	STRUCTURE - REINFORCE STRUCTURE TO ALLOW MTOW 72T-MLW 63T-MZFW 59T DESIGN WEIGHTS ALL
.	035A	20230	.....	LIGHTS - NAVIGATION LIGHTS - INSTALL A SECOND NAVIGATION LIGHT SYSTEM - ALL
.	035A	20268	.....	WINGS-WING TIP FENCES-INTRODUCE WING TIPS INCLUDING FENCES- ALL
.	035A	20283	.....	COMMUNICATIONS - PROVIDE "HOT MIKE" RECORDING ALL
.	036	20316	.....	NAVIGATION - AIR DATA - INSTALL METRIC ALTIMETER - ALL
.	036	20324	.....	FUEL - COUPLING REFUEL/DEFUEL - ADD COUPLING ON LH WING (72T MTOW A/C) ALL
.	035A	20327	.....	MINOR IMPROVEMENTS INTRODUCED FROM A/C 60 - AS ZONE - ALL
.	036	20406	.....	NAVIGATION - AIR DATA - PROVIDE QFE BARO SETTING ALL
.	035A	20994	.....	LANDING GEAR-WHEELS AND BRAKES-INSTALL BSCU STD5- ALL

M V T	REV	MOD MP SB	TITLE	VALIDITY
.	035A	21003	WATER/WASTE - RELOCATE POTABLE WATER TANK -	VP-BWA VP-BDM VP-BDN VP-BDO VP-BWG VP-BDK VP-BWD VP-BWE VP-BWF VP-BWH VP-BWI VP-BWJ VP-BWK VP-BWM VP-BWL VP-BQP VP-BQV VP-BQW VP-BRY VP-BRX VP-BRZ VP-BUK VP-BUN VP-BUO VP-BQU VP-BKX VP-BKY VP-BKC MSN 3574 MSN 3631
.	035A	21213	ELECTRICAL POWER - DC GENERATION - REVISE "BAT OFF" INDICATION -	ALL
.	035A	21230	ELECTRCIAL POWER - DC - IMPROVE BCL -	ALL
.	035A	21237	APU - INTRODUCE APU MODE 6 AND ASSOCIATED ECB (GARRETT)	ALL
.	035A	21391	NAVIGATION - MODIFY GPWC WARNING -	ALL
.	036	21437	COMMUNICATIONS - INSTALL PA IN USE INDICATORS LIGHT -	ALL
.	035A	21678	ELECTRICAL POWER-AC/DC ESSENTIAL POWER DISTRIBUTION-PROVIDE PROVISIONS FOR ETOPS-	ALL
.	035A	21679	HYDRAULIC POWER-MODIFY ELECTRICAL ROUTING OF GREEN LEAKAGE MEASUREMENT ELECTROVALVE CONTROL	ALL
.	036	21858	COMMUNICATIONS - INSTALL HF1 FOR EROPS	ALL

M V T	REV	MOD SB	MP	TITLE / VALIDITY
.	035A	21964	.....	FLIGHT CONTROLS - ELAC/EFCS SYSTEM - INTRODUCE SOFTWARE L62
	.....			ALL
.	037A	22006	.....	FIRE PROTECTION - INSTALL A SMOKE DETECTION AND FIRE EXTINGUISHING SYSTEM
	.....			VP-BWN VP-BWO VP-BWP
				VP-BQR VP-BQS VP-BQX
				VP-BQT VP-BRW VP-BUM
				VP-BUP
.	037A	22013	.....	FUSELAGE - REAR FUSELAGE SECTION 16A - DEFINE A321 BASIC STRUCTURE
	.....			VP-BWN VP-BWO VP-BWP
				VP-BQR VP-BQS VP-BQX
				VP-BQT VP-BRW VP-BUM
				VP-BUP
.	035A	22089	.....	ENGINE FUEL AND CONTROL - EIU/CFM - INTRODUCE SOFTWARE 11
	.....			ALL
.	035A	22112	.....	MINOR IMPROVEMENTS INTRODUCED FROM A/C 268 - AS ZONE
	.....			ALL
.	035A	22238	.....	ENGINE FUEL AND CONTROL - CFM 56 - INTRODUCE EIU VERSION 12 AND ADDITIONAL WIRING
	.....			ALL
.	035A	22249	.....	AUTO FLIGHT - ACTIVATE WINDSHEAR FUNCTION
	.....			ALL
.	035A	22311	.....	NAVIGATION - TCAS II - INTRODUCE COMPLETE PROVISIONS
	.....			ALL
.	036	22536	.....	NAVIGATION - INSTALL A BENDIX TCAS II COLLISION AVOIDANCE SYSTEM
	.....			ALL
.	035A	22561	.....	FIRE PROTECTION - LAVATORY SMOKE DETECTION - INTRODUCE AMBIENT SYSTEM
	.....			ALL

M V T	REV	MOD MP SB	TITLE	VALIDITY
.	035A	22567	EQUIPMENT/FURNISHINGS - EMERGENCY EQUIPMENT - INTRODUCE PBE DRAEGER IN THE COCKPIT	ALL
.	035A	22634	INDICATING/RECORDING SYSTEMS - CENTRAL WARNING SYSTEM - DEFINE STD FWC FOR A321	ALL
.	035A	22706	INDICATING/RECORDING SYSTEMS - CENTRAL WARNING SYSTEM - INSTALL SDAC A320/321 STANDARD	ALL
.	035A	22707	INDICATING RECORDING SYSTEMS - EIS - DEFINE COF A STANDARD FOR A320/A321 DMC	ALL
.	035A	22769	NAVIGATION - GPWS - INSTALL GPWC MARK V WITH INTERFACE WITH CFDS	ALL
.	036	22875	ICE AND RAIN PROTECTION - ICE DETECTION - INSTALL DUAL ADVISORY ICE DETECTION SYSTEM	ALL
.	035A	22941	EQUIPMENT/FURNISHINGS - COCKPIT SEATS - INTRODUCE TYPE A340 SEATS	ALL
.	035A	23119	HYDRAULIC POWER-BLUE MAIN HYDRAULIC POWER-IMPROVE MAINTENANCE STATUS OF BLUE HYDRAULIC RESERVOIR	VP-BWA VP-BDM VP-BDN VP-BDO VP-BWG VP-BDK VP-BWD VP-BWE VP-BWF VP-BWH VP-BWI VP-BWJ VP-BWK VP-BWM VP-BWL VP-BQP VP-BQV VP-BQW VP-BRY VP-BRX VP-BRZ VP-BUK VP-BUN VP-BUO VP-BQU VP-BKX VP-BKY VP-BKC MSN 3574 MSN 3631

M V T	REV	MOD SB	MP	TITLE / VALIDITY
.	035A	23124	.....	AIR CONDITIONING - PRESSURIZATION CONTROL - IMPROVE CONTROLLER TO ENABLE USE OF EXTERNAL MODE ALL
.	035A	23208	.....	LANDING GEAR - WHEELS AND BRAKES - INTRODUCE BSCU STD 6 ALL
.	041	23219	.....	NAVIGATION-AIR DATA/INERTIAL REFERENCE SYSTEM (ADIRS)-INSTALL 4 MCU ADIRS HONEYWELL VP-BWN VP-BWO VP-BWP VP-BQR VP-BQS VP-BQX VP-BQT VP-BRW VP-BUM VP-BUP
.	035A	23344	.....	AIR CONDITIONING - IMPROVE CABIN PRESSURIZATION CONTROL ON 25VU PANEL. ALL
.	035A	23577	.....	EQUIPMENT/FURNISHINGS-COCKPIT SEATS- INTRODUCE ADDITIONAL BONDING STRIP ON FOURTH CREW MEMBER'S SEAT ALL
.	035A	23585	.....	AUTO FLIGHT - FCU - INTRODUCE FCU M-9 STD ALL
.	035A	23642	.....	LIGHTS - COCKPIT ILLUMINATION - INTRODUCE IMPROVED COCKPIT LIGHTING ALL
.	035A	23672	.....	NAVIGATION - ADIRS - INSTALL LITTON 4MCU ON A321 A/C VP-BWA VP-BDM VP-BDN VP-BDO VP-BWG VP-BWJ VP-BWK VP-BWL VP-BWN VP-BWO VP-BWP VP-BQR VP-BQS VP-BQX VP-BQT VP-BRW VP-BUM VP-BUK VP-BUN VP-BUP VP-BUO

M V T	REV	MOD SB	MP	TITLE / VALIDITY
.	035A	23742	.....	AUTO FLIGHT - FCU - INTRODUCE FCU STANDARD M10
		.....		ALL
.	035A	23795	.....	HYDRAULIC POWER - INDICATING - REMOVE SENSOR AND ASSOCIATED WIRING FOR BLUE RESERVOIR INDICATION
				VP-BWA VP-BDM VP-BDN
				VP-BDO VP-BWG VP-BWJ
				VP-BWK VP-BWL VP-BWN
				VP-BWO VP-BWP VP-BQR
				VP-BQS VP-BQX VP-BQT
				VP-BRW VP-BUM VP-BUK
				VP-BUN VP-BUP VP-BUO
.	035A	23839	.....	FIRE PROTECTION - DETECTION - INTRODUCE MODIFIED ENGINE AND APU FIRE PANEL
		.....		ALL
.	035A	24035	.....	INDICATING/RECORDING SYSTEMS - GENERAL- DEFINE CPIP3
		.....		ALL
.	037A	24044	.....	LANDING GEAR - WHEELS AND BRAKES - INSTALL MESSIER GOODRICH WHEELS AND BRAKES ON A321
		.....		VP-BWN VP-BWO VP-BWP
				VP-BQR VP-BQS VP-BQX
				VP-BQT VP-BRW VP-BUM
				VP-BUP
.	035A	24064	.....	AUTO FLIGHT-FMS-INTRODUCE FMGC A320/321 B1 STD WITH OPTIONS AND 400 KILOWORDS FOR CFM 56 VERSIONS
		.....		ALL
.	035A	24077	.....	LANDING GEAR - BSCU - TWIN WHEEL - INTRODUCE A320/A321 STD 6 VERSION 60C
		.....		ALL
.	035A	24084	.....	AUTO FLIGHT - A320/A321 FOR IAE AND CFM ENGINES - INSTALL WIRING PROVISION FOR ENERGY MANAGEMENT ACTIVATION
		.....		ALL

M V T	REV	MOD SB	MP	TITLE / VALIDITY
.	035A	24105	.....	FUSELAGE - REAR FUSELAGE - ADAPT SECTION 17/19 STRUCTURE TO A319 DEFINITION VP-BWA VP-BDM VP-BDN VP-BDO VP-BWG VP-BWJ VP-BWK VP-BWL VP-BUK VP-BUN VP-BUO
.	035A	24139	.....	AIR CONDITIONING - COCKPIT AND CABIN TEMPERATURE CONTROL - INTRODUCE ZONE TEMPERATURE CONTROLLER -03 ALL
.	035A	24215	.....	AUTO FLIGHT - FAC - INSTALL TWO FACS P/N BAM 0509 ALL
.	036	24251	.....	POWER PLANT - A320 - CFM 56 - INSTALL DERATED ENGINES CFM 56-B4 VP-BDK VP-BWD VP-BWE VP-BWF VP-BWH VP-BWI VP-BWM VP-BQP VP-BQV VP-BQW VP-BRY VP-BRX VP-BRZ VP-BQU VP-BKX VP-BKY VP-BKC MSN 3574 MSN 3631
.	035A	24287	.....	INDICATING/RECORDING SYSTEMS - CFDR - INTRODUCE CFDIU STD -7 ALL
.	035A	24351	.....	INDICATING/RECORDING SYSTEMS - ELECTRICAL CLOCK - INSTALL A CLOCK SMITHS TYPE 2610 ALL
.	035A	24449	.....	LANDING GEAR - A320/A321 TWIN WHEELS - INTRODUCE BSCU STANDARD 7 (70B VERSION) ALL
.	035A	24511	.....	FLIGHT CONTROLS -S.E.C. SYSTEM INTRODUCE A320/A321 S.E.C STANDARD P/N BAM0508 ALL

M V T	REV	MOD SB	MP	TITLE / VALIDITY
.	035A	24588	.....	AUTO FLIGHT-FAC-INTRODUCE FAC P/N BAM 510 ALL
.	040	24692	.....	NAVIGATION - PREDICTIVE WINDSHEAR (RADAR) WIRING PROVISION ALL
.	035A	24745	.....	FLIGHT CONTROLS-SEC SYSTEM-"PARTIAL LIFT DUMPING" FUNCTION ACTIVATION ALL
.	040	24748	.....	NAVIGATION-SWITCHING AND INDICATING- INTRODUCE RMI/VOR/DME SEXTANT WITH MODIFIED SOFTWARE ALL
.	036	24785	.....	NAVIGATION-ADIRS-INTRODUCE 4MCU ADIRU HONEYWELL P/N C06 VP-BDK VP-BWD VP-BWE VP-BWF VP-BWH VP-BWI VP-BWM VP-BWN VP-BWO VP-BWP VP-BQP VP-BQR VP-BQS VP-BQV VP-BQW VP-BQX VP-BQT VP-BRY VP-BRX VP-BRZ VP-BRW VP-BUM VP-BUP VP-BQU VP-BKX VP-BKY VP-BKC MSN 3574 MSN 3631
.	035A	24805	.....	PNEUMATIC-ENGINE BLEED AIR SUPPLY- INTRODUCE A BLEED AIR MONITORNG COMPUTER STD6 ALL
.	035A	24851	.....	ICE AND RAIN PROTECTION-ICE DETECTION- PROVIDE ICE DETECTOR ILLUMINATION ALL
.	035A	24932	.....	POWER PLANT-INSTALL CFM 56-5B5 ENGINES FOR A319 (22 KLBS) VP-BWA VP-BDM VP-BDN VP-BDO VP-BWG VP-BWJ VP-BWK VP-BWL VP-BUK VP-BUN VP-BUO

M V T	REV	MOD SB	MP	TITLE / VALIDITY
.	040	25058	.....	NAVIGATION-WEATHER- RADAR SYSTEM- INHIBIT PREDICTIVE WINDSHEAR FUNCTION ALL
.	035A	25184	.....	NAVIGATION-TCAS-INSTALL ATC/TCAS CONTROL PANEL SEXTANT P/N 04-AA01. ALL
.	036	25225	.....	AUTO FLIGHT-FMGC-REDUCE VAPP FOR A320 CFM/IAE VP-BDK VP-BWD VP-BWE VP-BWF VP-BWH VP-BWI VP-BWM VP-BQP VP-BQV VP-BQW VP-BRY VP-BRX VP-BRZ VP-BQU VP-BKX VP-BKY VP-BKC MSN 3574 MSN 3631
.	035A	25293	.....	INDICATING/RECORDING SYSTEM - INSTALL A PORTABLE DATA LOADER CONNECTOR AND DISK STOWAGE ALL
.	036	25294	.....	NAVIGATION - ADIRS - INSTALL HONEYWELL ADIRS CAPABLE OF A319 A/C VP-BWA VP-BDM VP-BDN VP-BDO VP-BWG VP-BWJ VP-BWK VP-BWL VP-BUK VP-BUN VP-BUO
.	035A	25295	.....	AUTOFLIGHT - FMGC - ACTIVATE ACARS INTERFACE IN FMS (CFM AND IAE ENGINES) ALL
.	036	25296	.....	FLIGHT CONTROLS - FCDC SYSTEM - PROVIDE A VISUAL INDICATION FOR SIMULTANEOUS SIDE STICK ACTION ALL
.	035A	25345	.....	AUTOFLIGHT-FCU-INTRODUCE F.C.U. STANDARD M11 ALL

M V T	REV	MOD SB	MP	TITLE / VALIDITY
.	035A	25381	.....	AUTOFLIGHT - FMGC - ACTIVATE PRINTER INTERFACE IN FMS (CFM AND IAE ENGINES) ALL
.	035A	25404	.....	EXHAUST-THRUST REVERSER CONTROL AND INDICATING-ACTIVATE ADDITIONAL THRUST REVERSER LOCK CONTROL ALL
.	035A	25409	.....	INDICATING RECORDING SYSTEMS-DMC- INTRODUCE D.M.C. V31 STANDARD ALL
.	035A	25419	.....	ICE AND RAIN PROTECTION-WINDSHIELD RAIN PROTECTION-DESACTIVATION OF RAIN REPELLENT SYSTEM ALL
.	035A	25440	.....	NAVIGATION - GENERAL - CHANGE EQUIPMENTS TO COMPLY WITH MARCH 95 SPECS. ALL
.	039	25480	.....	NAVIGATION - R.M.I. - INSTALL VOR/ADF/DDRMI (SEXTANT) P/N 63543-253-2 VP-BWI VP-BWJ VP-BWK VP-BWM VP-BWL VP-BWN VP-BWO VP-BWP VP-BQP VP-BQR VP-BQS VP-BQV VP-BQW VP-BQX VP-BQT VP-BRY VP-BRX VP-BRZ VP-BRW VP-BUM VP-BUK VP-BUN VP-BUP VP-BUO VP-BQU VP-BKX VP-BKY VP-BKC MSN 3574 MSN 3631
.	036	25529	.....	NAVIGATION - WEATHER RADAR SYSTEM - ACTIVATE PREDICTIVE WINDSHEAR FUNCTION VP-BWA VP-BDM VP-BDN VP-BDO VP-BWG VP-BDK VP-BWD VP-BWE VP-BWF VP-BWH VP-BWI VP-BWJ VP-BWK VP-BWM VP-BWL VP-BWN VP-BWO VP-BWP

M V T	REV	MOD SB	MP	TITLE / VALIDITY
.	036	25538	.....	ENGINE FUEL AND CONTROL-CONTROLLING- INTRODUCE ECU SOFTWARE-STANDARD 5BE-1 FOR CFM56-5B (SAC ENGINES)
		.....		ALL
.	036	25590	.....	INDICATING/RECORDING SYSTEMS - FWC - DEFINE OEB REMINDER WITHIN FWC STD -E1 AND SUBSEQUENT
		.....		ALL
.	039	25819	.....	NAVIGATION - WEATHER RADAR SYSTEM - ACTIVATE DUAL PREDICTIVE WINDSHEAR FUNCTION
		.....		VP-BQP VP-BQR VP-BQS VP-BQV VP-BQW VP-BQX VP-BQT VP-BRY VP-BRX VP-BRZ VP-BRW VP-BUM VP-BUK VP-BUN VP-BUP VP-BUO VP-BQU VP-BKX VP-BKY VP-BKC MSN 3574 MSN 3631
.	035A	25863	.....	AUTO FLIGHT - FCU - DEFINE FLIGHT DIRECTOR ENGAGEMENT IN CROSSED BARS AT GO AROUND
		.....		ALL
.	036	25888	.....	A.P.U.-POWER PLANT-INTRODUCE ALLIED SIGNAL APU 131-9(A)
		.....		ALL
.	036	25893	.....	ENGINE FUEL AND CONTROL-CONTROLLING INTRODUCE ECU SOFTWARE STD5 BH FOR CFM56-5B -SAC-
		.....		ALL
.	035A	25999	.....	ELECTRICAL POWER-DC GENERATION- MODIFY TRANSFORMER RECTIFIER OVERHEAT PROTECTION
		.....		ALL
.	036	26001	.....	NAVIGATION-ADIRS-INTRODUCE HONEYWELL 4 MCU P/N AC09
		.....		ALL

M V T	REV	MOD SB	MP	TITLE / VALIDITY
.	035A	26017	.....	INDICATING/RECORDING SYSTEMS-FLIGHT WARNING COMPUTER (FWC)-INTRODUCE FWC ST2 E2 ALL
.	035A	26018	.....	INDICATING/RECORDING SYSTEMS-DISPLAY MANAGEMENT COMPUTER (DMC)-INTRODCUE DMC V32 STD ALL
.	039	26088	.....	DOORS EMERGENCY ESCAPE SLIDE RELEASE & OVERPRESS. WARNING SYSTEMS-MODIFY CTRL LOGIC OF THE OVERPRESS. WARNING SYST ALL
.	039	26117	.....	NAVIGATION - WEATHER RADAR SYSTEM - ACTIVATE COLLINS DUAL PREDICTIVE WINDSHEAR SYSTEM VP-BQP VP-BQR VP-BQS VP-BQV VP-BQW VP-BQX VP-BQT VP-BRY VP-BRX VP-BRZ VP-BRW VP-BUM VP-BUK VP-BUN VP-BUP VP-BUO VP-BQU VP-BKX VP-BKY VP-BKC MSN 3574 MSN 3631
.	035A	26169	.....	COM-CVR-INSTALL A SOLID STATE COCKPIT VOICE RECORDER (SSCVR) LORAL FAIRCHILD P/N 200-0012-00 (SFE) ALL
.	036	26194	.....	NAVIGATION - WEATHER RADAR SYSTEM - ALLIED SIGNAL CONFIGURATION AND FULL PROVISION FOR A SECOND TRANSCEIVER ALL
.	035A	26203	.....	COMMUNICATIONS - SSCVR - INSTALL SSCVR ALLIED SIGNAL P/N 980-6022-001 ALL
.	035A	26250	.....	WATER/WASTE-TOILET SYSTEM-INTRODUCE MODIFIED TOILET ASSY ALL

M V T	REV	MOD SB	MP	TITLE / VALIDITY
.	036	26274	.....	NAVIGATION - ADF - INSTALL A SECOND ADF RECEIVERS
	.....			ALL
.	035A	26275	.....	NAVIGATION-WEATHER RADAR SYSTEM- INSTALL FULL PROVISION FOR 2ND TRANSCEIVER
	.....			ALL
.	036	26335	.....	FLIGHT CONTROLS-GENERAL- DELETION OF L.A.F. FEATURE FROM A320 A/C (SERIAL SOLUTION)
	.....			VP-BDK VP-BWD VP-BWE VP-BWF VP-BWH VP-BWI VP-BWM VP-BQP VP-BQV VP-BQW VP-BRY VP-BRX VP-BRZ VP-BQU VP-BKX VP-BKY VP-BKC MSN 3574 MSN 3631
.	035A	26358	.....	AUTOFLIGHT-FLIGHT CONTROL UNIT- (FCU) INTRODUCE SEXTANT MODULAR FCU
	.....			ALL
.	037A	26359	.....	POWER PLANT-GENERAL-INTRODUCE CFM 56-5B3 ENGINE RATED AT 33OK LBS
	.....			VP-BWN VP-BWO VP-BWP VP-BQR VP-BQS VP-BQX VP-BQT VP-BRW VP-BUM VP-BUP
.	035A	26363	.....	AIR CONDITIONING-AIR COOLING SYSTEM- INTRODUCE MODIFIED RAM AIR OUTLET
	.....			ALL
.	035A	26497	.....	AUTO FLIGHT-GENERAL-ACTIVATE GLOBAL SPEED PROTECTION AND F/D DISENGAGEMENT UPON SPEED CONSTRAINTS
	.....			ALL
.	035A	26526	.....	NAVIGATION - GPWS - ACTIVATE ENHANCED FUNCTIONS OF THE EGPWS
	.....			ALL

M V T	REV	MOD SB	MP	TITLE / VALIDITY
.	036	26540	.....	INDICATING/RECORDING SYSTEMS - FWC - PROVIDE NEW SYNTHETIC VOICE "DUAL INPUT" ALL
.	039	26560	.....	NAVIGATION - WEATHER RADAR SYSTEM - INSTALL COLLINS SINGLE WEATHER RADAR WITH FULL PROVISION FOR A SECOND SYS VP-BQP VP-BQR VP-BQS VP-BQV VP-BQW VP-BQX VP-BQT VP-BRY VP-BRX VP-BRZ VP-BRW VP-BUM VP-BUK VP-BUN VP-BUP VP-BUO VP-BQU VP-BKX VP-BKY VP-BKC MSN 3574 MSN 3631
.	036	26621	.....	COMMUNICATIONS - CIDS - RELOCATE PA IN USE LIGHT IN COCKPIT ALL
.	036	26670	.....	NAVIGATION - ATC - INSTALL GABLES ATC/TCAS CONTROL PANEL P/N G6990-40 ALL
.	036	26923	.....	OXYGEN-PASSENGER OXYGEN-INTRODUCE MODIFIED CHEMICAL OXYGEN CONTAINER (DRAEGER) P/N -0004 ALL
.	039	26925	.....	LANDING GEAR-ALTERNATE BRAKING- INTRODUCE MODIFIED ALTERNATE BRAKING SYSTEM VP-BQP VP-BQR VP-BQS VP-BQV VP-BQW VP-BQX VP-BQT VP-BRY VP-BRX VP-BRZ VP-BRW VP-BUM VP-BUK VP-BUN VP-BUP VP-BUO VP-BQU VP-BKX VP-BKY VP-BKC MSN 3574 MSN 3631
.	035A	26963	.....	ICE AND RAIN PROTECTION-WINSHIELD RAIN PROTECTION-ACTIVATION OF RAIN REPELLENT SYS.(FLUID COMPATIBLE WITH OZONE RULES) ALL

M V T	REV	MOD SB	MP	TITLE / VALIDITY
.	038	26965	.....	LANDING GEAR-WHEELS AND BRAKES- INTRODUCE BSCU COMMON STD VP-BWA VP-BDM VP-BDN VP-BDO VP-BWG VP-BDK VP-BWD VP-BWE VP-BWF VP-BWH VP-BWI VP-BWJ VP-BWK VP-BWM VP-BWL VP-BQP VP-BQV VP-BQW VP-BRY VP-BRX VP-BRZ VP-BUK VP-BUN VP-BUO VP-BQU VP-BKX VP-BKY VP-BKC MSN 3574 MSN 3631
.	035A	26968	.....	AUTO FLIGHT-FMGC-INTRODUCE FMGC CAM0102 FOR A319 AUTOLAND AND GPS/ACARS FOR CFM ENGINES ALL
.	035A	26999	.....	NAVIGATION - MMR - INSTALL COLLINS MMR PROVIDING ILS AND GPS FUNCTION ALL
.	035A	27014	.....	HYDRAULIC POWER-AUXILIARY HYDRAULIC POWER-INTRODUCE MODIFIED SUNDSTRAND RAM AIR TURBINE ALL
.	036	27140	.....	ELECTRICAL POWER-GENERAL-DEFINE NEW ELECTRICAL GENERATION CONCEPT FOR SINGLE AISLE A/C ALL
.	036	27189	.....	HYDRAULIC POWER - AUXILIARY HYDRAULIC POWER - INSTALL A319 RAM AIR TURBINE ON A320 VP-BDK VP-BWD VP-BWE VP-BWF VP-BWH VP-BWI VP-BWM VP-BQP VP-BQV VP-BQW VP-BRY VP-BRX VP-BRZ VP-BQU VP-BKX VP-BKY VP-BKC MSN 3574 MSN 3631

M V T	REV	MOD SB	MP	TITLE / VALIDITY
.	036	27255	.....	OXYGEN - PASSENGER OXYGEN SYSTEM - INTRODUCE OXYGEN CONTAINER DRAGER P/N -0003 ALL
.	035A	27256	.....	AUTO FLIGHT - MULTIPURPOSE CONTROL AND DISPLAY UNIT (MCDU) - INTRODUCE MCDU HONEYWELL 2ND GENERATION (P/N -980) ALL
.	035A	27276	.....	FLIGHT CONTROLS-ELAC SYSTEM-INTRODUCE ELAC SOFTWARE "L80" ALL
.	035A	27285	.....	NAVIGATION-ATC MODE"S"-INTRODUCE ATC/TCAS CONTROL UNIT P/N C12404AB02 ALL
.	035A	27320	.....	INFORMATION SYSTEM-AIR TRAFFIC AND INFO MANAGEMENT SYS(ATIMS)-COCKPIT-INTRODUCE SYS PROVISIONS FOR FANS "A"(ATSU-2DCDU) ALL
.	035A	27330	.....	INDICATING/RECORDING SYSTEMS - ELECTRICAL CLOCK- INSTALL AIR PRECISION P/N APE5100-1 CAPABLE OF GPS TIME ALL
.	035A	27498	.....	ELECTRICAL POWER - GENERAL - AC-DC MAIN DISTRIBUTION - INSTALL AC-DC SHEDDABLE BUSBARS ALL
.	035A	27522	.....	INFORMATION SYSTEM - AIR TRAFFIC AND INFORMATION SYSTEM (ATIMS) - INSTALL ATSU COMPUTER FOR ACARS ALL
.	035A	27572	.....	OXYGEN-PASSENGER OXYGEN-INTRODUCE MODIFIED CHEMICAL OXYGEN CONTAINER -15 MIN- PURITAN ALL

M V T	REV	MOD SB	MP	TITLE / VALIDITY
.	040A	27620	.....	NAVIGATION-STANDBY DATA : ALTITUDE AND HEADING - INSTALL INTEGRATED STANDBY INSTRUMENT SYSTEM (ISIS) VP-BUM VP-BUK VP-BUN VP-BUP VP-BUO VP-BQU VP-BKX VP-BKY VP-BKC MSN 3574 MSN 3631
.	036	27698	.....	NAVIGATION - TCAS - INSTALL ALLIED SIGNAL TCAS COMPUTER P/N 066-50000-2220 (WITH CHANGE 7.0) ALL
.	035A	27993	.....	AIR CONDITIONING - PACK COOLING AIR CONTROL - INTRODUCE LOGIC RELAY FOR CONTROL PACK CLOSURE AT ENGINE START ALL
.	035A	27997	.....	INDICATING/RECORDING SYSTEMS-CFDS- INTRODUCE A COMBINED FDIU/DMU ALL
.	036	28160	.....	ELEC PWR-AC EMERGENCY GENERATION- ACTIVATE A319/A321 ELECTRICAL EMERGENCY CONFIGURATION ON A320 A/C VP-BDK VP-BWD VP-BWE VP-BWF VP-BWH VP-BWI VP-BWM VP-BQP VP-BQV VP-BQW VP-BRY VP-BRX VP-BRZ VP-BQU VP-BKX VP-BKY VP-BKC MSN 3574 MSN 3631
.	035A	28218	.....	NAVIGATION-ADIRS-INTRODUCE LITTON ADIRU 4 MCU STD-312 VP-BWA VP-BDM VP-BDN VP-BDO VP-BWG VP-BWJ VP-BWK VP-BWL VP-BWN VP-BWO VP-BWP VP-BQR VP-BQS VP-BQX VP-BQT VP-BRW VP-BUM VP-BUK VP-BUN VP-BUP VP-BUO

M V T	REV	MOD SB	MP	TITLE / VALIDITY
.	035A	28244	.....	NAVIGATION-GPWS-INTRODUCE EGPWS P/N 206-206 AND INHIBIT AUTOMATIC DEACTIVATION ENHANCED FUNCTIONS ALL
.	036	28293	.....	NAVIGATION - WEATHER RADAR SYSTEM - REINSTALL A SINGLE WEATHER RADAR CONFIGURATION VP-BWA VP-BDM VP-BDN VP-BDO VP-BWG VP-BDK VP-BWD VP-BWE VP-BWF VP-BWH VP-BWI VP-BWJ VP-BWK VP-BWM VP-BWL VP-BWN VP-BWO VP-BWP VP-BQP VP-BQR VP-BQS VP-BQV VP-BQW VP-BQX VP-BQT VP-BRY VP-BRX VP-BRZ VP-BRW VP-BUM VP-BUP VP-BQU VP-BKX VP-BKY VP-BKC MSN 3574 MSN 3631
.	035A	28308	.....	INDICATING RECORDING SYSTEM-DMC- INTRODUCE DMC V40 STANDARD ALL
.	036	28369	.....	INDICATING/RECORDING SYSTEMS - DMC - DISPLAY ALTITUDE IN METRIC UNITS ON THE PRIMARY FLIGHT DISPLAY (PFD) ALL
.	036	28479	.....	INDICATING RECORDING SYSTEM-FWC- INTRODUCE FWC STANDARD H2/E3P ALL
.	035A	28482	.....	LANDING GEAR-NOSE LANDING GEAR WHEELS-REMOVE RUBBING STRIPS ALL
.	036	28558	.....	ICE AND RAIN PROTECTION-ICE DETECTION- INTRODUCE ICE DETECTOR P/N 0871 DP4 ALL

M V T	REV	MOD SB	MP	TITLE / VALIDITY
.	040	28658	.....	NAV-STANDBY DATA: ATT AND HDG-INTRODUCE COMPLETE PROV FOR INTEGRATED STANDBY INSTRUMENT SYSTEM ELECTRICAL SUPPLY VP-BRY VP-BUM VP-BUK VP-BUN VP-BUP VP-BUO VP-BQU VP-BKX VP-BKY VP-BKC MSN 3574 MSN 3631
.	040C	31-1257	28916	INDICATING RECORDING SYSTEM-FWS INTRODUCE FWC STANDARD H1PE3P VP-BWA VP-BDM VP-BDN VP-BDO VP-BWG VP-BDK VP-BWD VP-BWE VP-BWF VP-BWH VP-BWI VP-BWJ VP-BWK VP-BWM VP-BWL VP-BWN VP-BWO VP-BWP
.	037A	.....	30051	ELECTRICAL POWER-GALLEY SUPPLY- INSTALL A RELAY FOR GALLEY SHEEDING IN A SINGLE GENERATION CONFIGURATION VP-BWN VP-BWO VP-BWP VP-BQR VP-BQS VP-BQX VP-BQT VP-BRW VP-BUM VP-BUP
.	035A	.....	30062	LANDING GEAR-PARKING/ULTIMATE EMERGENCY BRAKING-INTRODUCE A PRESSURE SWITCH ALL
.	036	.....	30339	EQUIPMENT/FURNISHINGS-ELEC SERVICE SUPPLY-DEFINE A PC POWER SYSTEM PROVIDING 110V/60HZ - VENDOR KID ALL
.	038	.....	30365	INDICATING RECORDING SYSTEM-SDAC- INTRODUCE STANDARD SDAC P/N 350E5500202 ALL
.	036	.....	30368	INDICATING RECORDING SYSTEMS- EIS-INSTALL DMC, DU AND DISKETTES FOR EIS2 ALL

M V T	REV	MOD SB	MP	TITLE / VALIDITY
.	036	30470	.....	EQPT/FURNISHINGS - MISCELLANEOUS EMER EQPT - INSTALL SEXTANT ELT WITH CONTROL PANEL IN COCKPIT AND PROGRAMMING DONGLE
		.....		VP-BWA VP-BDM VP-BDN
				VP-BDO VP-BWG VP-BDK
				VP-BWD VP-BWE VP-BWF
				VP-BWH VP-BWI VP-BWJ
				VP-BWK VP-BWM VP-BWL
				VP-BWN VP-BWO VP-BWP
.	038	30622	.....	INDICATING/RECORDING SYSTEMS-CFDIU- INTRODUCE CFDIU STANDARD 9B
		.....		ALL
.	039	30626	.....	AIR CONDITIONING-AIR COOLING- INSTALL A NEW ECS
		.....		VP-BQP VP-BQR VP-BQS
				VP-BQV VP-BQW VP-BQX
				VP-BQT VP-BRY VP-BRX
				VP-BRZ VP-BRW VP-BUM
				VP-BUK VP-BUN VP-BUP
				VP-BUO VP-BQU VP-BKX
				VP-BKY VP-BKC MSN 3574
				MSN 3631
.	036	30660	.....	INDICATING/RECORDING SYSTEMS - FWC - INSTALL FWC STANDARD H2E4
		.....		ALL
.	039D	30748	.....	GENERAL-FLIGHT ENVIRONMENTAL ENVELOPE- EXTENSION TO 12100 M (39800 FT)
		.....		ALL
.	037A	30977	.....	FLIGHT CONTROLS - ELAC SYSTEM - INTRODUCE ELAC SOFTWARE "L90"
		.....		VP-BWN VP-BWO VP-BWP
				VP-BQP VP-BQR VP-BQS
				VP-BQV VP-BQW VP-BQX
				VP-BQT VP-BRY VP-BRX
				VP-BRZ VP-BRW VP-BUM
				VP-BUK VP-BUN VP-BUP
				VP-BUO VP-BQU VP-BKX
				VP-BKY VP-BKC MSN 3574
				MSN 3631

M V T	REV	MOD SB	MP	TITLE / VALIDITY
.	039	31040	.....	AUTO-FLIGHT - FLIGHT AUGMENTATION COMPUTER (FAC) - INTRODUCE FAC SOFTWARE "BAM0616"
	.....			VP-BQP VP-BQR VP-BQS VP-BQV VP-BQW VP-BQX VP-BQT VP-BRY VP-BRX VP-BRZ VP-BRW VP-BUM VP-BUK VP-BUN VP-BUP VP-BU0 VP-BQU VP-BKX VP-BKY VP-BKC MSN 3574 MSN 3631
.	037A	31070	.....	NAVIGATION-ADIRS-INSTALL LITTON ADIRU 4 MCU STANDARD 0314 (A318 COEFF CFM ADDED)
	.....			VP-BWN VP-BW0 VP-BWP VP-BQR VP-BQS VP-BQX VP-BQT VP-BRW VP-BUM VP-BUK VP-BUN VP-BUP VP-BU0
.	037	31215	.....	COMMUNICATIONS-RADIO MANAGEMENT- INTRODUCE NEW RMP STANDARD 2A P/NO. C12848CA01
	.....			ALL
.	037	31216	.....	COMMUNICATIONS-RADIO MANAGEMENT-INSTALL A THIRD RADIO MANAGEMENT PANEL
	.....			ALL
.	037A	31265	.....	LIGHTS-EMERGENCY LIGHTING-MODIFY EPSU LOAD DISTRIBUTION FOR A321
	.....			VP-BWN VP-BW0 VP-BWP VP-BQR VP-BQS VP-BQX VP-BQT VP-BRW VP-BUM VP-BUP

M V T	REV	MOD SB	MP	TITLE / VALIDITY
.	035A	31266	.....	LIGHTS-EMERGENCY LIGHTING-MODIFY EPSU LOAD DISTRIBUTION FOR A319/A320 VP-BWA VP-BDM VP-BDN VP-BDO VP-BWG VP-BDK VP-BWD VP-BWE VP-BWF VP-BWH VP-BWI VP-BWJ VP-BWK VP-BWM VP-BWL VP-BQP VP-BQV VP-BQW VP-BRY VP-BRX VP-BRZ VP-BUK VP-BUN VP-BUO VP-BQU VP-BKX VP-BKY VP-BKC MSN 3574 MSN 3631
.	039	31283	.....	INDICATING RECORDING SYSTEM-FWC-
	31-1257			INTRODUCE FWC STANDARD H2 F1 ALL
.	036	31286	.....	COMMUNICATIONS-HF SYSTEM-ACTIVATE DATA LINK FUNCTION FOR HFDR1 ALL
.	036	31367	.....	NAVIGATION-GPWS-ACTIVATE PEAKS MODE ON EGPWS IN CONJUNCTION WITH TERRAIN DISPLAY ALL
.	035A	31371	.....	INFORMATION SYSTEMS-ATIMS-DEFINE AND INSTALL MODIFIED SOTFWARE ATSU A/C INTERFACE UPGRADED ALL
.	037	31375	.....	NAVIGATION - EGPWS - ACTIVATE OBSTACLE OPTION ON THE EGPWS ALL
.	035A	31395	.....	FLIGHT CONTROLS - ELAC SYSTEM - INTRODUCE ELAC STD L81 ALL
.	036	31426	.....	NAVIGATIONS-EGPWS-ACTIVATE GEOMETRIC ALTITUDE FUNCTION IN THE EGPWS ALL

M V T	REV	MOD SB	MP	TITLE / VALIDITY
.	039	31459	.....	OXYGEN - OXYGEN DISTRIBUTION - INSTALL FOURTH OXYGEN MASK EROS WITH ASSOCIATED BOX VP-BQP VP-BQR VP-BQS VP-BQV VP-BQW VP-BQX VP-BQT VP-BRY VP-BRX VP-BRZ VP-BRW VP-BUM VP-BUK VP-BUN VP-BUP VP-BUO VP-BQU VP-BKX VP-BKY VP-BKC MSN 3574 MSN 3631
.	036	31495	.....	INDICATING/RECORDING SYSTEM-EIS2-INSTALL MODIFIED EIS2 SOFTWARE ALL
.	035A	31891	.....	ELECTRICAL POWER-GENERAL-CHANGE IFE POWER SUPPLY BUSBARS INTO SHEDDABLE BUSBARS 220XP AND 212PP ALL
.	035A	31896	.....	AUTOFLIGHT-FMGC-INSTALL FMGC CFM C13042AA01 (EQUIPPED WITH FMS2) HONEYWELL ALL
.	036	32007	.....	NAVIGATION-ATC-INSTALL REMOTE ATC BOX VP-BWH VP-BWI VP-BWJ VP-BWK VP-BWM VP-BWL VP-BWN VP-BWO VP-BWP
.	039A	32087	.....	COMMUNICATIONS-ANTI HIJACK CAMERA MONITORING-INSTALL A COCKPIT DOOR SURVEILLANCE SYSTEM VP-BQP VP-BQV VP-BQW VP-BRY VP-BRX VP-BRZ VP-BKX
.	035A	32088	.....	EQUIPMENT FURNISHINGS-CURTAINS AND PARTITIONS-MODIFIED INTRUSION AND PENETRATION RESISTANT COCKPIT DOOR ALL

M V T	REV	MOD SB	MP	TITLE / VALIDITY
.	035A	32090	.....	DOORS-PASSENGER COMPARTMENT FIXED INTERIOR DOORS-INSTALL ELECTRICAL COCKPIT DOOR RELEASE SYSTEM ALL
.	039	32205	.....	INDICATING RECORDING SYSTEM-SDAC INSTALL WIRING PROVISIONS FOR SDAC H2-E1 PIN PROGRAMMING ALL
.	037	32494	.....	INFORMATION SYSTEMS-ATIMS-ATSU PROVIDE ATSU A/C INTERFACE SOFTWARE CSB 3.2C CAPABLE OF VDL MODE 2 ALL
.	037	32496	.....	INFORMATION SYSTEMS-ATIMS-ATSU ACTIVATE VDL MODE 2 FUNCTION IN THE ATSU ALL
.	037	32526	.....	COMMUNICATIONS-AUDIO MANAGEMENT-INSTALL ACP WITH A NEW FRONT FACE DESIGN TO COMPLY WITH"LS"FUNCTIONS(PROD.SOLUTION) ALL
.	035A	32600	.....	AUTO FLIGHT - FLIGHT MANAGEMENT AND GUIDANCE SYSTEM - ACTIVATE FMA ENHANCEMENT FUNCTION ALL
.	036	32619	.....	ENGINE FUEL AND CONTROL - FADEC SYSTEM INTRODUCE NEW FADEC SOFTWARE "5BK" ON SAC CFM56-5B ENGINES ALL
.	039	32650	.....	FUEL - QUANTITY INDICATION - INTRODUCE FUEL LEAK DETECTION VP-BRV VP-BRX VP-BRZ VP-BUK VP-BUN VP-BUO VP-BQU VP-BKX VP-BKY VP-BKC MSN 3574 MSN 3631

M V T	REV	MOD SB	MP	TITLE / VALIDITY
.	040	32651 28-1150 01	.....	FUEL-QUANTITY INDICATION-REMOVE FUEL LEAK DETECTION FUNCTION ASSOCIATED WITH FQIC 13-9 (ANTI-MOD FOR MOD 32650) VP-BQP VP-BQV VP-BQW VP-BRY VP-BRX VP-BRZ VP-BUK VP-BUN VP-BUO VP-BQU VP-BKX VP-BKY VP-BKC MSN 3574 MSN 3631
.	039	33100	.....	COMMUNICATIONS-CIDS-INTRODUCE ENHANCED CIDS (A318 VERSION) AND RELATED SYSTEMS ON SINGLE AISLE FAMILY VP-BQP VP-BQR VP-BQS VP-BQV VP-BQW VP-BQX VP-BQT VP-BRY VP-BRX VP-BRZ VP-BRW VP-BUM VP-BUK VP-BUN VP-BUP VP-BUO VP-BQU VP-BKX VP-BKY VP-BKC MSN 3574 MSN 3631
.	037	33239	.....	ENGINE FUEL AND CONTROL - FADEC SYSTEM - INSTALL "5BL" STANDARD ECU SOFTWARE FOR CFM56-5B ENGINES (A318 CAPABLE) ALL
.	037A	33253	.....	NAVIGATION - WEATHER RADAR SYSTEM - INSTALL HONEYWELL DUAL CONTROL UNIT CAPABLE OF AUTO-TILT FUNCTION VP-BWN VP-BWO VP-BWP VP-BQP VP-BQR VP-BQS VP-BQV VP-BQW VP-BQX VP-BQT VP-BRY VP-BRX VP-BRZ VP-BRW VP-BUM VP-BUK VP-BUN VP-BUP VP-BUO VP-BQU VP-BKX VP-BKY VP-BKC MSN 3574 MSN 3631

M V T	REV	MOD SB	MP	TITLE / VALIDITY
.	039	33299	.....	AUTO FLIGHT - FLIGHT AUGMENTATION COMPUTER - INSTALL FAC STANDARD BAM0617 FOR A318
		.....		VP-BQP VP-BQR VP-BQS
				VP-BQV VP-BQW VP-BQX
				VP-BQT VP-BRY VP-BRX
				VP-BRZ VP-BRW VP-BUM
				VP-BUK VP-BUN VP-BUP
				VP-BUO VP-BQU VP-BKX
				VP-BKY VP-BKC MSN 3574
				MSN 3631
.	037	33376	.....	LANDING GEAR - NORMAL BRAKING -
		32-1261		INSTALL BSCU STD L4.5
				ALL
.	040E	33497	.....	NAVIGATION - STANDBY DATA: ATTITUDE AND
		.....		HEADING - REPLACE THALES ISIS BY THE 3
				CONVENTIONAL STANDBY INSTRUMENTS
				VP-BUM VP-BUK VP-BUN
				VP-BUP VP-BUO VP-BQU
				VP-BKX VP-BKY VP-BKC
				MSN 3574 MSN 3631
.	040A	33503	.....	NAVIGATION - DDRMI -
		.....		REMOVE DDRMI VOR/ADF/DME INDICATORS
				VP-BUM VP-BUK VP-BUN
				VP-BUP VP-BUO VP-BQU
				VP-BKX VP-BKY VP-BKC
				MSN 3574 MSN 3631
N	041D	33777	.....	EQUIPMENT/FURNISHINGS-CURTAINS AND
		.....		PARTITIONS-INSTALL DEADBOLT ON CENTER
				LATCH OF REINFORCED COCKPIT DOOR
				VP-BKC MSN 3574
.	039	33907	.....	INDICATING/RECORDING SYSTEMS - FWC -
		31-1266 02		INTRODUCE IAS DISCREPANCY AND DUAL
				PITOT MONITORING ON FWC H2F1
				ALL

M V T	REV	MOD SB	MP	TITLE / VALIDITY
.	039	34207	.....	NAVIGATION-TCAS-INSTALL A NEW HONEYWELL TCAS TPA 100 CHANGE 7.0 WITH COLLINS ATC TPR901 OR HNWL TRA67A VP-BQP VP-BQR VP-BQS VP-BQV VP-BQW VP-BQX VP-BQT VP-BRY VP-BRX VP-BRZ VP-BRW VP-BUM VP-BUK VP-BUN VP-BUP VP-BU0 VP-BQU VP-BKX VP-BKY VP-BKC MSN 3574 MSN 3631
N	041D	34429	.....	NAVIGATION - STANDBY DATA: INTEGRATED STANDBY INSTRUMENT SYSTEM (ISIS) - INSTALL ISIS STANDARD VA01 MSN 3574 MSN 3631
.	039	34571 31A1220 01	.....	INDICATING/RECORDING SYSTEMS-ELECTRONIC INSTRUMENT SYSTEM(EIS)- INSTALL DISPLAY MANAGEMENT COMPUTER SOFTWARE EIS2 S4-2 ALL
.	039	34573 22-1168 01	.....	AUTO FLIGHT - FLIGHT MANAGEMENT AND GUIDANCE COMPUTER (FMGC)-INSTALL FMS2 HONEYWELL P1C11 ON A/C WITH CFMI PPS VP-BWA VP-BDM VP-BDN VP-BDO VP-BWG VP-BDK VP-BWD VP-BWE VP-BWF VP-BWH VP-BWI VP-BWJ VP-BWK VP-BQP VP-BQR VP-BQS VP-BQV VP-BQW VP-BQX VP-BQT VP-BRY VP-BRX VP-BRZ VP-BRW VP-BUM VP-BUK VP-BUN VP-BUP VP-BU0 VP-BQU VP-BKX VP-BKY VP-BKC MSN 3574 MSN 3631
.	039	34634	.....	NAVIGATION - EGPWS - INSTALL EGPWC CAPABLE OF PEAKS/OBSTACLE FUNCTIONS WITH EIS1 & USING GPS LATERAL POSITION ALL

M V T	REV	MOD SB	MP	TITLE / VALIDITY
N	041D	34665	.....	INDICATING/RECORDING SYSTEM - ELECTRONIC INSTRUMENT SYSTEM (EIS)- ACTIVATE ENGINE AVAIL DISPLAY MSN 3631
.	039	34673	.....	AIR CONDITIONING - PRESSURE CONTROL AND MONITORING - INSTALL RPCU AND WIRING PROVISIONS FOR RPWS VP-BQP VP-BQR VP-BQS VP-BQV VP-BQW VP-BQX VP-BQT VP-BRY VP-BRX VP-BRZ VP-BRW VP-BUM VP-BUK VP-BUN VP-BUP VP-BUO VP-BQU VP-BKX VP-BKY VP-BKC MSN 3574 MSN 3631
.	038	34783	.....	NAVIGATION - ATC/MODE S - DEACTIVATE RATC FUNCTION VP-BWN VP-BWO VP-BWP
.	039	34825	.....	NAVIGATION- GPWS - USE LATERAL GPS POSITION WITH AUTOMATIC DESELECTION VP-BQP VP-BQR VP-BQS VP-BQV VP-BQW VP-BQX VP-BQT VP-BRY VP-BRX VP-BRZ VP-BRW VP-BUM VP-BUK VP-BUN VP-BUP VP-BUO VP-BQU VP-BKX VP-BKY VP-BKC MSN 3574 MSN 3631
.	039	34869	46-1015 01	INFORMATION SYSTEMS - ATIMS - UPGRADE ATSU A/C INTERFACE SOFTWARE FOR FANS A+ CSB4.1 IMPLEMENTATION VP-BWA VP-BDO VP-BWD VP-BWE VP-BWF VP-BQP VP-BQR VP-BQS VP-BQV VP-BQW VP-BQX VP-BQT VP-BRY VP-BRX VP-BRZ VP-BRW VP-BUM VP-BUK VP-BUN VP-BUP VP-BUO VP-BQU VP-BKX VP-BKY VP-BKC MSN 3574 MSN 3631

M V T	REV	MOD SB	MP	TITLE / VALIDITY
.	039A	35000	.....	COMMUNICATIONS - ANTI HIJACK CAMERA MONITORING - REPLACE CDSS LCD/SYSTEM CONTROLLER VP-BQP VP-BQV VP-BQW VP-BRY VP-BRX VP-BRZ VP-BKX
N	041D	35137	.....	EQUIPMENT/FURNISHINGS - CURTAINS AND PARTITIONS - MODIFY DEADBOLT FOR REINFORCED COCKPIT DOOR VP-BKC MSN 3574
.	041	35216	.....	LANDING GEAR - NORMAL BRAKING - INSTALL BSCU STD L4.8 (EM2) VP-BQP VP-BQR VP-BQS VP-BQV VP-BQW VP-BQX VP-BQT VP-BRY VP-BRX VP-BRZ VP-BRW VP-BUM VP-BUK VP-BUN VP-BUP VP-BUO VP-BQU VP-BKX VP-BKY VP-BKC MSN 3574 MSN 3631
.	039D	35220	.....	INDICATING/RECORDING SYSTEMS - FLIGHT WARNING COMPUTER (FWC) - INSTALL FWC STANDARD H2F3 VP-BRY VP-BRX VP-BRZ VP-BRW VP-BUM VP-BUK VP-BUN VP-BUP VP-BUO VP-BQU VP-BKX VP-BKY VP-BKC MSN 3574 MSN 3631
.	039D	35240	.....	NAVIGATION - ATC/MODE S (SELECT) - CERTIFY EHS FUNCTION ALL
		34-1369 01		

M V T	REV	MOD SB	MP	TITLE / VALIDITY
.	039	35436	.....	EQUIPMENT/FURNISHINGS - MISC. EMERGENCY EQUIPMENT-INSTALL ELT(406AF) WITH PROG. DONGLE AND RCP IN COCKPIT - THALES VP-BQP VP-BQR VP-BQS VP-BQV VP-BQW VP-BQX VP-BQT VP-BRY VP-BRX VP-BRZ VP-BRW VP-BUM VP-BUK VP-BUN VP-BUP VP-BUO VP-BQU VP-BKX VP-BKY VP-BKC MSN 3574 MSN 3631
.	039D	35485	.....	INDICATING/RECORDING SYSTEM-ELECTRONIC INSTRUMENT SYSTEM (EIS)-INSTALL DISPLAY MANAGEMENT COMPUTER SOFTWARE EIS2 S6-1 VP-BRY VP-BRX VP-BRZ VP-BRW VP-BUM VP-BUK VP-BUN VP-BUP VP-BUO VP-BQU VP-BKX VP-BKY VP-BKC MSN 3574 MSN 3631
.	041	35536	.....	NAVIGATION - STANDBY DATA: INTEGRATED STANDBY INSTRUMENT SYSTEM (ISIS) - INSTALL ISIS STD WB01 VP-BUM VP-BUK VP-BUN VP-BUP VP-BUO VP-BQU VP-BKX VP-BKY VP-BKC MSN 3574 MSN 3631
.	039D	35538	.....	AUTOFLIGHT-MULTIPURPOSE CONTROL AND DISPLAY UNIT (MCDU) - INSTALL HONEYWELL LCD MCDU VP-BQP VP-BQR VP-BQS VP-BQV VP-BQW VP-BQX VP-BQT VP-BRY VP-BRX VP-BRZ VP-BRW VP-BUM VP-BUK VP-BUN VP-BUP VP-BUO VP-BQU VP-BKX VP-BKY VP-BKC MSN 3574 MSN 3631

M V T	REV	MOD SB	MP	TITLE / VALIDITY
.	040A	35550	.....	PNEUMATIC - ENGINE BLEED AIR SUPPLY SYSTEM - INSTALL BMC STD 9 CAPABLE OF A318 PW VP-BUM VP-BUK VP-BUN VP-BUP VP-BUO VP-BQU VP-BKX VP-BKY VP-BKC MSN 3574 MSN 3631
.	039	35555	.....	NAVIGATION - WEATHER RADAR SYSTEM - REMOVE WXR TRANSCEIVER COLLINS -623 AND DEACTIVATE PWS (ANTI-MOD 32740/26560) VP-BQP VP-BQR VP-BQS VP-BQV VP-BQW VP-BQX VP-BQT VP-BRY VP-BRX VP-BRZ VP-BRW VP-BUM VP-BUK VP-BUN VP-BUP VP-BUO VP-BQU VP-BKX VP-BKY VP-BKC MSN 3574 MSN 3631
.	041	35793	.....	NAVIGATION - ADIRU - INSTALL HONEYWELL ADIRU P/N HG2030-AE23 VP-BRY VP-BRX VP-BRZ VP-BUM VP-BUK VP-BUN VP-BUP VP-BUO VP-BQU VP-BKX VP-BKY VP-BKC MSN 3574 MSN 3631
.	039	35864	.....	AIRBORNE AUXILIARY POWER - GENERAL - INSTALL APIC APS3200 APU AS STANDARD (REPLACES HONEYWELL GTCP36-300) VP-BQP VP-BQR VP-BQS VP-BQV VP-BQW VP-BQX VP-BQT VP-BRY VP-BRX VP-BRZ VP-BRW VP-BUM VP-BUK VP-BUN VP-BUP VP-BUO VP-BQU VP-BKX VP-BKY VP-BKC MSN 3574 MSN 3631

M V T	REV	MOD SB	MP	TITLE / VALIDITY
.	040A	35865 46-1018 02	.....	INFORMATION SYSTEMS - GENERAL - CERTIFY FANS B CONFIGURATIONS VP-BWA VP-BDO VP-BWD VP-BWE VP-BWF VP-BQX VP-BQT VP-BRZ VP-BRW VP-BUM VP-BUK VP-BUN VP-BUP VP-BUO VP-BQU VP-BKX VP-BKY VP-BKC MSN 3574 MSN 3631
.	039A	36043	.....	LIGHTS- EMERGENCY LIGHTING- DEFINE FLOOR MOUNTED LUFTHANSA TECHNIK 900 SERIES EEPMS VP-BQP VP-BQR VP-BQS VP-BQV VP-BQW VP-BQX VP-BQT VP-BRY VP-BRX VP-BRZ VP-BRW VP-BUM VP-BUK VP-BUN VP-BUP VP-BUO VP-BQU VP-BKX VP-BKY VP-BKC MSN 3574 MSN 3631
.	041	36368 32-1305	.....	LANDING GEAR - NORMAL BRAKING - INSTALL BSCU STD L4.8 (EM2) - BY SB ONLY VP-BDN VP-BDO VP-BWG VP-BDK VP-BWE VP-BWH VP-BWI VP-BWJ VP-BWK VP-BWM VP-BWN VP-BWO VP-BWP
N	041D	36427	.....	AUTO-FLIGHT-MULTIPURPOSE CONTROL AND DISPLAY UNIT(MCDU) - ACTIVATE BACK-UP NAV FUNCTION MSN 3574 MSN 3631
.	040	36462	.....	ENGINE FUEL AND CONTROL - FADEC SYSTEM- INSTALL "5BM" STANDARD ECU SOFTWARE FOR CFM 56-5B ENGINES VP-BQR VP-BQS VP-BQV VP-BQW VP-BQX VP-BQT VP-BRY VP-BRX VP-BRZ VP-BRW VP-BUM VP-BUK VP-BUN VP-BUP VP-BUO VP-BQU VP-BKX VP-BKY VP-BKC MSN 3574 MSN 3631

M V T	REV	MOD SB	MP	TITLE / VALIDITY
.	040B	36725	.....	INDICATING/RECORDING SYSTEMS-ELECTRONIC INSTRUMENT SYSTEM(EIS)-INSTALL DISPLAY MANAGEMENT COMPUTER SOFTWARE EIS2 S7 VP-BRY VP-BRX VP-BRZ VP-BRW VP-BUM VP-BUK VP-BUN VP-BUP VP-BUO VP-BQU VP-BKX VP-BKY VP-BKC MSN 3574 MSN 3631
.	040C	37317	.....	ELECTRICAL POWER - AC ESSENTIAL GENERATION SWITCHING - INSTALL AUTO SWITCHING SYSTEM FOR AC AND DC ESS BUS VP-BRZ VP-BRW VP-BUM VP-BUK VP-BUN VP-BUP VP-BUO VP-BQU VP-BKX VP-BKY VP-BKC MSN 3574 MSN 3631
.	041	37329	.....	LIGHTS - INSTRUMENT AND PANEL INTEGRAL LIGHTING- ENSURE EMERGENCY LIGHTING FOR STAND-BY INSTRUMENTS (WITH ISIS PROV) VP-BUM VP-BUK VP-BUN VP-BUP VP-BUO VP-BQU VP-BKX VP-BKY VP-BKC MSN 3574 MSN 3631
.	041	37330	.....	LIGHTS- INSTRUMENT AND PANEL INTEGRAL LIGHTING- ENSURE EMERGENCY LIGHTING FOR STAND-BY INSTRUMENTS -WITHOUT ISIS PROV VP-BRZ VP-BRW
.	040D	37331	.....	WINGS - FIXED PARTITION - INTRODUCE A STANDARD OF BOX WITHOUT DRY BAY VP-BUK VP-BUN VP-BUO VP-BQU VP-BKX VP-BKY VP-BKC MSN 3574 MSN 3631
N	041D	37444	.....	AUTO FLIGHT - FLIGHT AUGMENTATION COMPUTER - INTRODUCE TAIL STRIKE INDICATION ON PFD FOR A320 AND A321 A/C MSN 3574 MSN 3631
N	041D	37445	.....	AUTO FLIGHT - FLIGHT AUGMENTATION COMPUTER- INTRODUCE TAIL STRIKE "PITCH-PITCH" CALL-OUT FOR A320 AND A321 A/C MSN 3574 MSN 3631

M V T	REV	MOD SB	MP	TITLE	VALIDITY
.	041	37589	.....	NAVIGATION - RADIO MAGNETIC INFORMATION SWITCHING AND INDICATING - RE-INSTALL THALES DDRMI VOR/DME INDICATORS	VP-BUM VP-BUK VP-BUN VP-BUP VP-BUO VP-BQU VP-BKX VP-BKY VP-BKC MSN 3574 MSN 3631

20.00 CONTENTS

20.10 INTRODUCTION

20.20 GENERAL ARRANGEMENT

– PRINCIPAL DIMENSIONS 1
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– ANTENNAS LOCATION 2
– GROUND MANEUVERING 3
– GROUND SERVICE CONNECTIONS AND PANELS 4

GENERAL

The A320 is a subsonic, medium-range, civil transport aircraft.

ENGINES

The aircraft has 2 high bypass turbofan engines, mounted under the wings.

COCKPIT

The cockpit is arranged for a 2 member crew. It also has a place for 2 observers.

CABIN

The passenger seating layout may be varied to suit operating requirements. The certificated maximum is 180 seats.

CARGO

There are 2 cargo compartments under the cabin floor.

GENERAL

The A321 is a subsonic, medium-range, civil transport aircraft.

ENGINES

The aircraft has two high bypass turbofan engines mounted under the wings.

COCKPIT

The cockpit is designed for a two-member crew. It also has a place for 2 observers.

CABIN

The passenger seating layout may vary, depending on operating requirements. The certified maximum is 220 seats.

CARGO

Two cargo compartments are under the cabin floor.

GENERAL

The A319 is a subsonic, medium-range, civil transport aircraft.

ENGINES

The aircraft has two high bypass turbofan engines mounted under the wings.

COCKPIT

The cockpit is designed for a two-member crew. It also has a place for 2 observers.

CABIN

The passenger seating layout may vary, depending on operating requirements. The certified maximum is 145 seats.

CARGO

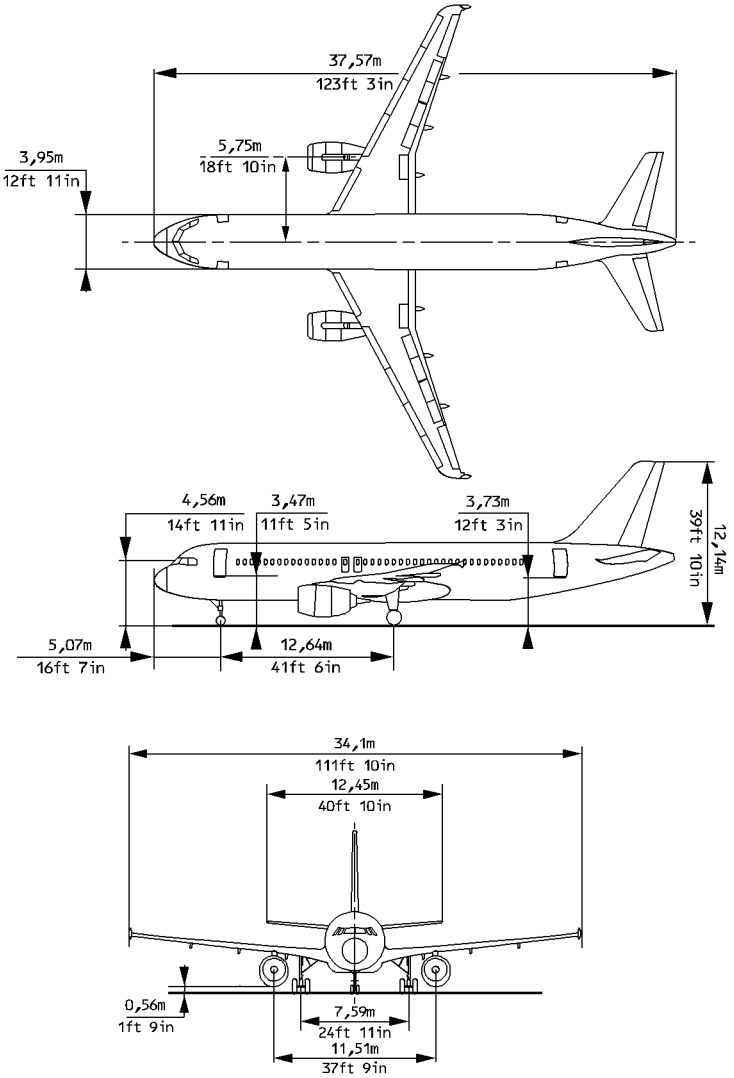
Two cargo compartments are under the cabin floor.

GENERAL ARRANGEMENT

This subchapter gives the principal aircraft dimensions, location of unpressurized areas, antennas, ground service connections, and ground maneuvering characteristics.

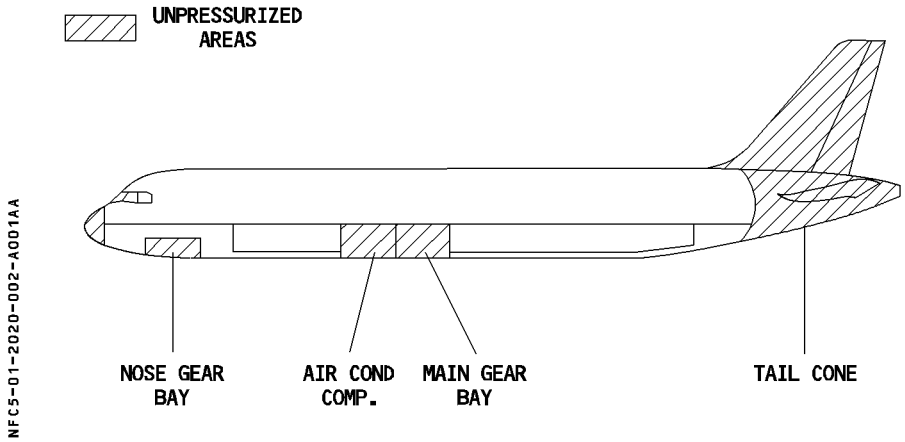
PRINCIPAL DIMENSIONS

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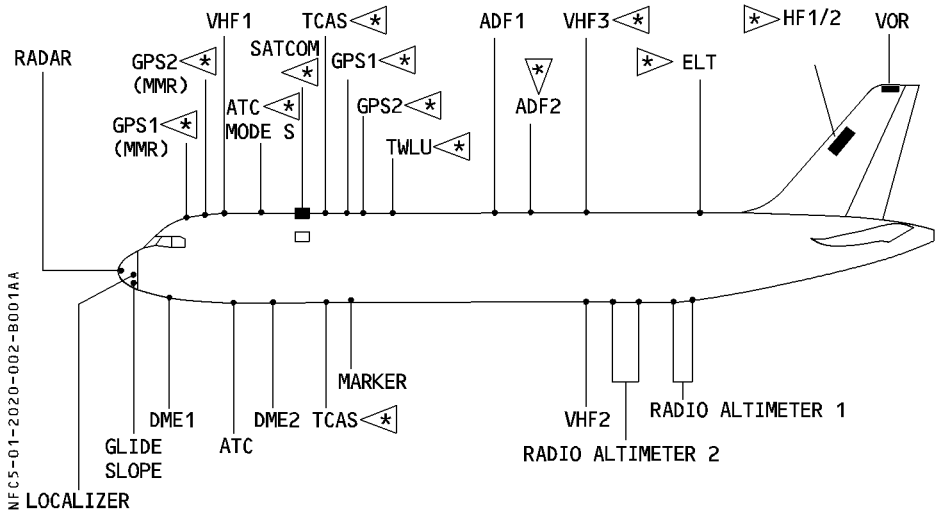
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UNPRESSURIZED COMPARTMENTS



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ANTENNA LOCATIONS

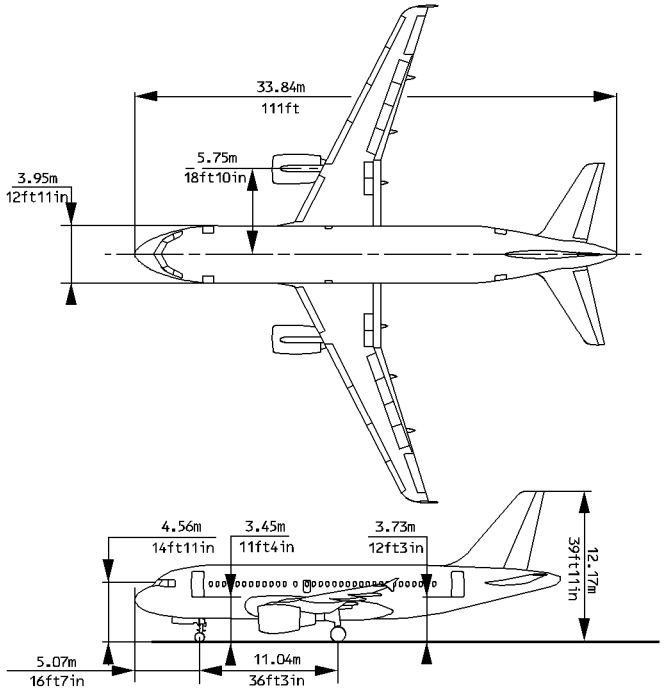


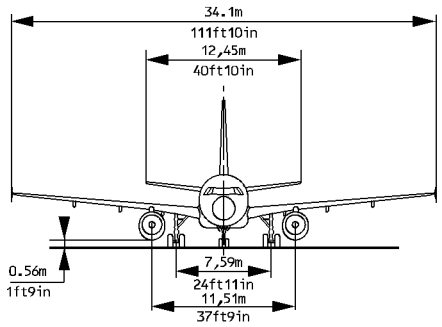
GENERAL ARRANGEMENT

This subchapter gives the principal aircraft dimensions, location of unpressurized areas, antennas, ground service connections, and ground maneuvering characteristics.

PRINCIPAL DIMENSIONS

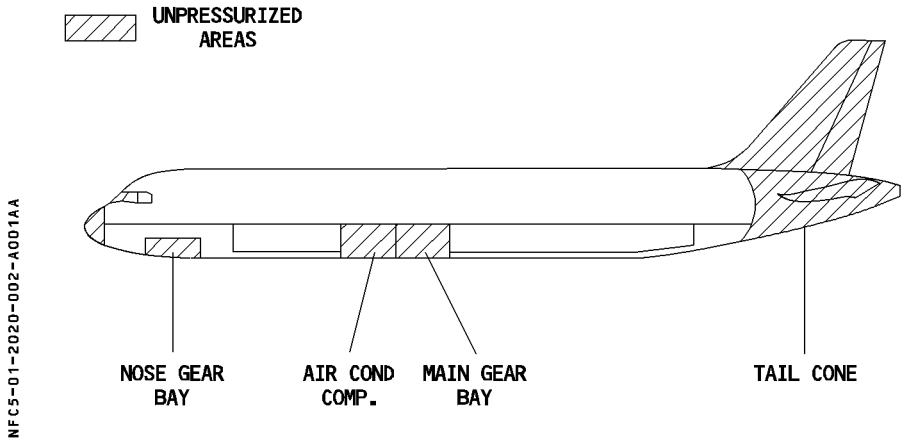
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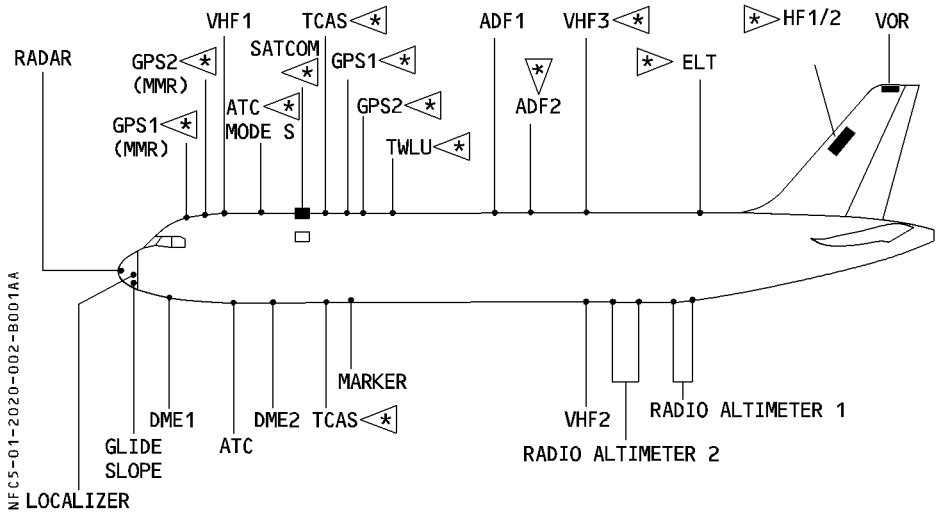
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UNPRESSURIZED COMPARTMENTS



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ANTENNA LOCATIONS

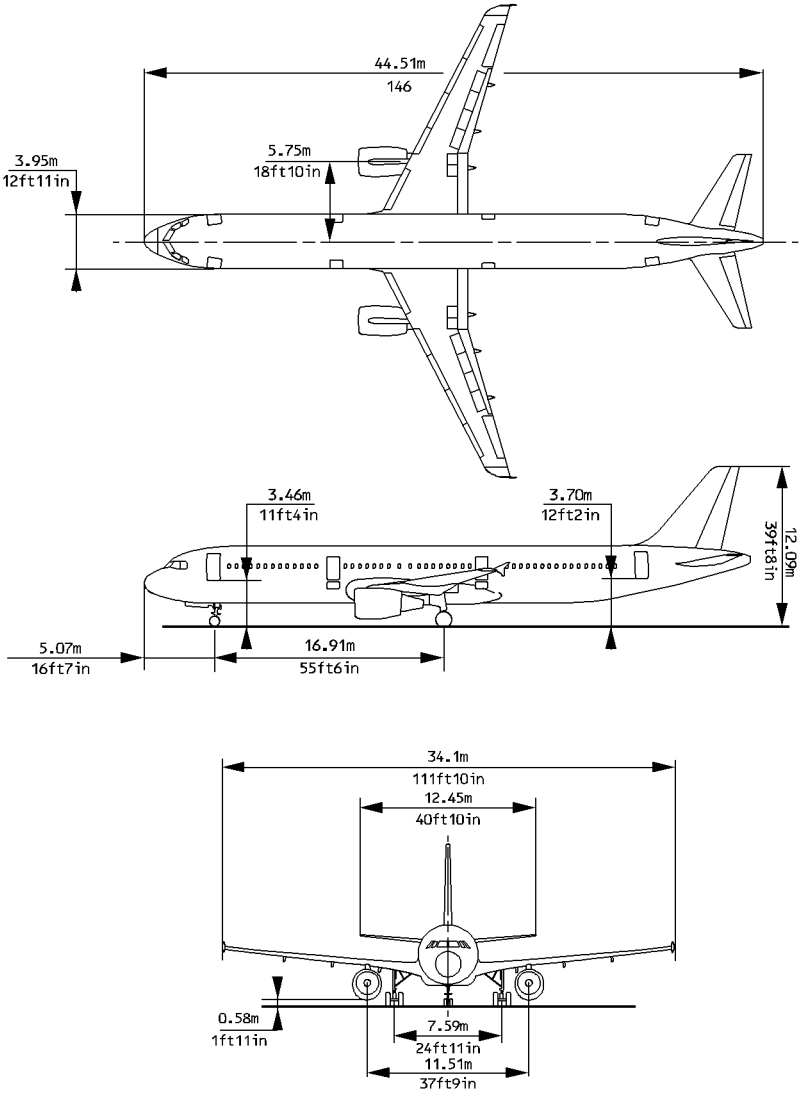


GENERAL ARRANGEMENT

This subchapter gives the principal aircraft dimensions, and location of unpressurized areas, antennas, ground service connections and ground maneuvering characteristics.

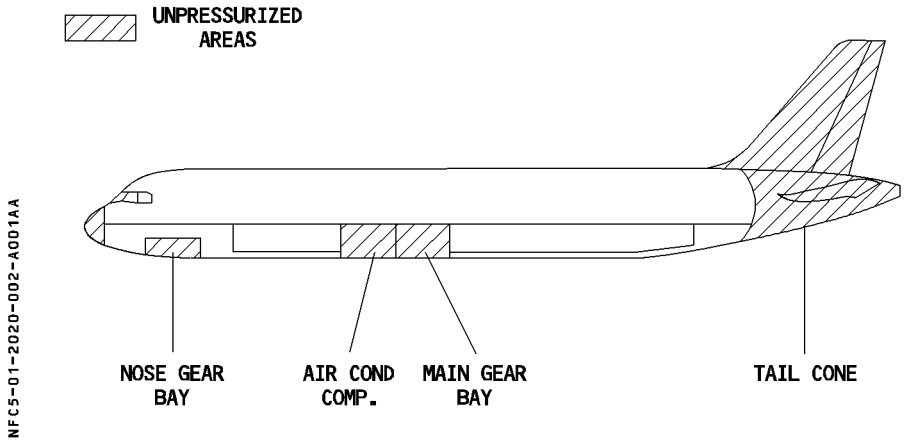
PRINCIPAL DIMENSIONS

R



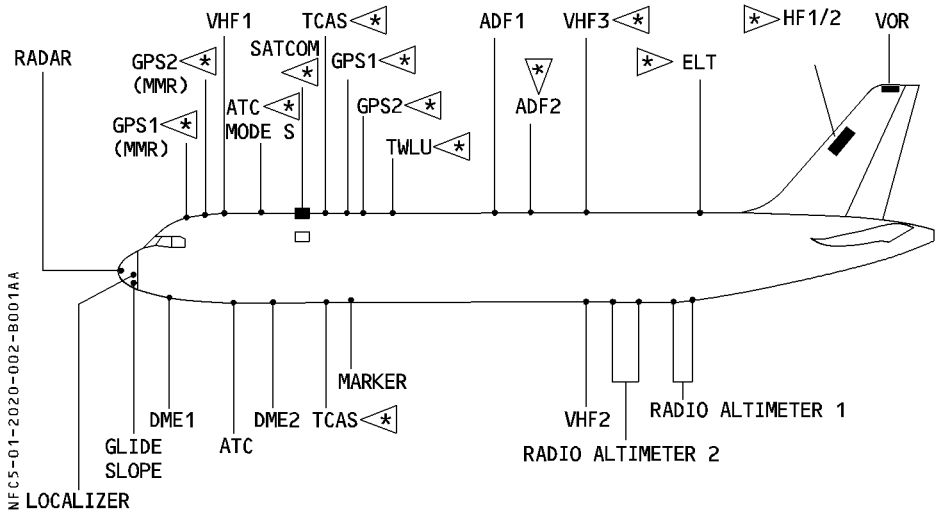
NFC5-01-2020-001-A103AA

UNPRESSURIZED COMPARTMENTS



R

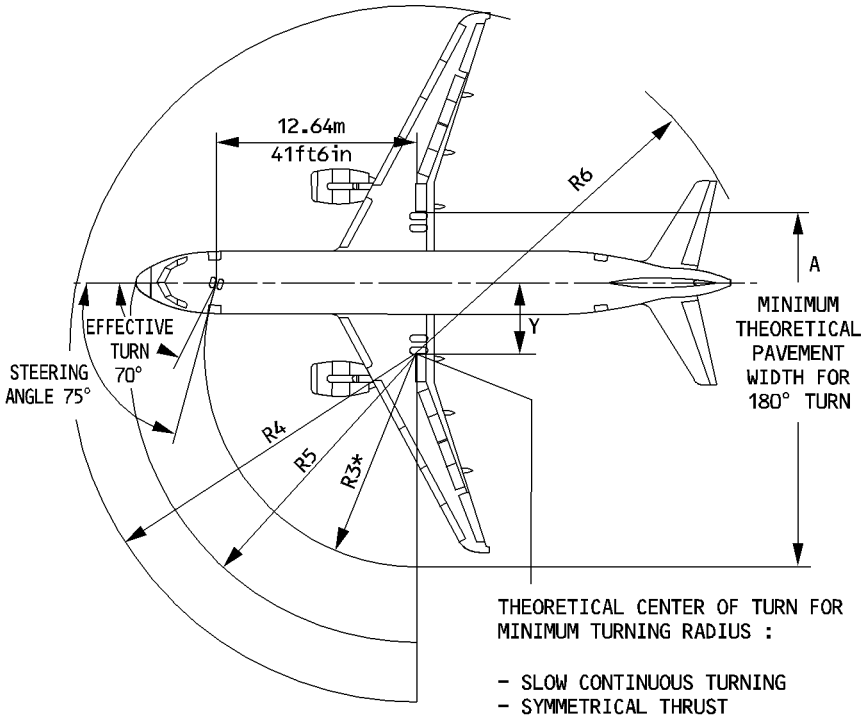
ANTENNA LOCATIONS



GROUND MANEUVERING

R

MINIMUM TURNING RADIUS

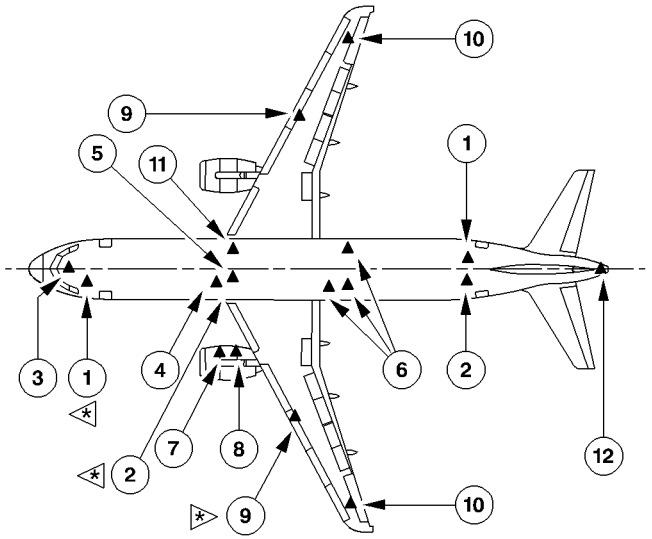


	Y	A	R3	R4	R5	R6
FT	15ft1in	75ft2in	45ft4in	72ft2in	60ft	71ft11in
M	4.60	22.90	13.81	21.99	18.30	21.91

* NOSE GEAR RADIUS (R3) MEASURED FROM OUTSIDE FACE OF TIRE

NFC5-01-2020-003-A100AA

R **GROUND SERVICE CONNECTIONS AND PANELS**



(1) Toilet servicing

R (2) Water filling and/or draining

R (3) Electrical ground power receptacle

(4) LP ground air supply connector

(5) HP ground air supply connector

(6) Hydraulic

(7) IDG oil filling

(8) Engine oil filling

(9) Refueling/defueling

(10) Gravity filling panels

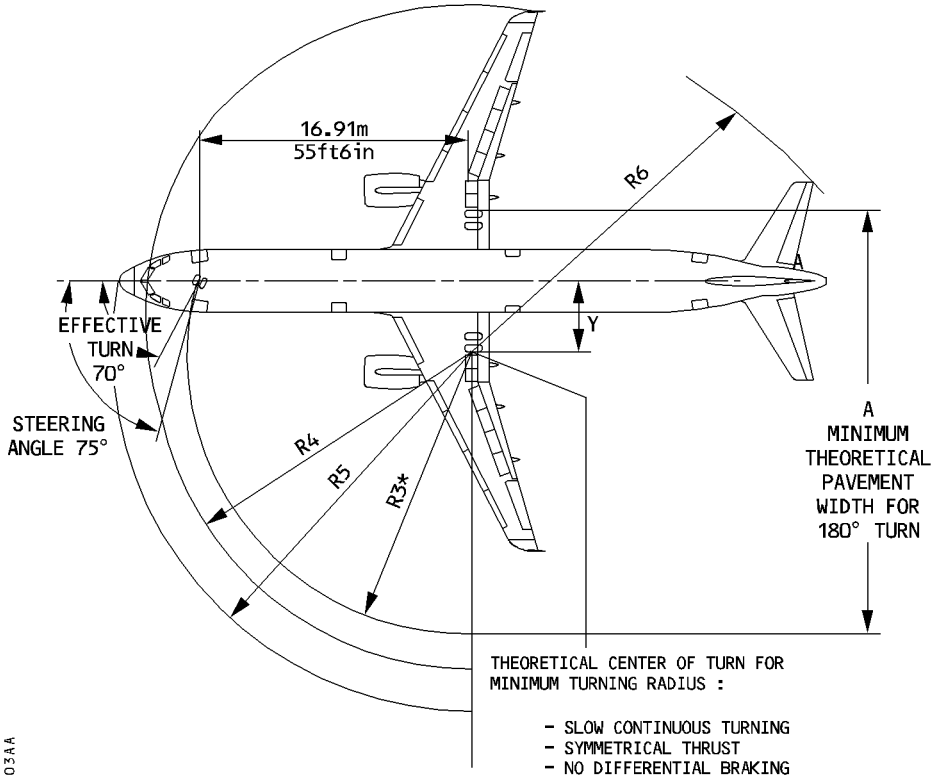
(11) Refueling/defueling panel

(12) APU oil filling

GROUND MANEUVERING

R

MINIMUN TURNING RADIUS

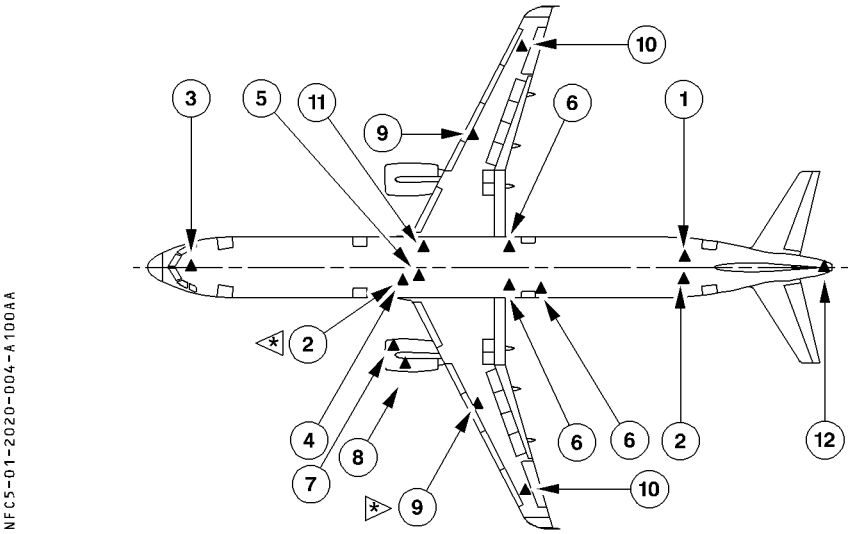


	Y	A	R3	R4	R5	R6
FT	16ft9in	90ft7in	59ft1in	74ft6in	74ft2in	80ft5in
M	5.1	27.6	18	22.7	22.6	24.5

* NOSE GEAR RADIUS (R3) MEASURED FROM OUTSIDE FACE OF TIRE

NFCS-01-2020-003-A203AA

R GROUND SERVICE CONNECTIONS AND PANELS



(1) Toilet servicing

R (2) Water filling and/or draining

R (3) Electrical ground power receptacle

(4) LP ground air supply connector

(5) HP ground air supply connector

(6) Hydraulic

(7) IDG oil filling

(8) Engine oil filling

(9) Refueling/defueling

(10) Gravity filling panels

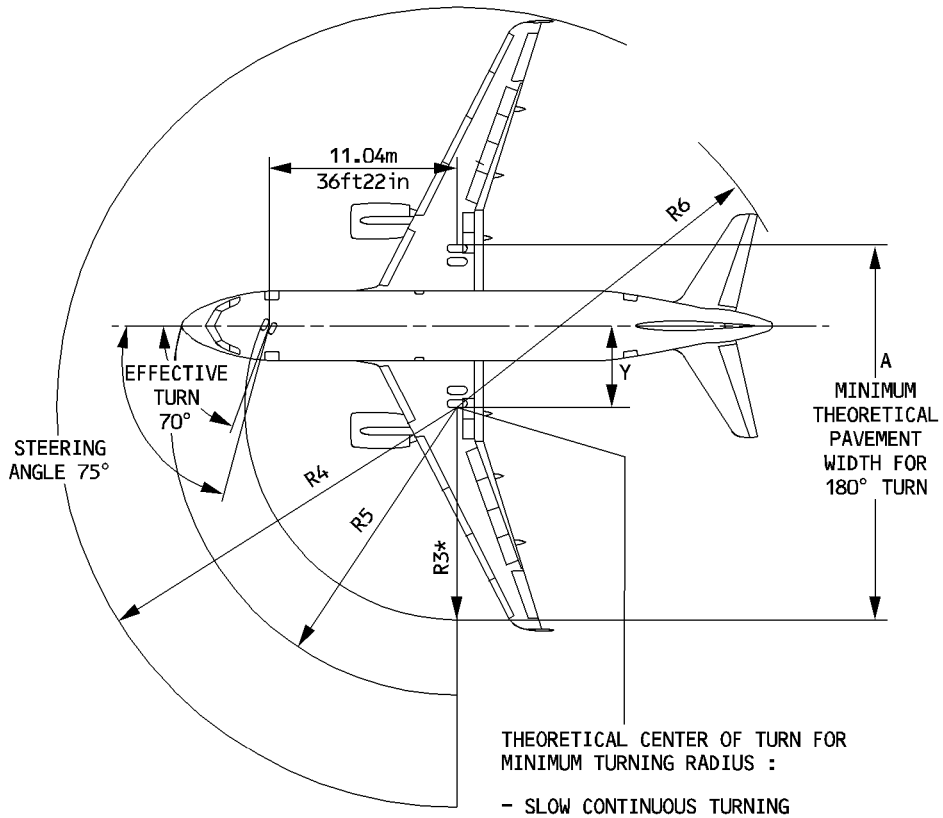
(11) Refueling/defueling panel

(12) APU oil filling

GROUND MANEUVERING

R

MINIMUM TURNING RADIUS

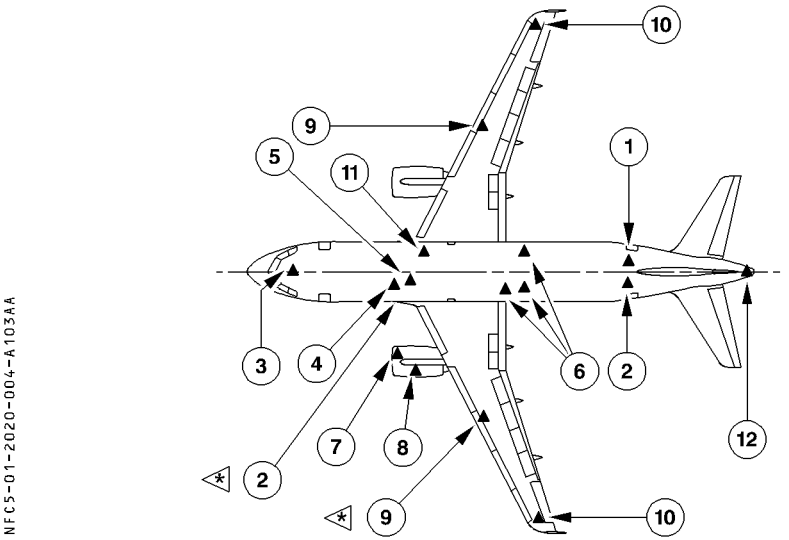


	Y	A	R3	R4	R5	R6
FT	13ft2in	67ft9in	39ft9in	70ft10in	54ft6in	64ft10in
M	4.01	20.64	12.11	21.58	16.6	19.77

* NOSE GEAR RADIUS (R3) MEASURED FROM OUTSIDE FACE OF TIRE

NFC5-01-2020-003-A206AA

R **GROUND SERVICE CONNECTIONS AND PANELS**



(1) Toilet servicing

R (2) Water filling and/or draining

R (3) Electrical ground power receptacle

(4) LP ground air supply connectors

(5) HP ground air supply connectors

(6) Hydraulic

(7) IDG oil filling

(8) Engine oil filling

(9) Refueling/defueling

(10) Gravity filling panels

(11) Refueling/defueling panel

(12) APU oil filling

21.00 CONTENTS

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21.20 PRESSURIZATION
– GENERAL 1
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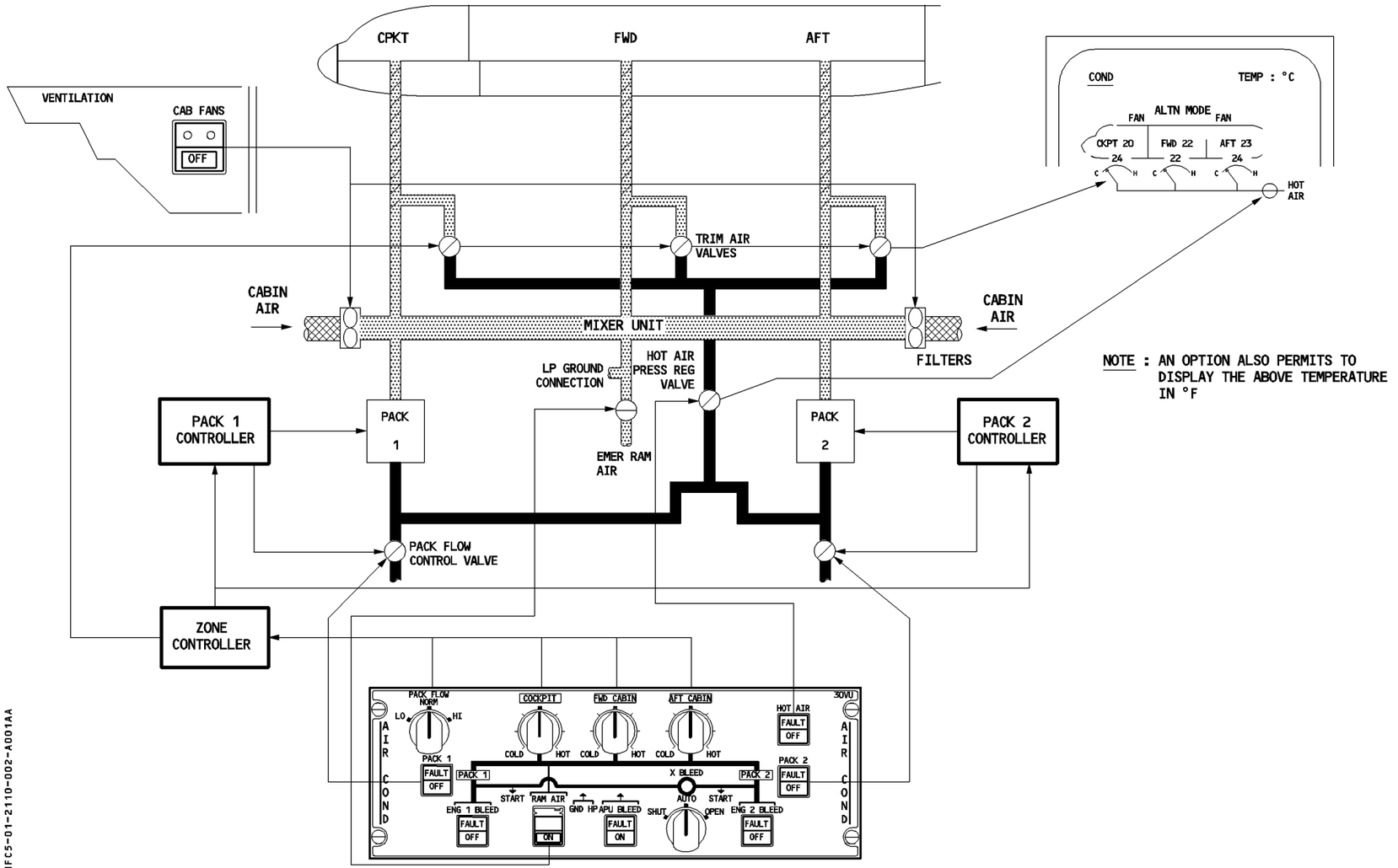
21.30 VENTILATION
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21.50 ELECTRICAL SUPPLY

GENERAL

The air conditioning system operation is fully automatic.
It provides a continual renewal of air and maintains a constant selected temperature in the three following zones : COCKPIT, FWD CABIN, AFT CABIN which are independently controlled.
The air is supplied by the pneumatic system, via :
– two pack flow control valves
– two packs
– the mixing unit, which mixes the air coming from the cabin and from the packs.
It is then distributed to the cockpit and the cabin.
The temperature regulation is optimized through the hot air pressure regulating valve and the trim air valves which add hot air tapped upstream of the packs to the mixing unit air.
In an emergency, a ram air inlet can provide ambient air to the mixing unit.
The temperature regulation is controlled by a zone controller and two pack controllers.
Flight deck and cabin temperature can be selected from the AIR COND panel in the cockpit.
Low pressure air is supplied to the mixing unit by a ground connection.

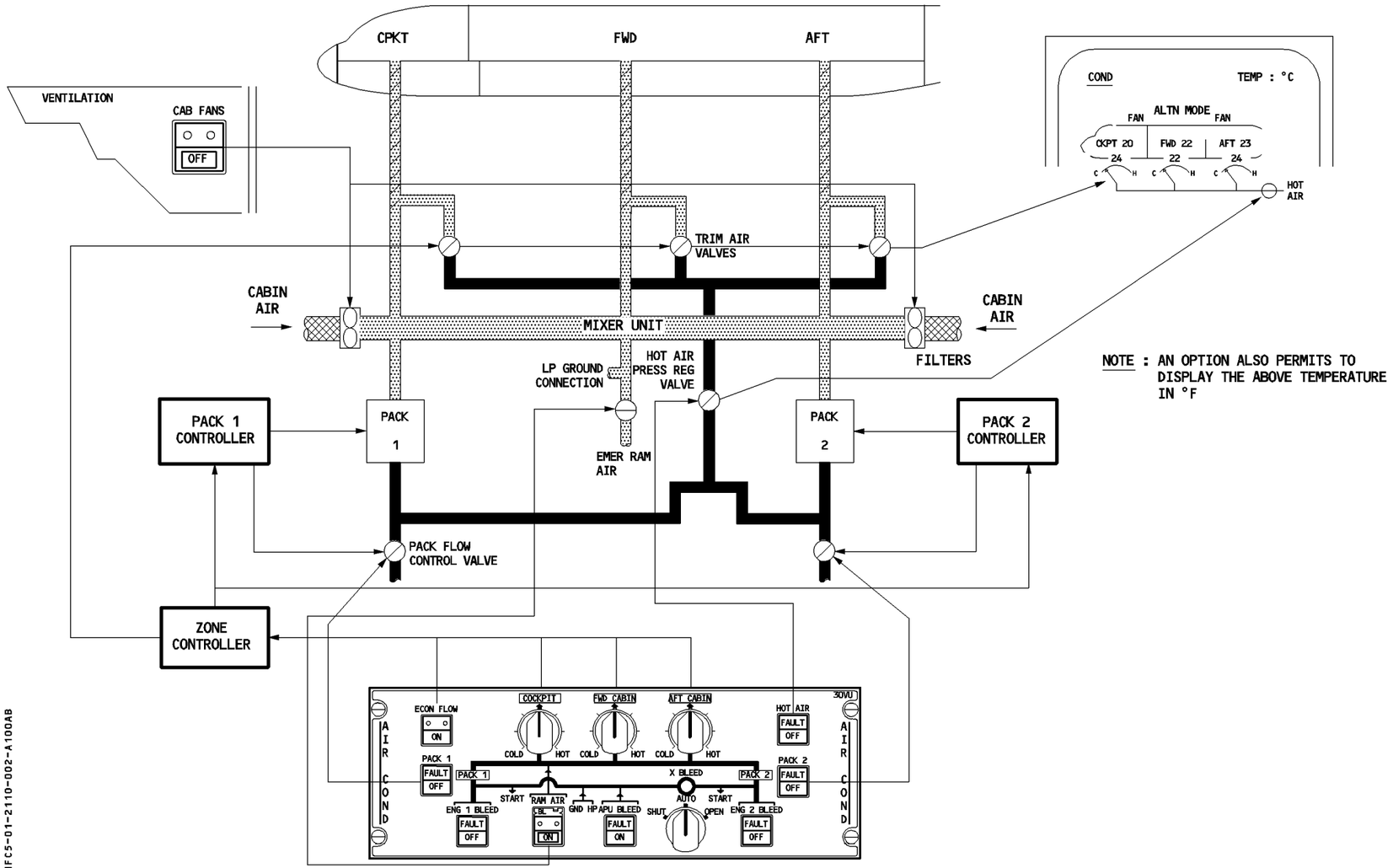


NFCS-01-2110-002-A001AA

NOTE : AN OPTION ALSO PERMITS TO DISPLAY THE ABOVE TEMPERATURE IN °F

GENERAL

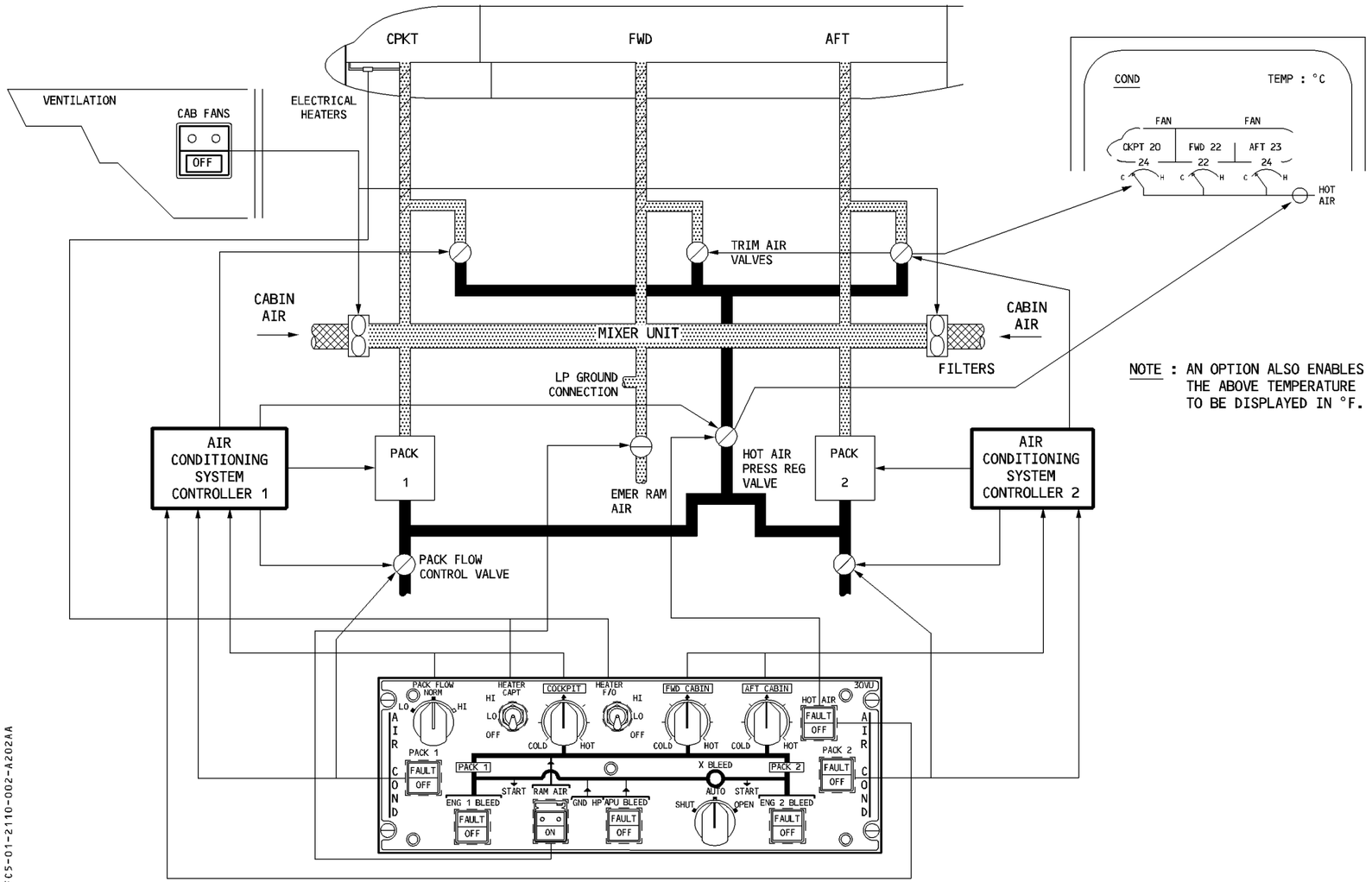
The air conditioning system operation is fully automatic.
It provides a continual renewal of air and maintains a constant selected temperature in the three following zones : COCKPIT, FWD CABIN, AFT CABIN which are independently controlled.
The air is supplied by the pneumatic system, via :
– two pack flow control valves
– two packs
– the mixing unit, which mixes the air coming from the cabin and from the packs.
It is then distributed to the cockpit and the cabin.
The temperature regulation is optimized through the hot air pressure regulating valve and the trim air valves which add hot air tapped upstream of the packs to the mixing unit air.
In an emergency, a ram air inlet can provide ambient air to the mixing unit.
The temperature regulation is controlled by a zone controller and two pack controllers.
Flight deck and cabin temperature can be selected from the AIR COND panel in the cockpit.
Low pressure air is supplied to the mixing unit by a ground connection.



NFCS-01-2110-002-A100AB

GENERAL

The air conditioning system is fully automatic.
It provides continuous air renewal and maintains a constant, selected temperature in the following three zones : COCKPIT, FWD CABIN, AFT CABIN. These three zones are independently controlled.
Air is supplied by the pneumatic system, via :
– Two pack flow control valves,
– Two packs,
– The mixing unit, which mixes the air that comes from the cabin and the packs.
Air is then distributed to the cockpit and the cabin.
Temperature regulation is optimized via the hot air pressure regulating valve, and the trim air valves that add hot air, tapped upstream of the packs, to the mixing unit air.
In an emergency, a ram air inlet can provide ambient air to the mixing unit.
Temperature regulation is controlled by two Air Conditioning System Controllers. Flight deck and cabin temperature can be selected from the cockpit's AIR COND panel.
A control panel is provided on the Forward Attendant Panel. During cruise, the cabin crew can modify each cabin zone temperature that is selected from the cockpit, with a limited
R authority of ± 2.5°C. (± 4.5°F).
Low-pressure air is supplied to the mixing unit by a ground connection.



NOTE : AN OPTION ALSO ENABLES THE ABOVE TEMPERATURE TO BE DISPLAYED IN °F.

NFCS-01-2110-002-A202AA

MAIN COMPONENTS

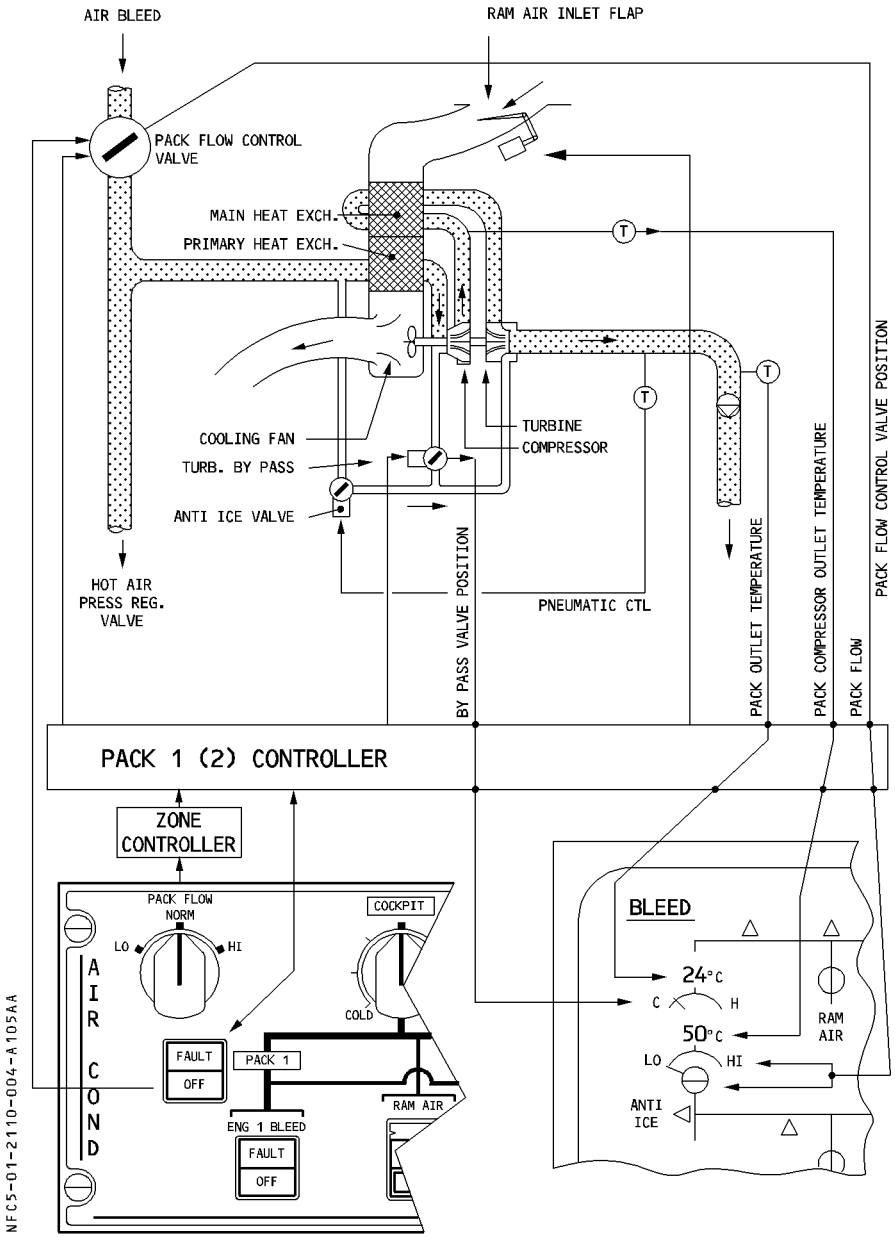
AIR CONDITIONING PACK

The two packs operate automatically and independently of each other. Pack operation is controlled by pack controller signals.
Warm pre-conditioned bleed air enters the cooling path via the pack valve and is ducted to the primary heat exchanger.
Then the cooled bleed air enters the compressor section of the air-cycle machine and is compressed to a higher pressure and temperature.
It is cooled again in the main heat exchanger and enters the turbine section, where it expands and in expanding generates power to drive the compressor and cooling air fan. The removal of energy during this process reduces the temperature of the air, resulting in very low air temperature at turbine discharge.

FOR INFO

A water separator system dries the air before it enters the turbine section.

PACK SCHEMATIC (SIMPLIFIED)



MAIN COMPONENTS

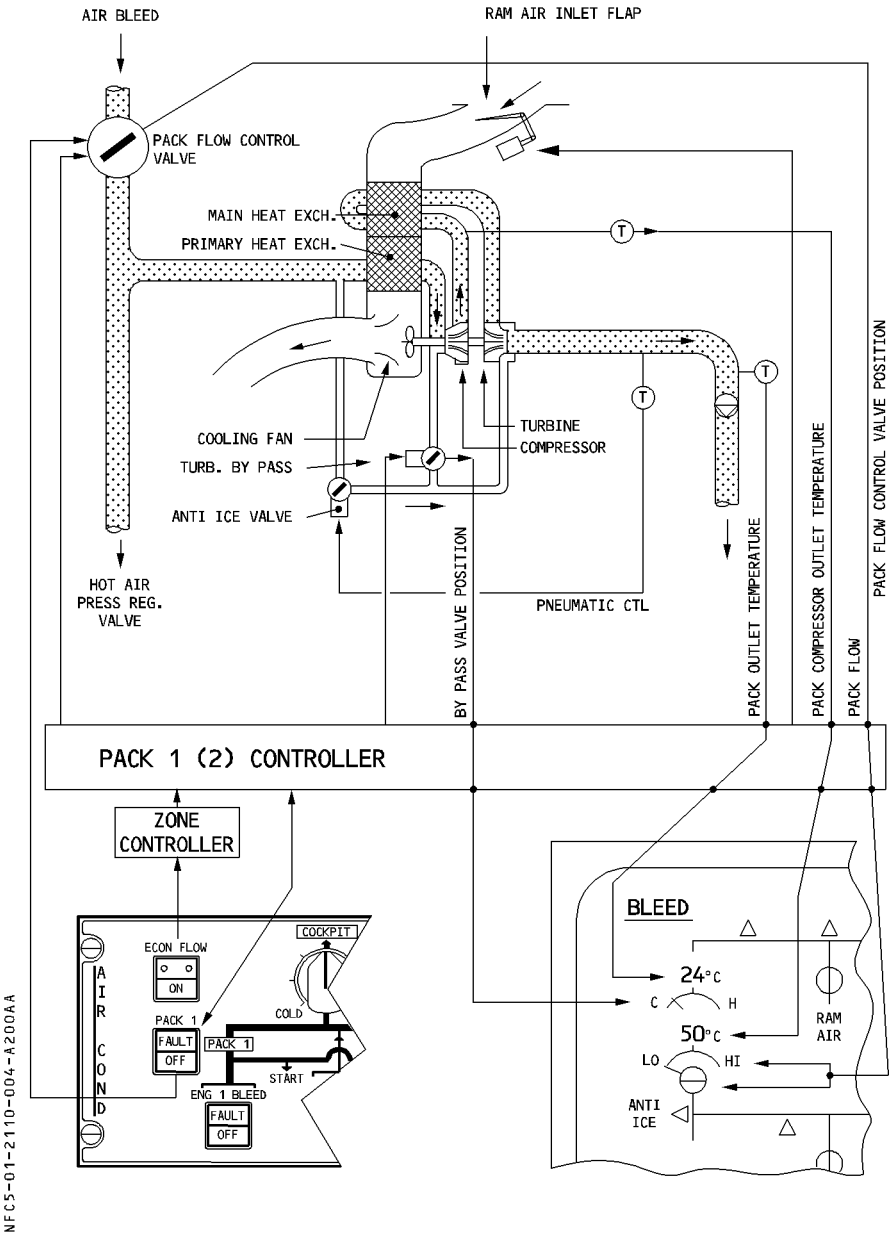
AIR CONDITIONING PACK

The two packs operate automatically and independently of each other. Pack operation is controlled by pack controller signals.
Warm pre-conditioned bleed air enters the cooling path via the pack valve and is ducted to the primary heat exchanger.
Then the cooled bleed air enters the compressor section of the air-cycle machine and is compressed to a higher pressure and temperature.
It is cooled again in the main heat exchanger and enters the turbine section, where it expands and in expanding generates power to drive the compressor and cooling air fan. The removal of energy during this process reduces the temperature of the air, resulting in very low air temperature at turbine discharge.

FOR INFO

A water separator system dries the air before it enters the turbine section.

PACK SCHEMATIC (SIMPLIFIED)



MAIN COMPONENTS

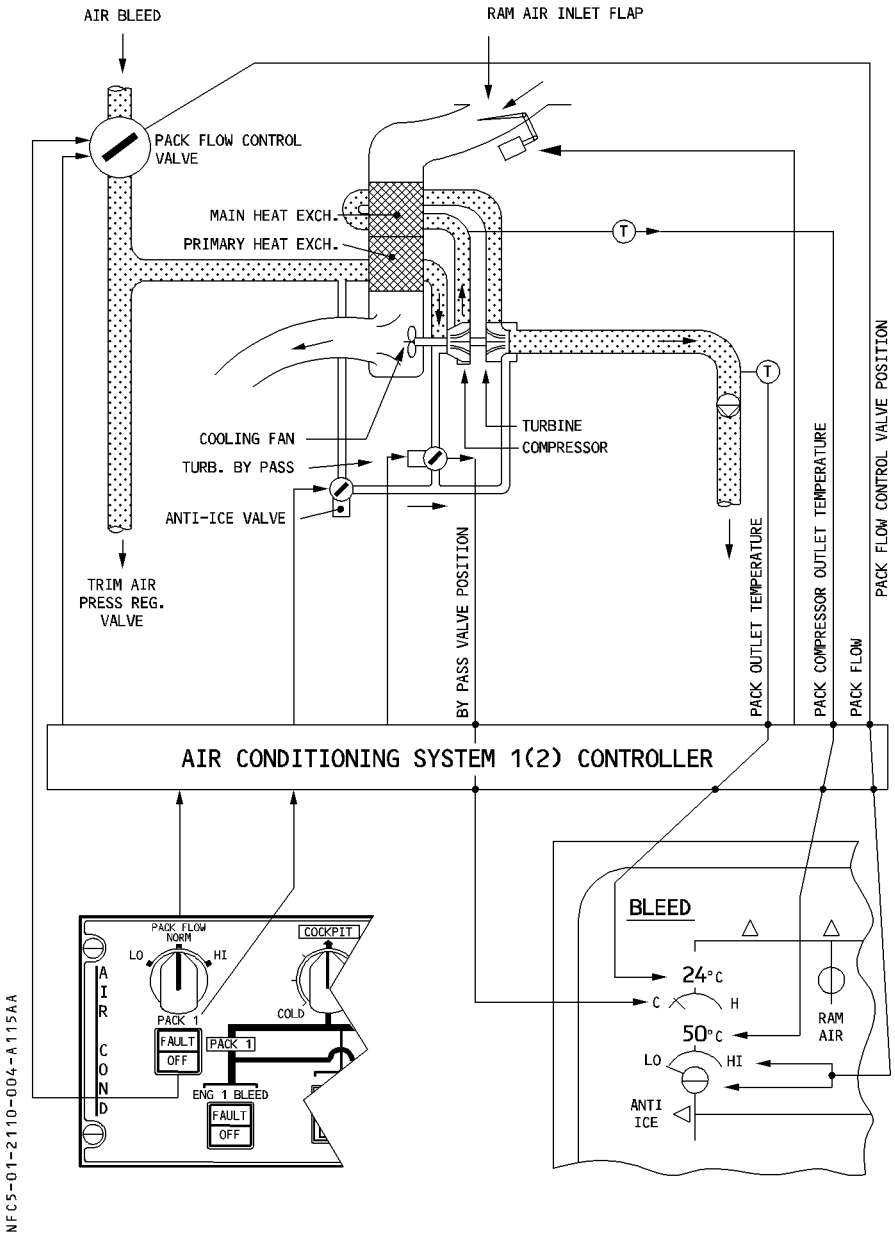
AIR CONDITIONING PACK

The two packs operate automatically and independently of each other. Pack operation is controlled by air conditioning system controller signals.
Warm pre-conditioned bleed air enters the cooling path via the pack flow control valve, and is ducted to the primary heat exchanger.
Then, the cooled bleed air enters the compressor section of the air-cycle machine and is compressed to a higher pressure and temperature.
It is cooled again in the main heat exchanger and enters the turbine section, where it expands and, in expanding, generates power to drive the compressor and cooling air fan. The removal of energy during this process reduces air temperature, resulting in very low air temperature at turbine discharge.

FOR INFO

A water separator system dries the air before it enters the turbine section.

PACK SCHEMATIC (SIMPLIFIED)



MAIN COMPONENTS

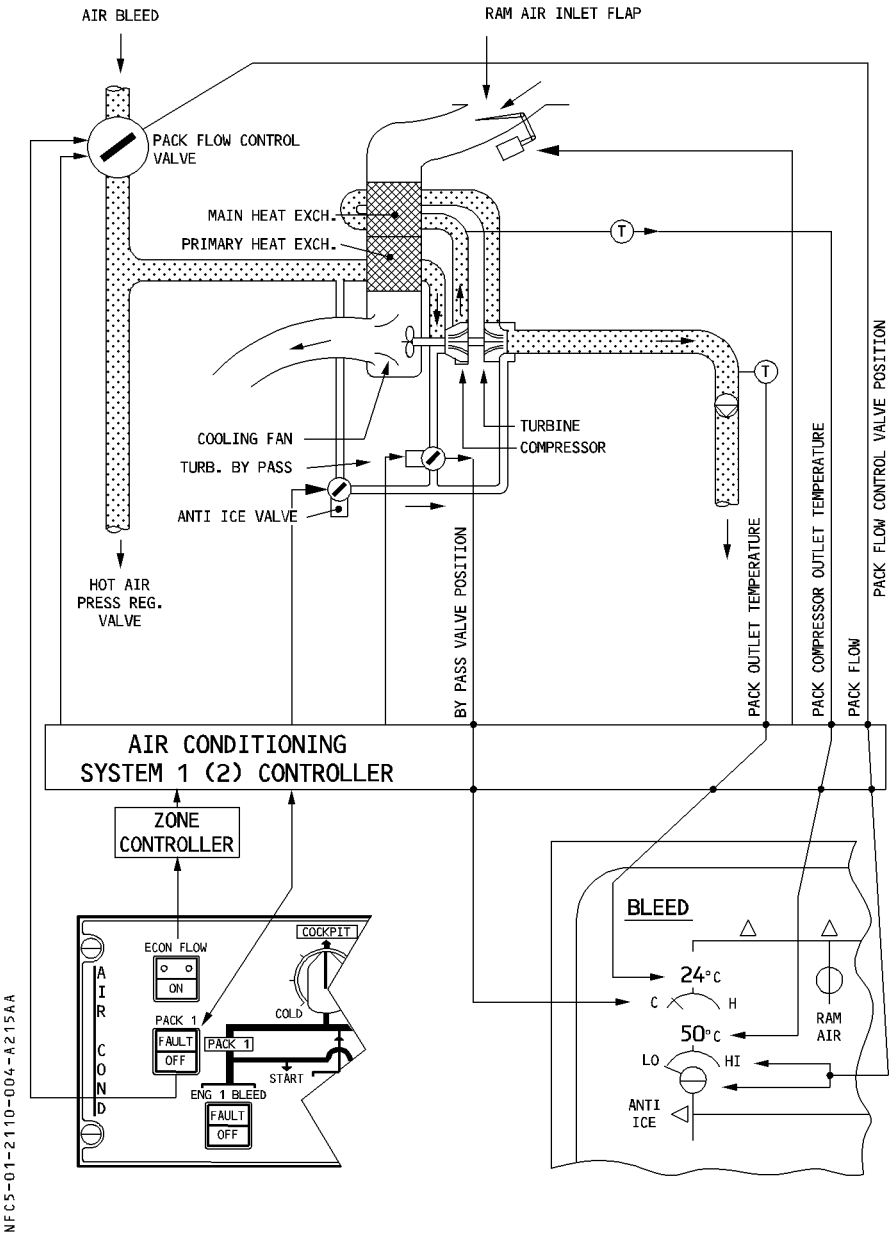
AIR CONDITIONING PACK

The two packs operate automatically and independently of each other. Pack operation is controlled by air conditioning system controller signals.
Warm pre-conditioned bleed air enters the cooling path via the pack flow control valve, and is ducted to the primary heat exchanger.
Then, the cooled bleed air enters the compressor section of the air-cycle machine and is compressed to a higher pressure and temperature.
It is cooled again in the main heat exchanger and enters the turbine section, where it expands and, in expanding, generates power to drive the compressor and cooling air fan. The removal of energy during this process reduces air temperature, resulting in very low air temperature at turbine discharge.

FOR INFO

A water separator system dries the air before it enters the turbine section.

PACK SCHEMATIC (SIMPLIFIED)



PACK FLOW CONTROL VALVE

This valve is pneumatically-operated and electrically-controlled. It regulates the air flow in accordance with signals received from the pack controller.
In the absence of air pressure, a spring keeps the valve closed.
The valve closes automatically in case of pack overheating, engine starting, or operation of the fire or ditching pushbutton.
The valve is controlled from the AIR COND panel.

RAM AIR

An emergency ram air inlet ventilates the cockpit and cabin to remove smoke, or if both packs fail.
The emergency ram air inlet valve is controlled by the RAM AIR pushbutton on the AIR COND panel.
This pushbutton opens the ram air valve, provided that ditching is not selected.
R When the RAM AIR pushbutton is ON : The outflow valve opens about 50 %, provided that
R it is under automatic control and △P is less than one psi. The outflow valve does not
R automatically open if it is under manual control, even if △P is less than one psi. If △P is greater than one psi, the check valve located downstream the ram air door will not open, even if the ram air door has been selected open. No airflow will then be supplied.

MIXER UNIT

This unit mixes cold fresh air from the packs with the cabin air being recirculated through recirculation fans. The mixer unit is also connected to the emergency ram air inlet and the low pressure ground inlets.

HOT-AIR PRESSURE-REGULATING VALVES

This valve regulates the pressure of hot air, tapped upstream of the packs.
It is pneumatically-operated and electrically-controlled from the HOT AIR pushbutton on the AIR COND panel. In the absence of air, a spring keeps the valve closed.
The valve closes automatically, if :
– The duct overheats, or
– The cockpit trim air valve fails, or
– Both cabin trim air valves fail.
The hot-air pressure-regulating valve remains operative, even if either the forward or aft cabin trim air valve fails.

TRIM AIR VALVES

These valves are electrically-controlled by the zone controller. A trim air valve, associated with each zone, adjusts the temperature by adding hot air.

TEMPERATURE AND FLOW REGULATION

Temperature regulation is automatic and controlled by one zone controller and two pack controllers.

PACK CONTROLLER

Each pack controller regulates the temperature of its associated pack, in accordance with a demand signal from the zone controller, by modulating the bypass valve and the ram air inlet flaps.
The ram air inlet flaps close during takeoff and landing to avoid ingestion of foreign matter.

Note : During takeoff, the ram air inlet flaps close when TO. power is set and the main landing gear struts are compressed.
During landing they close as soon as the main landing gear struts are compressed, as long as speed is at or above 70 knots.
They open 20 seconds after the speed drops below 70 knots.

The pack controllers also regulate flow by modulating the associated pack flow control valve.

ZONE CONTROLLER

PACK FLOW CONTROL

The crew can use the PACK FLOW selector to adjust the pack flow for the number of passengers and for external conditions.
Whatever the crew selects, the system delivers high flow for any of the following circumstances :
– in single-pack operation,
– when the APU is supplying bleed air.
The system delivers normal flow if the crew selects LO flow and the temperature demand cannot be satisfied.

Engine pressure demand
When the cooling demand in one zone cannot be satisfied, if the bleed pressure is too low, the zone controller sends a pressure demand signal to both Engine Interface Units (EIU) to increase the minimum idle and to raise the bleed pressure.

APU flow demand
When the APU bleed valve is open, the zone controller signals the APU's Electronic Control Box (ECB) to increase the APU flow output when any zone temperature demand cannot be satisfied.

PACK FLOW CONTROL VALVE

This valve is pneumatically-operated and electrically-controlled. It regulates the air flow in accordance with signals received from the pack controller.
In the absence of air pressure, a spring keeps the valve closed.
The valve closes automatically in case of pack overheating, engine starting, or operation of the fire or ditching pushbutton.
The valve is controlled from the AIR COND panel.

RAM AIR

An emergency ram air inlet ventilates the cockpit and cabin to remove smoke, or if both packs fail.
The emergency ram air inlet valve is controlled by the RAM AIR pushbutton on the AIR COND panel.
This pushbutton opens the ram air valve, provided that ditching is not selected.
R When the RAM AIR pushbutton is ON : The outflow valve opens about 50 %, provided that
R it is under automatic control and △P is less than one psi. The outflow valve does not
R automatically open if it is under manual control, even if △P is less than one psi. If △P is greater than one psi, the check valve located downstream the ram air door will not open, even if the ram air door has been selected open. No airflow will then be supplied.

MIXER UNIT

This unit mixes cold fresh air from the packs with the cabin air being recirculated through recirculation fans. The mixer unit is also connected to the emergency ram air inlet and the low pressure ground inlets.

HOT-AIR PRESSURE-REGULATING VALVES

This valve regulates the pressure of hot air, tapped upstream of the packs.
It is pneumatically-operated and electrically-controlled from the HOT AIR pushbutton on the AIR COND panel. In the absence of air, a spring keeps the valve closed.
The valve closes automatically, if :
– The duct overheats, or
– The cockpit trim air valve fails, or
– Both cabin trim air valves fail.
The hot-air pressure-regulating valve remains operative, even if either the forward or aft cabin trim air valve fails.

TRIM AIR VALVES

These valves are electrically-controlled by the zone controller. A trim air valve, associated with each zone, adjusts the temperature by adding hot air.

TEMPERATURE AND FLOW REGULATION

Temperature regulation is automatic and controlled by one zone controller and two pack controllers.

PACK CONTROLLER

Each pack controller regulates the temperature of its associated pack, in accordance with a demand signal from the zone controller, by modulating the bypass valve and the ram air inlet flaps.
The ram air inlet flaps close during takeoff and landing to avoid ingestion of foreign matter.

Note : During takeoff, the ram air inlet flaps close when TO. power is set and the main landing gear struts are compressed.
During landing they close as soon as the main landing gear struts are compressed, as long as speed is at or above 70 knots.
They open 20 seconds after the speed drops below 70 knots.

The pack controllers also regulate flow by modulating the associated pack flow control valve.

ZONE CONTROLLER

PACK FLOW CONTROL

The crew can use the ECON FLOW pushbutton to adjust the pack flow for the number of passengers and for external conditions.
Whatever the crew selects, the system delivers high flow (40 % more than the ECON flow) for any of the following circumstances :
– in single-pack operation,
– when the APU is supplying bleed air,
The system delivers normal flow (20 % more than the ECON flow) if the crew selects ECON flow and the temperature demand cannot be satisfied.

Engine pressure demand
When the cooling demand in one zone cannot be satisfied, if the bleed pressure is too low, the zone controller sends a pressure demand signal to both Engine Interface Units (EIU) to increase the minimum idle and to raise the bleed pressure.

APU flow demand
When the APU bleed valve is open, the zone controller signals the APU's Electronic Control Box (ECB) to increase the APU flow output when any zone temperature demand cannot be satisfied.

PACK FLOW CONTROL VALVE

This valve is pneumatically-operated and electrically-controlled. It regulates the air flow in accordance with signals received from the air conditioning system controllers.
In the absence of air pressure, a spring keeps the valve closed.
The valve closes automatically in case of pack overheating, engine starting, or operation of the fire or ditching pushbutton. The valve is controlled from the AIR COND panel.

RAM AIR

An emergency ram air inlet ventilates the cockpit and cabin to remove smoke, or if both packs fail. The emergency ram air inlet valve is controlled by the RAM AIR pushbutton on the AIR COND panel. This pushbutton opens the ram air valve, provided that ditching is not selected.
When the RAM AIR pushbutton is ON : The outflow valve opens about 50 %, provided that it is under automatic control and $\triangle P$ is less than one psi. The outflow valve does not automatically open if it is under manual control, even if $\triangle P$ is less than one psi. If $\triangle P$ is greater than one psi, the check valve located downstream the ram air door will not open, even if the ram air door has been selected open. No airflow will then be supplied.

MIXER UNIT

This unit mixes cold fresh air from the packs with the cabin air being recirculated through recirculation fans. The mixer unit is also connected to the emergency ram air inlet and the low pressure ground inlets.

HOT-AIR PRESSURE-REGULATING VALVE

In the absence of air, a spring keeps the valve closed. This pneumatically-operated and electrically-controlled valve regulates hot air pressure, which is tapped upstream of the packs. The air conditioning system controller 1 regulates this valve. This valve closes upon pressing the HOT AIR pushbutton on the AIR COND panel, or when both lanes of one air conditioning system controller fail.
The valve closes automatically, if :
– The duct overheats, or
– The cockpit trim air valve fails, or
– Both cabin trim air valves fail.
The hot-air pressure-regulating valve remains operative, even if either the forward or aft cabin trim air valve fails.

TRIM AIR VALVES

These valves are electrically-controlled by the air conditioning system controllers. The cockpit trim air valve, controlled by the air conditioning system controller 1, and the cabin trim air valves, controlled by the air conditioning system controller 2, adjust the temperature by adding hot air.

TEMPERATURE AND FLOW REGULATION

Temperature regulation is automatic and controlled by the air conditioning system controllers.

AIR CONDITIONING SYSTEM CONTROLLERS

Each air conditioning system controller regulates the temperature of its associated pack, by modulating the bypass valve and the ram air inlet flap.
The ram air inlet flap closes during takeoff and landing to avoid the ingestion of foreign matter.

Note : During takeoff, the ram air inlet flap closes when takeoff power is set, and the main landing gear struts are compressed.
During landing, it closes as soon as the main landing gear struts are compressed, as long as speed is at or above 70 knots.
It opens 20 seconds after the speed drops below 70 knots.

The air conditioning system controllers also regulate flow by modulating the associated pack flow control valve.

PACK FLOW CONTROL

The crew can use the PACK FLOW selector to adjust the pack flow for the number of passengers and for external conditions.
Whatever the crew selects, the system delivers high flow for any of the following circumstances :
– in single-pack operation,
– when the APU is supplying bleed air.
The system delivers normal flow if the crew selects LO flow and the temperature demand cannot be satisfied.

Engine pressure demand

When the cooling demand in one zone cannot be satisfied, if the bleed pressure is too low, the air conditioning system controller sends a pressure demand signal to both Engine Interface Units (EIU) to increase the minimum idle and to raise the bleed pressure.

APU flow demand

When the APU bleed valve is open, the air conditioning system controller signals the APU's Electronic Control Box (ECB) to increase the APU flow output when any zone temperature demand cannot be satisfied.

PACK FLOW CONTROL VALVE

This valve is pneumatically-operated and electrically-controlled. It regulates the air flow in accordance with signals received from the air conditioning system controllers.
In the absence of air pressure, a spring keeps the valve closed.
The valve closes automatically in case of pack overheating, engine starting, or operation of the fire or ditching pushbutton. The valve is controlled from the AIR COND panel.

RAM AIR

An emergency ram air inlet ventilates the cockpit and cabin to remove smoke, or if both packs fail. The emergency ram air inlet valve is controlled by the RAM AIR pushbutton on the AIR COND panel. This pushbutton opens the ram air valve, provided that ditching is not selected.
When the RAM AIR pushbutton is ON : The outflow valve opens about 50 %, provided that it is under automatic control and $\triangle P$ is less than one psi. The outflow valve does not automatically open if it is under manual control, even if $\triangle P$ is less than one psi. If $\triangle P$ is greater than one psi, the check valve located downstream the ram air door will not open, even if the ram air door has been selected open. No airflow will then be supplied.

MIXER UNIT

This unit mixes cold fresh air from the packs with the cabin air being recirculated through recirculation fans. The mixer unit is also connected to the emergency ram air inlet and the low pressure ground inlets.

HOT-AIR PRESSURE-REGULATING VALVE

In the absence of air, a spring keeps the valve closed. This pneumatically-operated and electrically-controlled valve regulates hot air pressure, which is tapped upstream of the packs. The air conditioning system controller 1 regulates this valve. This valve closes upon pressing the HOT AIR pushbutton on the AIR COND panel, or when both lanes of one air conditioning system controller fail.
The valve closes automatically, if :
– The duct overheats, or
– The cockpit trim air valve fails, or
– Both cabin trim air valves fail.
The hot-air pressure-regulating valve remains operative, even if either the forward or aft cabin trim air valve fails.

TRIM AIR VALVES

These valves are electrically-controlled by the air conditioning system controllers. The cockpit trim air valve, controlled by the air conditioning system controller 1, and the cabin trim air valves, controlled by the air conditioning system controller 2, adjust the temperature by adding hot air.

TEMPERATURE AND FLOW REGULATION

Temperature regulation is automatic and controlled by the air conditioning system controllers.

PACK CONTROLLER

Each air conditioning system controller regulates the temperature of its associated pack, by modulating the bypass valve and the ram air inlet flap.
The ram air inlet flap closes during takeoff and landing to avoid ingestion of foreign matter.

Note : During takeoff, the ram air inlet flaps close when TO. power is set and the main landing gear struts are compressed.
During landing they close as soon as the main landing gear struts are compressed, as long as speed is at or above 70 knots.
They open 20 seconds after the speed drops below 70 knots.

The air conditioning system controllers also regulate flow by modulating the associated pack flow control valve.

ZONE CONTROLLER

PACK FLOW CONTROL

The crew can use the ECON FLOW pushbutton to adjust the pack flow for the number of passengers and for external conditions.
Whatever the crew selects, the system delivers high flow (40 % more than the ECON flow) for any of the following circumstances :
– in single-pack operation,
– when the APU is supplying bleed air,
The system delivers normal flow (20 % more than the ECON flow) if the crew selects ECON flow and the temperature demand cannot be satisfied.

Engine pressure demand
When the cooling demand in one zone cannot be satisfied, if the bleed pressure is too low, the zone controller sends a pressure demand signal to both Engine Interface Units (EIU) to increase the minimum idle and to raise the bleed pressure.

APU flow demand
When the APU bleed valve is open, the zone controller signals the APU's Electronic Control Box (ECB) to increase the APU flow output when any zone temperature demand cannot be satisfied.

TEMPERATURE REGULATION

The zone controller regulates the temperature of the two cabin zones and the cockpit.

BASIC TEMPERATURE REGULATION

The flight crew uses the temperature selectors on the air conditioning panel in the cockpit to select the reference temperatures. The zone controller computes a temperature demand from the selected temperature and the actual temperature.
The actual temperature is measured by sensors :
– in the cockpit, for the cockpit zone
– in the lavatory extraction circuit and galley ventilation system, for the cabin.
A signal corresponding to the lowest demanded zone temperature goes to the pack controller, which then makes both packs produce the required outlet temperature.

OPTIMIZED TEMPERATURE REGULATION

The zone controller optimizes the temperature by action on the trim air valves.
The temperature selection range is from 18°C (64°F) to 30°C (86°F).

SYSTEM OPERATION UNDER FAILURE CONDITION

Each controller consists of a primary channel that is normally in control and a secondary channel that acts as a backup if the primary channel fails.

ZONE CONTROLLER

PRIMARY CHANNEL FAILURE

The secondary channel operates as backup.
The flow setting function and optimized temperature regulation are not available. HOT AIR and TRIM AIR valves close.
The zones are controlled to 24°C (76°F) (backup regulation). Pack 1 controls the cockpit temperature. Pack 2 controls the FWD and AFT cabin temperatures.
ALTN MODE appears on the ECAM (Electronic Centralized Aircraft Monitoring) COND page.

SECONDARY CHANNEL FAILURE

This has no effect on zone temperature regulation.
Backup mode is lost.

PRIMARY AND SECONDARY CHANNEL FAILURE

Optimized and backup temperature regulation is lost.
The packs deliver a fixed temperature : 20°C (68°F) for pack 1, 10°C (50°F) for pack 2. The
R failure removes all information from the ECAM COND page, which then displays PACK REG.

PACK CONTROLLERS

PRIMARY CHANNEL FAILURE

The secondary computer operates as a backup.
Regulation is not optimized.
Pack flow is fixed at the previous setting.

SECONDARY CHANNEL FAILURE

This failure has no effect on pack regulation. Backup mode is lost.
ECAM signals related to the corresponding pack are lost.

TEMPERATURE REGULATION

The air conditioning system controller 2 regulates the temperature of the two cabin zones, and the air conditioning system controller 1 regulates, the cockpit temperature.

BASIC TEMPERATURE REGULATION

The flight crew uses the temperature selectors on the cockpit's air conditioning panel to select the reference temperatures which are fine tuned through the Forward Attendant Panel (FAP) for the cabin zones. The air conditioning system controllers compute a temperature demand from the selected temperature and the actual temperature.
The actual temperature is measured by sensors :
– In the cockpit, for the cockpit zone ;
– In the lavatory extraction circuit and galley ventilation system, for the cabin.
A signal corresponding to the lowest demanded zone temperature goes to the air conditioning system controllers, which then make both packs produce the required outlet temperature.

OPTIMIZED TEMPERATURE REGULATION

The air conditioning system controllers optimize temperature by acting on the trim air valves.
The temperature selection range is from 18°C (64°F) to 30°C (86°F).

COCKPIT - ELECTRICAL HEATERS

The ambient temperature of the cockpit is regulated via the COCKPIT selector, located on the AIR COND panel. In addition, an electrical heater is installed inside each foot air outlet ducting to enable the increase of the air temperature in the foot area. Two HEATER switches, located on the AIR COND panel, control these electrical heaters (one for the Captain's side and one for the First Officer's side).

SYSTEM OPERATION UNDER FAILURE CONDITION

Each controller is comprised of two lanes. One lane controls the system, the other takes over full control, in case of an active lane failure.

AIR CONDITIONING SYSTEM CONTROLLER

ONE LANE FAILURE

No effect, as the second lane takes over.

BOTH LANES' FAILURE

The related pack is lost, and the hot air pressure-regulating valve and associated trim air valves close.

PRIMARY AND SECONDARY CHANNEL FAILURE

As a backup, corresponding pack outlet temperature is controlled by the anti-ice valve and is stabilized to a temperature between 5°C (41°F) and 30°C (86°F) in a maximum of 6 minutes.
ECAM signals, related to the corresponding pack, are lost.

AIR CYCLE MACHINE FAILURE

If the Air Cycle Machine (ACM) fails (compressor/turbine seizure), the affected pack may be operated in heat exchanger cooling mode.
Warm pre-conditioned bleed air enters the cooling path via the pack valve, and goes to the primary heat exchanger. Then, the main part of the cooled air goes directly downstream of the ACM turbine through the bypass valve, and the rest goes through the failed ACM.
The ACM seizure reduces the pack flow.
As for normal pack operation :

- The pack controller regulates temperature, in accordance with zone controller demand, by modulating the bypass valve and the ram air inlet flap.
- The zone controller regulates the hot air flow through the trim air valves to optimize cockpit/cabin temperature regulation. Hot air flow is lower than in normal pack operation, because pack flow is reduced.

HOT AIR PRESSURE REGULATING VALVE FAILURE

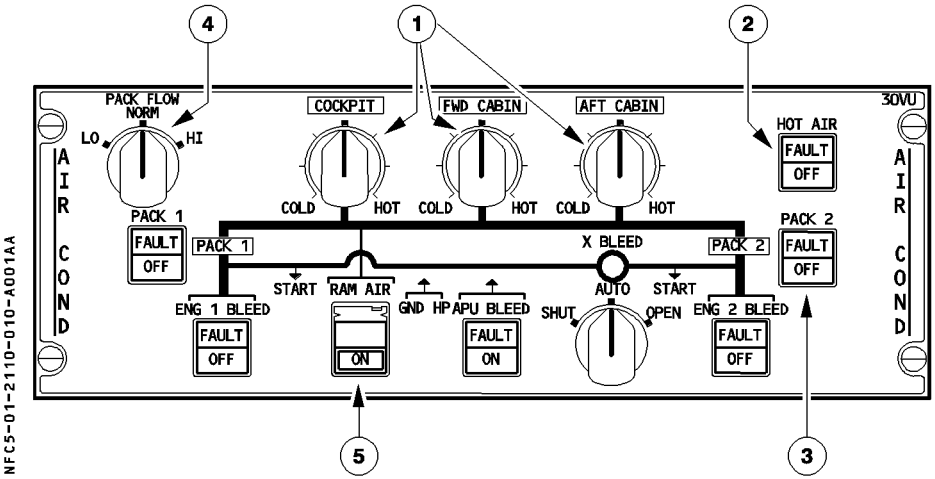
Failed open : No effect.
Failed closed : Optimized regulation is lost. Trim air valves are driven to the full closed position. Pack 1 controls the cockpit temperature to the selected value, and pack 2 controls the cabin temperature (FWD and AFT) to the mean value, of the selected temperatures.

TRIM AIR VALVE FAILURE

Optimized temperature regulation of the corresponding zone is lost.

CONTROLS AND INDICATORS

CONTROLS ON OVERHEAD PANEL



(1) Zone temperature sel

- 12 o'clock position : 24°C (76°F).
- COLD position : 18°C (64°F).
- HOT position : 30°C (86°F).

(2) HOT AIR pushbutton

On : The valve regulates hot air pressure.
OFF : The valve closes, and the trim air valves close.
The FAULT circuit is reset.
FAULT : The amber light, and associated ECAM caution come on when duct overheat is detected. The fault circuit detects an overheat when the duct
R temperature reaches 88°C (190°F).
The valve and the trim air valves close automatically.
The FAULT light goes off when the temperature drops below 70°C (158°F), and the flight crew selects OFF.

PRIMARY AND SECONDARY CHANNEL FAILURE

As a backup, corresponding pack outlet temperature is controlled by the anti-ice valve and is stabilized to a temperature between 5°C (41°F) and 30°C (86°F) in a maximum of 6 minutes.
ECAM signals, related to the corresponding pack, are lost.

AIR CYCLE MACHINE FAILURE

If the Air Cycle Machine (ACM) fails (compressor/turbine seizure), the affected pack may be operated in heat exchanger cooling mode.
Warm pre-conditioned bleed air enters the cooling path via the pack valve, and goes to the primary heat exchanger. Then, the main part of the cooled air goes directly downstream of the ACM turbine through the bypass valve, and the rest goes through the failed ACM.
The ACM seizure reduces the pack flow.
As for normal pack operation :

- The pack controller regulates temperature, in accordance with zone controller demand, by modulating the bypass valve and the ram air inlet flap.
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HOT AIR PRESSURE REGULATING VALVE FAILURE

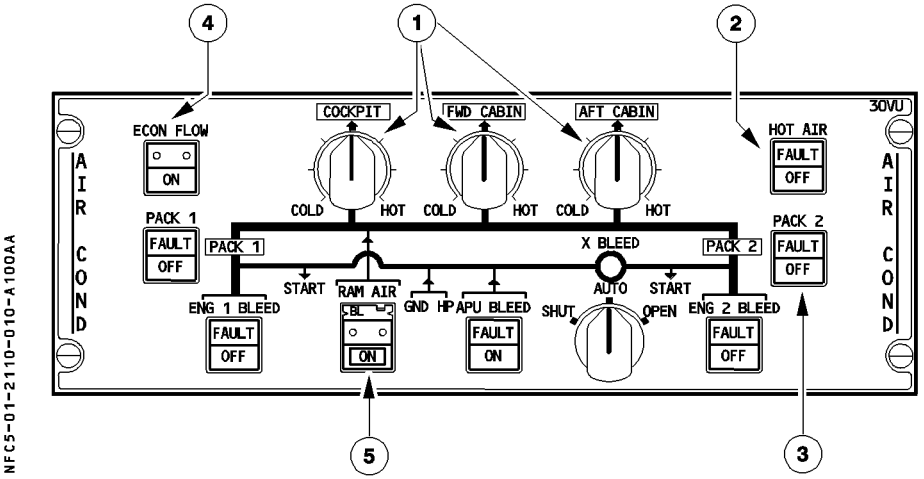
Failed open : No effect.
Failed closed : Optimized regulation is lost. Trim air valves are driven to the full closed position. Pack 1 controls the cockpit temperature to the selected value, and pack 2 controls the cabin temperature (FWD and AFT) to the mean value, of the selected temperatures.

TRIM AIR VALVE FAILURE

Optimized temperature regulation of the corresponding zone is lost.

CONTROLS AND INDICATORS

CONTROLS ON OVERHEAD PANEL



(1) Zone temperature sel

- 12 o'clock position : 24°C (76°F).
- COLD position : 18°C (64°F).
- HOT position : 30°C (86°F).

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On : The valve regulates hot air pressure.
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The FAULT circuit is reset.
FAULT : The amber light, and associated ECAM caution come on when duct overheat is detected. The fault circuit detects an overheat when the duct
R temperature reaches 88°C (190°F).
The valve and the trim air valves close automatically.
The FAULT light goes off when the temperature drops below 70°C (158°F), and the flight crew selects OFF.

AIR CYCLE MACHINE FAILURE

If the Air Cycle Machine (ACM) fails (compressor/turbine seizure), the affected pack may be operated in heat exchanger cooling mode.
Warm pre-conditioned bleed air enters the cooling path via the pack valve and goes to the primary heat exchanger. Then, the main part of the cooled air goes directly downstream of ACM turbine through the bypass valve, and the rest goes through the failed ACM.
The ACM seizure reduces the pack flow.
As for normal pack operation :

- The air conditioning system controller regulates temperature by modulating the bypass valve and the ram air inlet flap.
- The air conditioning system controller regulates the hot air flow through the hot air valves to optimize cockpit/cabin temperature regulation. Hot air flow is lower than in normal pack operation, because pack flow is reduced.

HOT AIR PRESSURE REGULATING VALVE FAILURE

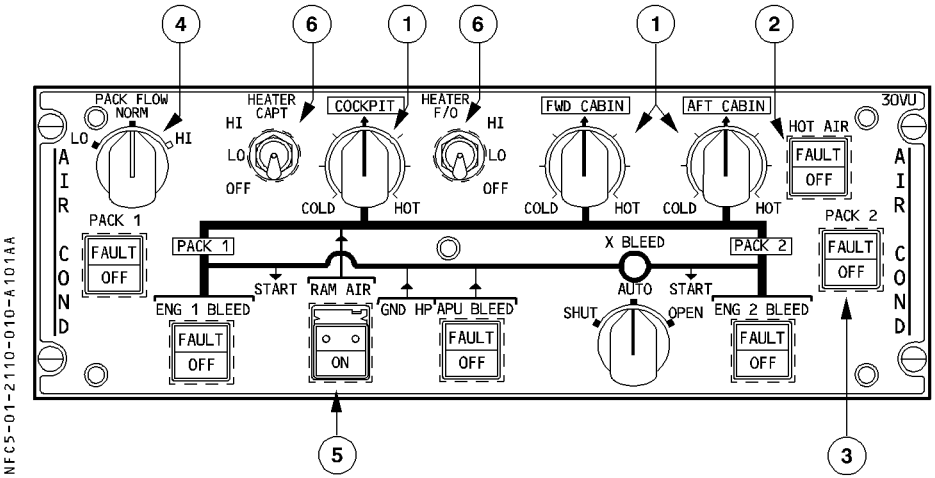
Failed open : No effect.
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TRIM AIR VALVE FAILURE

Optimized temperature regulation of the corresponding zone is lost.

CONTROLS AND INDICATORS

CONTROLS ON OVERHEAD PANEL



(1) Zone temperature sel

- 12 o'clock position : 24°C (76°F).
- COLD position : 18°C (64°F).
- HOT position : 30°C (86°F).

(2) HOT AIR pushbutton

On : The valve regulates hot air pressure.
OFF : The valve closes, and the trim air valves close.
The FAULT circuit is reset.
FAULT : The amber light, and associated ECAM caution come on when duct overheat is detected. The fault circuit detects an overheat when the duct temperature reaches 88°C (190°F).
The valve and the trim air valves close automatically.
The FAULT light goes off when the temperature drops below 70°C (158°F), and the flight crew selects OFF.

③ PACK pb

On : The pack flow control valve is automatically controlled.
It opens, except in the following cases :
– Upstream pressure below minimum ;
– Compressor outlet overheat ;
– Engine start sequence :
1. If the crossbleed valve is closed, the valve located on the starting engine side immediately closes, when the MODE selector is set to IGN (or CRK).
2. It remains closed on the starting engine side (provided the crossbleed valve is closed) when :
· The MASTER switch is set to ON (or the MAN START pushbutton is set to ON), and
· The start valve is open, and
· N2 < 50 %.

Note : If the crossbleed valve is open at engine start, both pack flow control valves close.

3. On ground, reopening of the valves is delayed for 30 seconds to avoid a supplementary pack closure cycle during second engine start.
– The fire pushbutton, of the engine on the related side, is pressed,
– Ditching is selected.

OFF : The pack flow control valve closes.

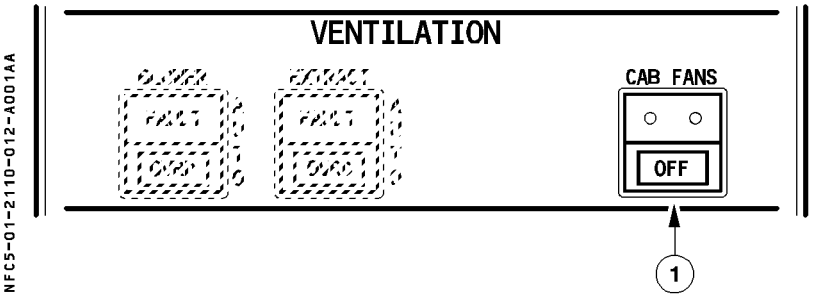
FAULT lt : Comes on amber, and a caution appears on the ECAM, if the pack flow control valve position disagrees with the selected position, or in the case of compressor outlet overheat or pack outlet overheat.

④ PACK FLOW sel

· Permits the selection of pack valve flow, according to the number of passengers and ambient conditions (smoke removal, hot or wet conditions).
LO (80 %) – NORM (100 %) – HI (120 %).
· Manual selection is irrelevant in single pack operation, or with APU bleed supply. In these cases, HI is automatically selected.
· If LO is selected, the pack flow can be automatically selected up to 100 % when the cooling demand cannot be satisfied.

(5) RAM AIR pb (guarded)

ON : The ON light comes on white.
If the DITCHING pushbutton, on the CABIN PRESS panel, is in normal position :
– The RAM air inlet opens.
– If $\Delta p \geq 1$ psi : The outflow valve control remains normal. No emergency RAM air flows in.
R – If $\Delta p < 1$ psi : The outflow valve opens to about 50 % when under automatic
R control. It does not automatically open when it is under manual control.
R Emergency RAM airflow is directly supplied to the mixer unit.
Off : The RAM air inlet closes.



(1) CAB FAN pushbutton

On : The two cabin fans are on.
OFF : The two cabin fans are off.

③ PACK pb

On : The pack flow control valve is automatically controlled.
It opens, except in the following cases :
– Upstream pressure below minimum ;
– Compressor outlet overheat ;
– Engine start sequence :
1. If the crossbleed valve is closed, the valve located on the starting engine side immediately closes, when the MODE selector is set to IGN (or CRK).
2. It remains closed on the starting engine side (provided the crossbleed valve is closed) when :
· The MASTER switch is set to ON (or the MAN START pushbutton is set to ON), and
· The start valve is open, and
· N2 < 50 %.

Note : If the crossbleed valve is open at engine start, both pack flow control valves close.

3. On ground, reopening of the valves is delayed for 30 seconds to avoid a supplementary pack closure cycle during second engine start.
– The fire pushbutton, of the engine on the related side, is pressed,
– Ditching is selected.

OFF : The pack flow control valve closes.

FAULT lt : Comes on amber, and a caution appears on the ECAM, if the pack flow control valve position disagrees with the selected position, or in the case of compressor outlet overheat or pack outlet overheat.

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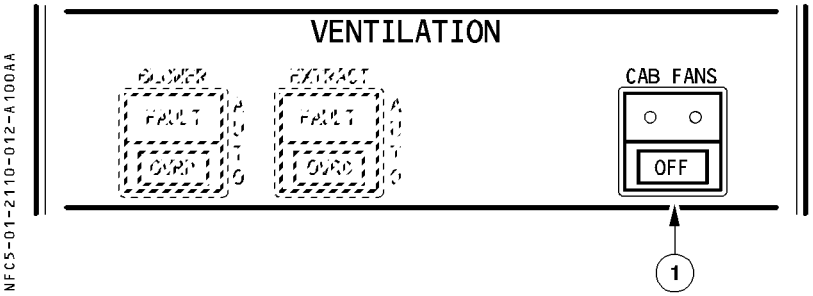
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- If $\Delta p < 1$ psi : The outflow valve opens to about 50 % when under automatic control. It does not automatically open when it is under manual control. Emergency RAM airflow is directly supplied to the mixer unit.

Off : The RAM air inlet closes.

(6) HEATER CAPT (F/O) switch

OFF : The foot heater is off. Air outlet temperature is based on the COCKPIT selector.
LO : Air temperature at heater air outlet increased by 12.5°C
HI : Air temperature at heater air outlet increased by 25°C



(1) CAB FAN pushbutton

On : The two cabin fans are on.
OFF : The two cabin fans are off.

③ PACK pb

On : The pack flow control valve is automatically controlled.
It opens, except in the following cases :
– Upstream pressure below minimum ;
– Compressor outlet overheat ;
– Engine start sequence :
1. If the crossbleed valve is closed, the valve located on the starting engine side immediately closes, when the MODE selector is set to IGN (or CRK).
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· The MASTER switch is set to ON (or the MAN START pushbutton is set to ON) and,
· The start valve is open and,
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Note : If the crossbleed valve is open at engine start, both pack flow control valves close.

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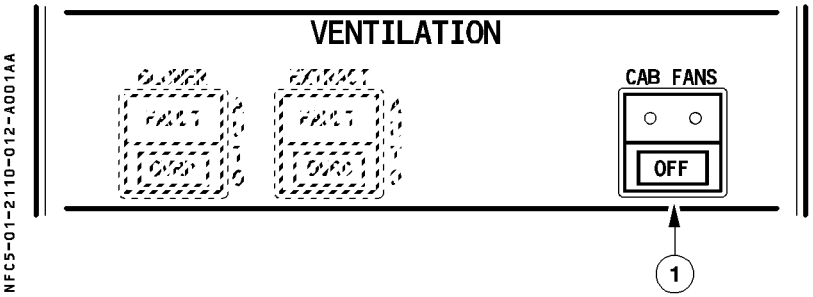
FAULT lt : Comes an amber, and a caution appears on the ECAM, if the pack flow control valve position disagrees with the selected position, or in the case of compressor outlet overheat or pack outlet overheat.

④ PACK FLOW pb

· Permits the selection of ECON or normal pack valve flow, according to the number of passengers and ambient conditions (smoke removal, hot or wet conditions).
ON : ECON flow is selected.
Off : Normal flow is selected. Normal flow provides 20 % more than ECON flow.
· Manual selection is irrelevant in single pack operation, or with APU bleed supply.
In these cases, the system delivers high flow (40 % more than the ECON flow).
· If ECON flow is selected, the pack flow can be automatically selected up to normal flow.

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On : The two cabin fans are on.
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It opens, except in the following cases :
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– Engine start sequence :
1. If the crossbleed valve is closed, the valve located on the starting engine side immediately closes, when the MODE selector is set to IGN (or CRK).
2. It remains closed on the starting engine side (provided the crossbleed valve is closed) when :
· The MASTER switch is set to ON (or the MAN START pushbutton is set to ON) and,
· The start valve is open and,
· N2 < 50 %.

Note : If the crossbleed valve is open at engine start, both pack flow control valves close.

3. On ground, reopening of the valves is delayed for 30 seconds to avoid a supplementary pack closure cycle during second engine start.
– Fire pushbutton, of the engine on the related side, is pressed,
– Ditching is selected.

OFF : The pack flow control valve closes.

FAULT lt : Comes an amber, and a caution appears on the ECAM, if the pack flow control valve position disagrees with the selected position, or in the case of compressor outlet overheat or pack outlet overheat.

④ PACK FLOW pb

· Permits the selection of ECON or normal pack valve flow, according to the number of passengers and ambient conditions (smoke removal, hot or wet conditions).
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· If ECON flow is selected, the pack flow can be automatically selected up to normal flow.

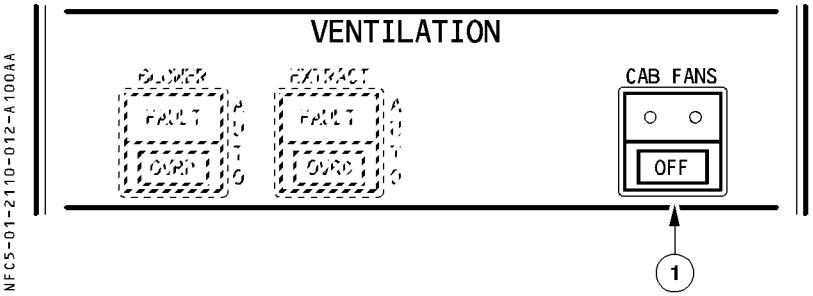
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LO : Air temperature at heater air outlet increased by 12.5°C
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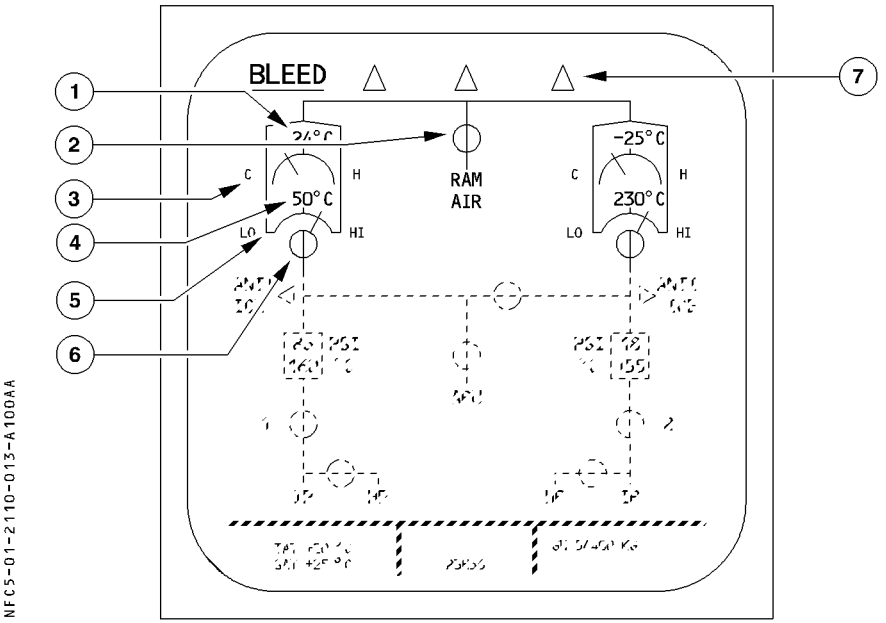
NFC5-01-2110-012-A100AA

(1) CAB FAN pushbutton

On : The two cabin fans are on.
OFF : The two cabin fans are off.

ECAM BLEED PAGE

R



(1) Pack outlet temperature

It appears in green. It becomes amber, if the temperature is higher than 90°C.

(2) RAM AIR inlet

Crossline – Green : The flap is normally closed.
In transit – Amber : The flap is partially open
R Inline – Amber : The flap is fully open on ground.
R Inline – Green : The flap is fully open in flight.

(3) Pack bypass valve position

Indication is green.
C = Cold – Valve closed
H = Hot – Valve open.

(4) Pack compressor outlet temperature

It appears in green. It becomes amber, if the temperature is higher than 230°C.

(5) Pack flow

It appears in green. It becomes amber, if the pack flow control valve is closed.

Note : The pack flow indication can be up to 30 % below the actual flow rate.

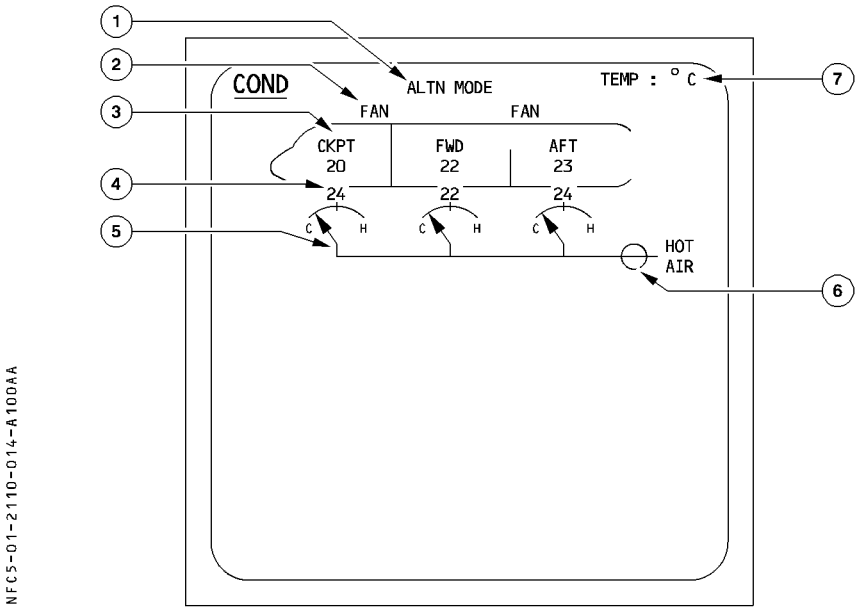
(6) Pack flow control valve

Inline - Green : Open.
Inline - Amber : Open, and disagrees with the control position.
Crossline - Green : Fully closed.
Crossline - Amber : Fully closed, and disagrees with the control position.

R (7) User Indication

R It appears in green.
R It becomes amber, when the RAM AIR flap and the two packs are fully closed.

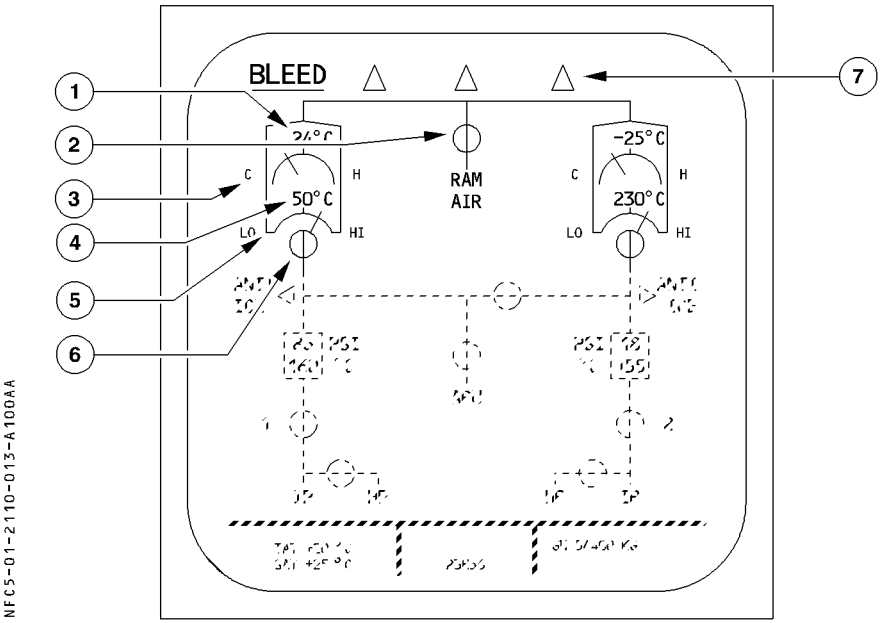
ECAM COND PAGE



NFC5-01-2110-014-A100AA

ECAM BLEED PAGE

R



(1) Pack outlet temperature

It appears in green. It becomes amber, if the temperature is higher than 90°C.

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Crossline – Green : The flap is normally closed.
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R Inline – Amber : The flap is fully open on ground.
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(3) Pack bypass valve position

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(5) Pack flow

It appears in green. It becomes amber, if the pack flow control valve is closed.

Note : The pack flow indication can be up to 30 % below the actual flow rate.

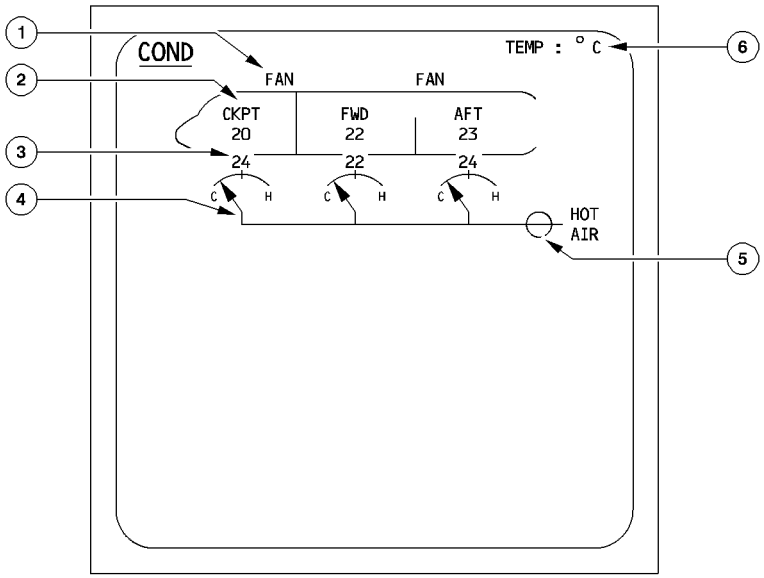
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Crossline - Green : Fully closed.
Crossline - Amber : Fully closed, and disagrees with the control position.

R (7) User Indication

R It appears in green.
R It becomes amber, when the RAM AIR flap and the two packs are fully closed.

ECAM COND PAGE



NFCS-01-2110-014-A200AA

(1) Zone controller fault indication

ALTN MODE : Primary zone controller fault (green).
PACK REG : Zone controller fault (basic regulation by packs only) (green).
No indication : Zone controller normal operation.

(2) Cabin FAN fault indication

It appears in amber, if the recirculation fan is detected as faulty.

(3) Zone temperature indication

It is green.

(4) Zone duct temperature

It appears in green, and becomes amber at 80°C (176°F).

(5) Zone trim air valve position indication

It appears in green, and becomes amber, if the valve fails.
C = Cold valve is fully closed.
H = Hot valve is fully open.

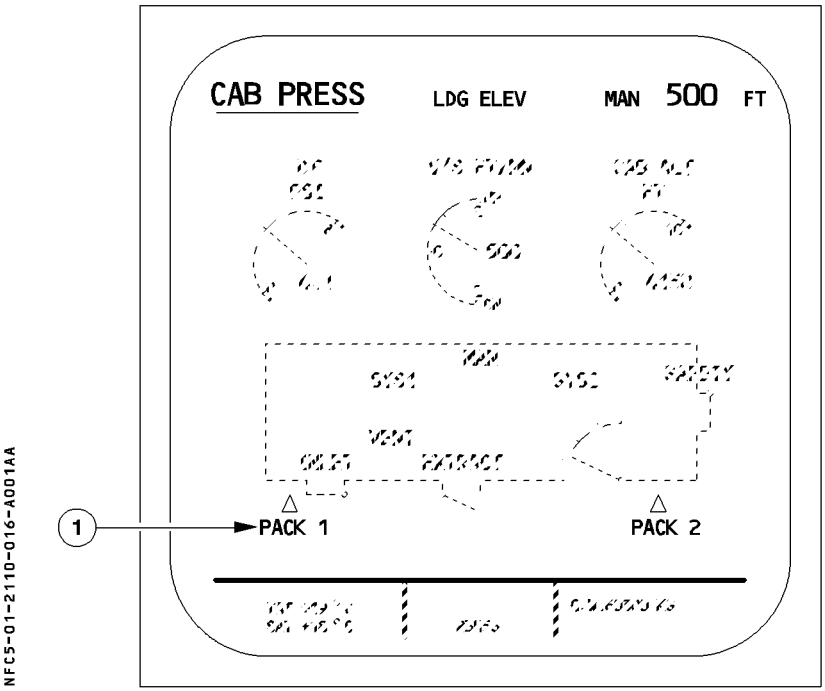
(6) Hot air pressure regulating valve

In line – Green : The valve is open.
In line – Amber : The valve is not closed ; disagrees with the control position.
Crossline – Green : The valve is fully closed, and the pushbutton is at auto.
Crossline – Amber : The valve is closed, and pushbutton is OFF, or the valve disagree is closed.

(7) TEMP

Unit of measure (°C or °F) is indicated in cyan.

ECAM CAB PRESS PAGE



(1) PACK indication

Triangle normally green, PACK 1(2) indication normally white. Both become amber when pack flow control valve is closed with associated engine running.

(1) Cabin FAN fault indication

It appears in amber, if the recirculation fan is detected as faulty.

(2) Zone temperature

It is in green.

(3) Zone duct temperature

It appears in green, and becomes amber at 80°C (176°F).

(4) Zone trim air valve position

It appears in green and becomes amber if the valve fails.
C = Cold valve fully closed.
H = Hot valve fully open.

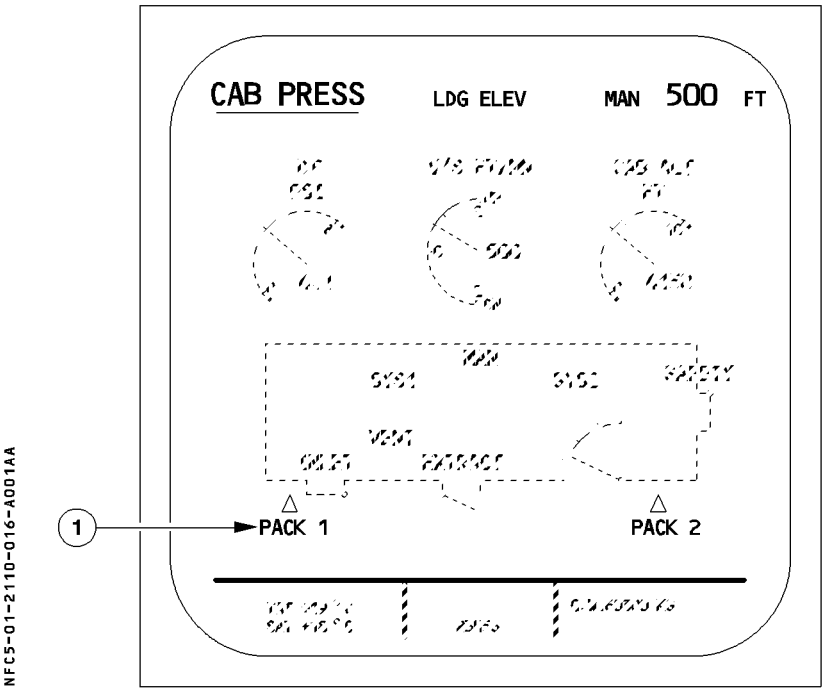
(5) Hot air pressure regulating valve

In line	- Green :	Valve is normally open.
In line	- Amber :	Valve is abnormally open (disagrees with control position).
Crossline	- Green :	Valve is normally fully closed.
Crossline	- Amber :	Valve is closed and pushbutton OFF, or valve position disagrees with control position.

(6) TEMP

Unit of measure (°C or °F) is indicated in cyan.

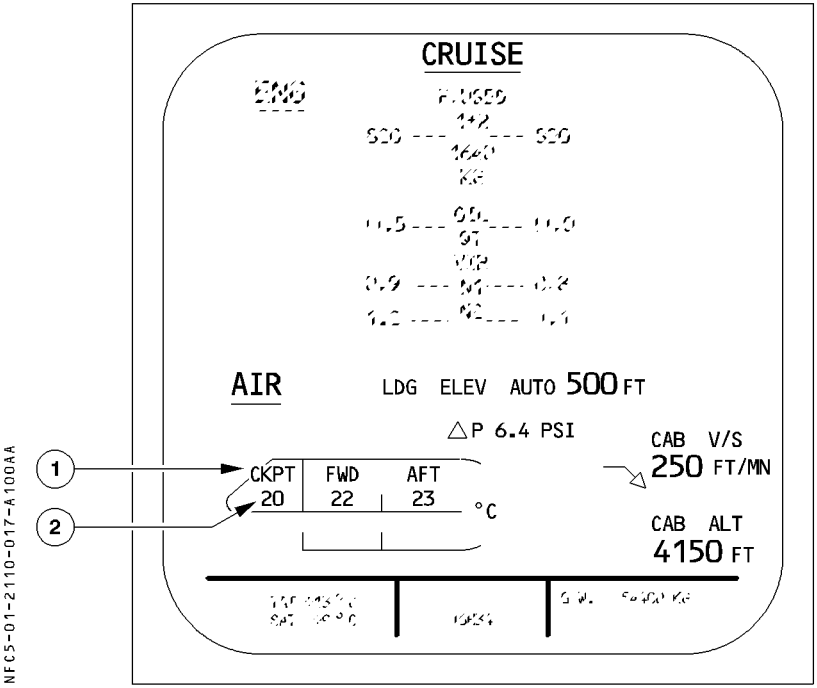
ECAM CAB PRESS PAGE



(1) PACK indication

Triangle normally green, PACK 1(2) indication normally white. Both become amber when pack flow control valve is closed with associated engine running.

ECAM CRUISE PAGE

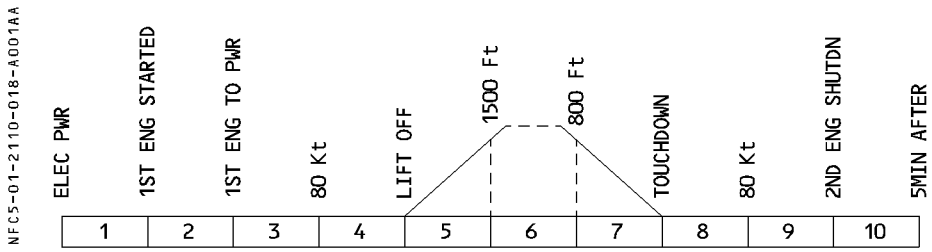


(1) Zone indication

This field also displays the temperature scale in use (°C or °F).

(2) Zone temperature

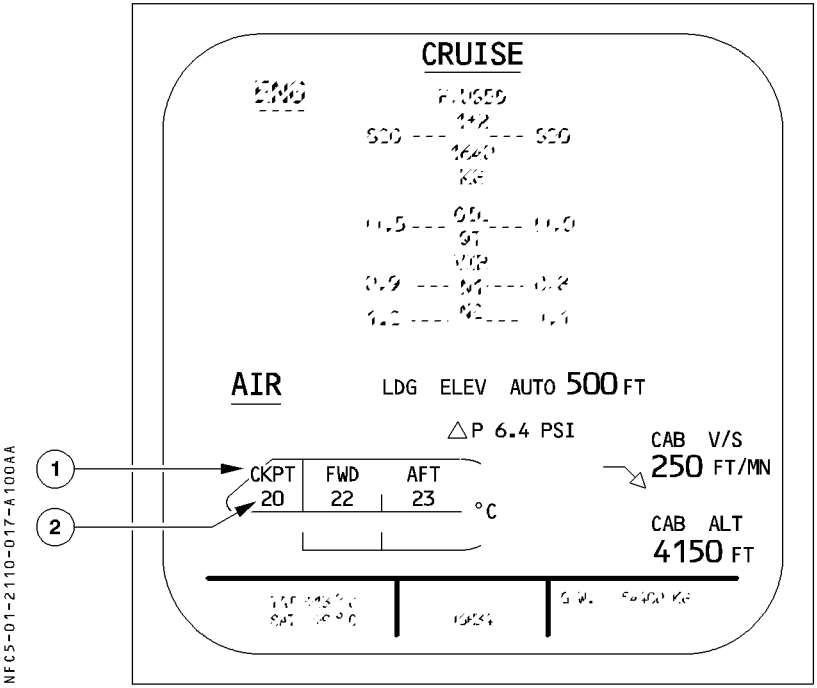
WARNINGS AND CAUTIONS



R

E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
PACK 1 (or 2) OVHT Pack compressor outlet temperature above 260°C, or pack outlet temp above 95°C.	SINGLE CHIME	MASTER CAUT	BLEED	PACK FAULT lt	3, 4, 5, 7, 8
PACK 1 (or 2) FAULT Pack valve disagree with selected position, or Pack compressor outlet temperature above 230°C four times during one flight.					
PACK 1 + 2 FAULT One pack off, then the other fault					
PACK 1 (2) OFF Pack pb at off with no failure				NIL	1, 2, 3, 4, 5, 7 8, 9, 10
CKPT (FWD CAB OR AFT CAB) DUCT OVHT Duct temperature above 88°C.			COND	HOT AIR FAULT lt	3, 4, 5, 7, 8
HOT AIR FAULT Hot air pressure regulating valve disagrees with selected position					
L + R CAB FAN FAULT Both fan failure				NIL	
PACK 1(2) REGUL FAULT Pack main channel, or pack main and secondary channels failed.	NIL	NIL	BLEED		
ZONE REGUL FAULT Zone controller main channel, or main and secondary channels failed.			COND		
LAV + GALLEY FAN FAULT			NIL		3, 4, 5, 7, 8, 9
TRIM AIR SYS FAULT One trim air valve fault, or overpressure downstream hot air valve.					3, 4, 5, 7, 8

ECAM CRUISE PAGE

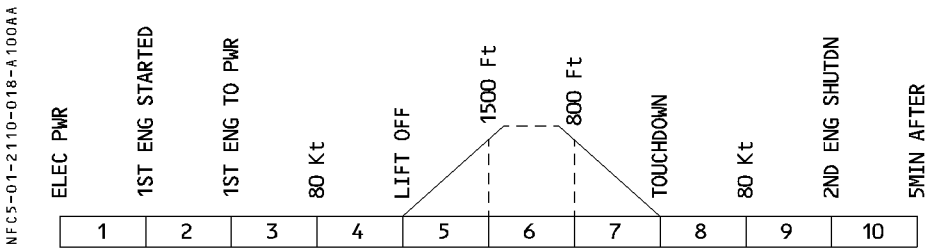


(1) Zone indication

This field also displays the temperature scale in use (°C or °F).

(2) Zone temperature

WARNINGS AND CAUTIONS



E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
PACK 1 (or 2) OVHT Pack compressor outlet temperature above 260°C, or above 230°C four times during one flight.	SINGLE CHIME	MASTER CAUT	BLEED	PACK FAULT lt	3, 4, 5, 7, 8
PACK 1 (or 2) FAULT Pack valve disagree with selected position, or pack valve closed					
PACK 1 + 2 FAULT Loss of ACSC 1 and ACSC 2					
PACK 1 (2) OFF Pack pb at OFF with no failure				NIL	1, 2, 3, 4, 5, 7 8, 9, 10
CKPT (FWD CAB OR AFT CAB) DUCT OVHT Duct temperature above 88°C or above 80°C four times during one flight			COND	HOT AIR FAULT lt	3, 4, 5, 7, 8
HOT AIR FAULT Hot air pressure regulating valve disagrees with selected position					
L + R CAB FAN FAULT Both fan failure				NIL	
PACK 1 (2) REGUL FAULT Failure of the By Pass Valve, or the RAM Air Inlet, or the Compressor Outlet Temperature sensor or the Flow Control Valve.	NIL	NIL	BLEED		
LAV + GALLEY FAN FAULT			NIL		3, 4, 5, 7, 8, 9
TRIM AIR SYS FAULT One trim air valve fault, or overpressure downstream hot air valve.					3, 4, 5, 7, 8
CTL 1 (2) - A (B) FAULT The lane A (B) of ACSC 1 (2) fails.					3, 4, 5, 7, 8

MEMO DISPLAY

RAM AIR ON appears in green if the ram air pushbutton switch is ON.

GENERAL

The cabin pressurization system has four general functions :
- Ground function : Fully opens the outflow valve on ground.
- Prepressurization : During takeoff, increases cabin pressure to avoid a surge in cabin pressure during rotation.
- Pressurization in flight : Adjusts cabin altitude, and rate of change to provide passengers with a comfortable flight.
- Depressurization : After touchdown, gradually releases residual cabin overpressure before the ground function fully opens the outflow valve.

The system consists of :
- Two Cabin Pressure Controllers (CPC)
- One outflow valve, with an actuator that incorporates three motors (two for automatic operation, one for manual operation)
- One control panel
- Two safety valves

Any one of the three independent electric motors may power the outflow valve.
Normally, one of the two cabin pressure controllers operates the outflow valve by means of its associated automatic motor.
In case of ditching, an override switch on the control panel allows the flight crew to close the outflow valve and all valves below the flotation line.
The flight crew can set the system to operate automatically, semi-automatically, or manually.
In normal operation, cabin pressurization is fully automatic.

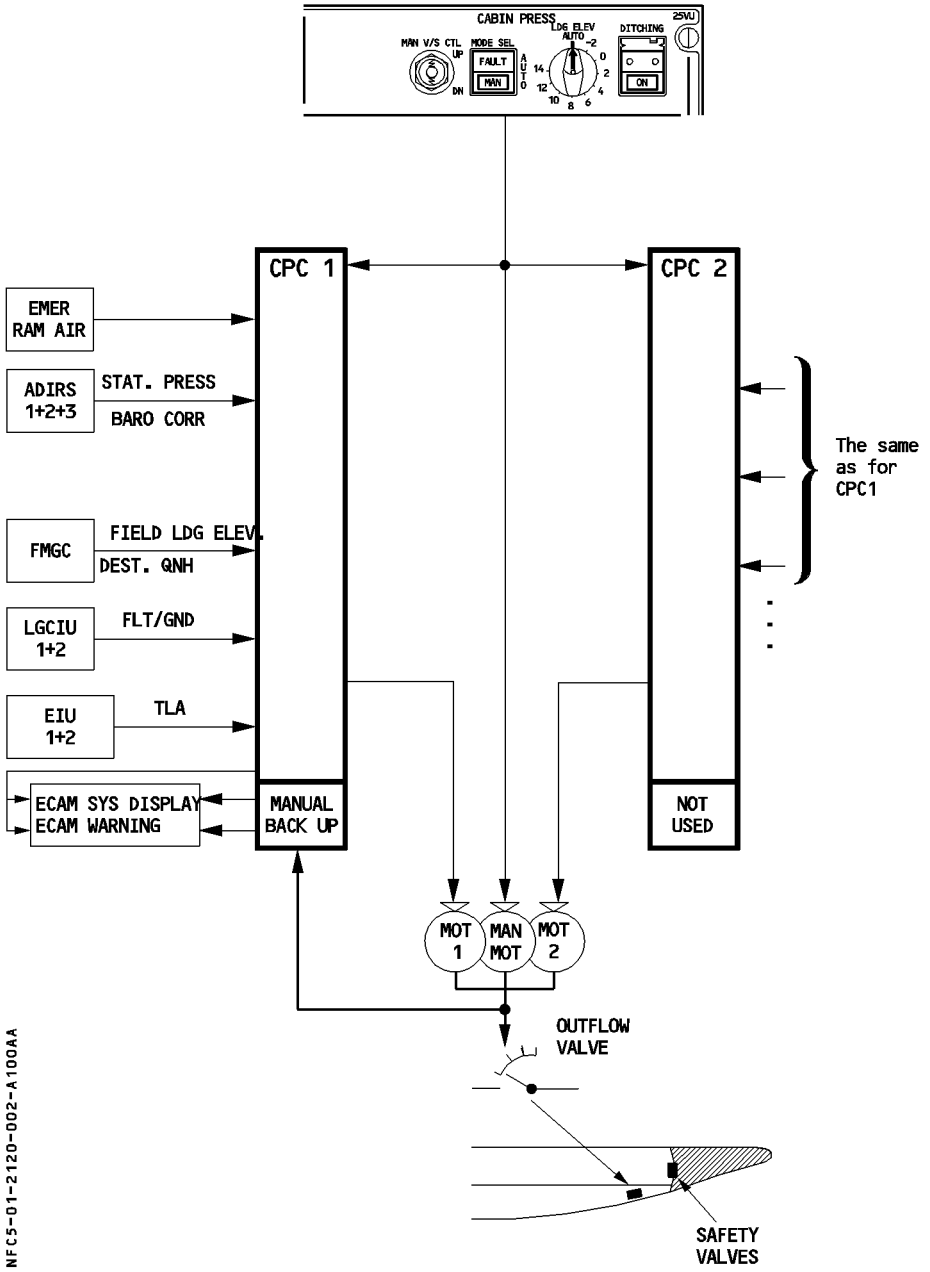
AUTOMATIC OPERATION

The flight crew monitors the operation of the system, but does nothing to control it. Air pressure in the cabin follows external schedules that the system receives as signals from the Flight Management and Guidance System (FMGS).
When FMGS data is not available for automatic pressurization, the crew only needs to select the landing field elevation.
R The pressurization system then uses the manually-selected landing field elevation for
R internal schedules.

MANUAL OPERATION

In manual mode, the flight crew controls the cabin altitude via the manual motor of the outflow valves, by operating controls on the pressurization control panel.

SCHEMATICS


CABIN PRESS
MAN V/S CTL
UP
DN
MODE SEL
FAULT
MAN
AUTO
LDG ELEV
AUTO
-2
0
2
4
6
8
10
12
14
DITCHING
ON
25VU
CPC 1
CPC 2
EMER
RAM AIR
ADIRS
1+2+3
STAT. PRESS
BARO CORR
FMGC
FIELD LDG ELEV.
DEST. QNH
LGCIU
1+2
FLT/GND
EIU
1+2
TLA
ECAM SYS DISPLAY
ECAM WARNING
MANUAL
BACK UP
NOT
USED
The same
as for
CPC1
MOT
1
MAN
MOT
MOT
2
OUTFLOW
VALVE
SAFETY
VALVES
NFC5-01-2120-002-A100AA

GENERAL

The cabin pressurization system has four general functions :
- Ground function : Fully opens the outflow valve on ground.
- Prepressurization : During takeoff, increases cabin pressure to avoid a surge in cabin pressure during rotation.
- Pressurization in flight : Adjusts cabin altitude, and rate of change to provide passengers with a comfortable flight.
- Depressurization : After touchdown, gradually releases residual cabin overpressure before the ground function fully opens the outflow valve.

The system consists of :
- Two Cabin Pressure Controllers (CPC)
- One Residual Pressure Control Unit (RPCU)
- One outflow valve, with an actuator that incorporates three motors (two for automatic operation, one for manual operation)
- One control panel
- Two safety valves

Any one of the three independent electric motors may power the outflow valve.
Normally, one of the two cabin pressure controllers operates the outflow valve by means of its associated automatic motor.
In case of ditching, an override switch on the control panel allows the flight crew to close the outflow valve and all valves below the flotation line.
The flight crew can set the system to operate automatically, semi-automatically, or manually.
In normal operation, cabin pressurization is fully automatic.

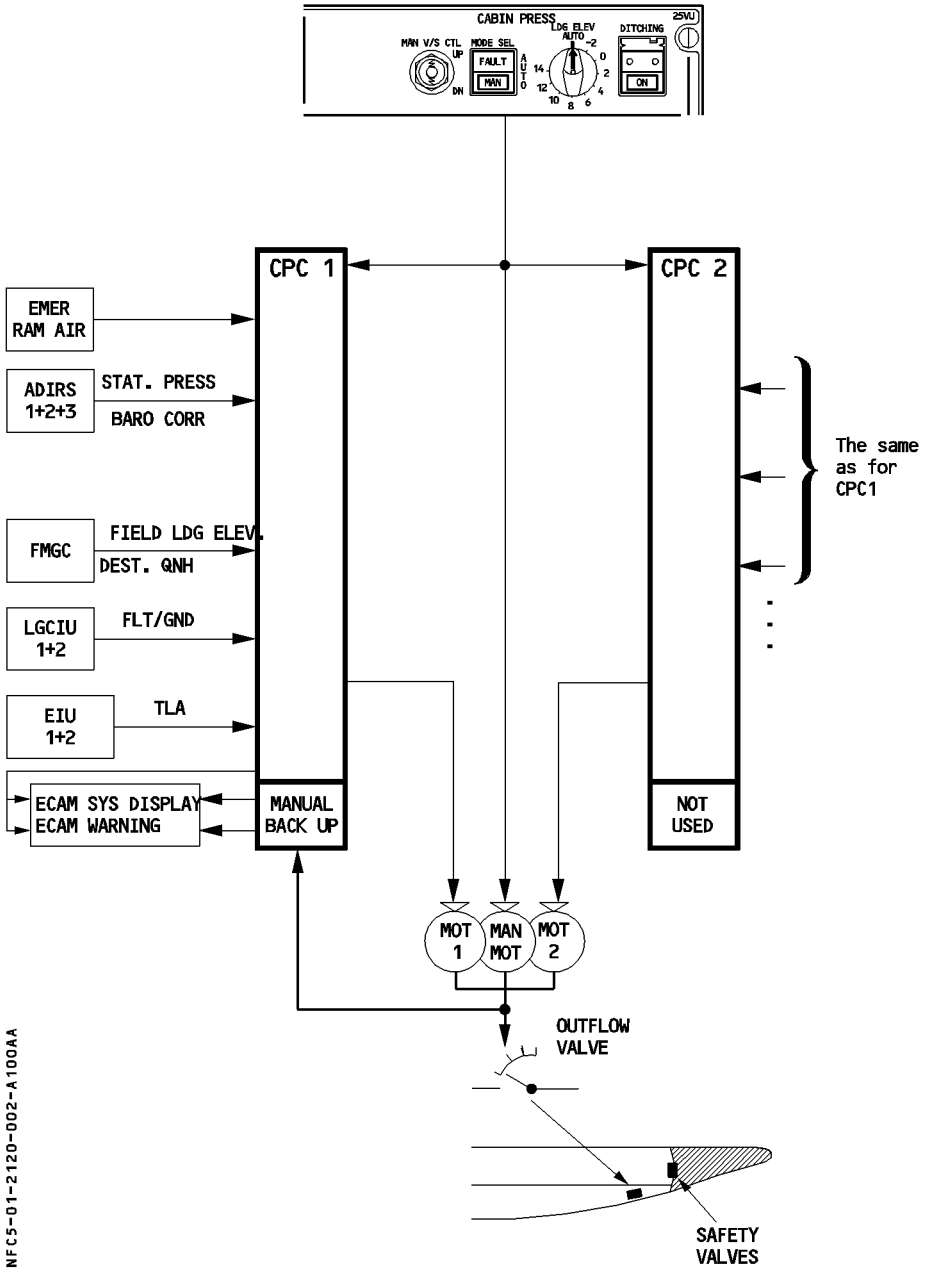
AUTOMATIC OPERATION

The flight crew monitors the operation of the system, but does nothing to control it. Air pressure in the cabin follows external schedules that the system receives as signals from the Flight Management and Guidance System (FMGS).
When FMGS data is not available for automatic pressurization, the crew only needs to select the landing field elevation.
The pressurization system then uses the manually-selected landing field elevation for internal schedules.

MANUAL OPERATION

In manual mode, the flight crew controls the cabin altitude via the manual motor of the outflow valves, by operating controls on the pressurization control panel.

SCHEMATICS


CABIN PRESS
MAN V/S CTL
UP
DN
MODE SEL
FAULT
MAN
AUTO
LDG ELEV
AUTO
-2
0
2
4
6
8
10
12
14
DITCHING
ON
25VU
CPC 1
CPC 2
EMER RAM AIR
ADIRS 1+2+3
STAT. PRESS
BARO CORR
FMGC
FIELD LDG ELEV.
DEST. QNH
LGCIU 1+2
FLT/GND
EIU 1+2
TLA
ECAM SYS DISPLAY
ECAM WARNING
MANUAL BACK UP
NOT USED
The same as for CPC1
MOT 1
MAN MOT
MOT 2
OUTFLOW VALVE
SAFETY VALVES
NFC5-01-2120-002-A100AA

MAIN COMPONENTS

CABIN PRESSURE CONTROLLERS

Two identical, independent, digital controllers automatically control the system, by maintaining the proper cabin pressure. They receive signals from the Air Data Inertial Reference System (ADIRS), the Flight Management and Guidance Computer (FMGC), the Engine Interface Unit (EIU), and the Landing Gear Control Interface Unit (LGCIU).
When the system is in automatic or semi-automatic mode, one controller is active, the other is on standby.
The controllers also generate signals for the Electronic Centralized Aircraft Monitoring (ECAM).
For operation in manual mode, each controller has a backup section, which is powered by an independent power supply in the controller N°1 position. This section also has a pressure sensor that generates the cabin altitude and pressure signal for the ECAM, when MAN mode is selected.
The controllers communicate with each other via a cross-channel link.

OUTFLOW VALVE

The outflow valve is on the right-hand side of fuselage, behind the aft cargo compartment and below the flotation line.
The outflow valve assembly consists of a flush, skin-mounted, rectangular frame, carrying inward and outward opening flaps linked to the actuator. The actuator contains the drives of the two automatic motors and the manual motor. Either of two automatic motors operates the valve in automatic mode, and the manual motor operates it in manual mode.
In automatic mode, the operating controller signals the position of the valve to the ECAM.
In manual mode, the backup section of the N° 1 controller signals the position of the valve to the ECAM.

Note : When the RAM AIR pushbutton is ON, and $\triangle p$ is below 1 psi, the system drives the outflow valve about 50 % open if it is under automatic control. If the system is under manual control, the outflow valve does not automatically open, even if $\triangle p$ is below 1 psi.

SAFETY VALVES

Two independent pneumatic safety valves prevent cabin pressure from going too high (8.6
R psi above ambient) or too low (1 psi below ambient).
They are located on the rear pressure bulkhead, above the flotation line.

RESIDUAL PRESSURE CONTROL UNIT

The Residual Pressure Control Unit (RPCU) automatically depressurizes the aircraft in case of abnormal residual pressure on ground. It automatically opens the outflow valve, when:

- The outflow valve is not fully open, and
- Both CPCs are failed, or manual mode is selected, and
- The aircraft is on ground, and
- All engines are shutdown, or all ADIRS indicate an airspeed below 100 kts.

SYSTEM OPERATION

AUTOMATIC PRESSURE CONTROL MODE

– Two identical, independent, automatic systems (each consisting of a controller and its associated motors) control cabin pressure.
Either system controls the single outflow valve.
Only one controller operates at a time.
An automatic transfer occurs :
· 70 seconds after each landing.
· If the operating system fails.
– The controller automatically controls the cabin pressure. It limits the cabin pressure to 8000 feet maximum and optimizes it during climb and descent phases.
– The controller normally uses the landing elevation and the QNH from the FMGC, and the pressure altitude from ADIRS.
If FMGC data are not available, the controller uses the captain Baro Reference from the ADIRS and the LDG ELEV selection.
– Pressurization is assumed through the following modes :

Ground (GN)

Before takeoff, and 55 seconds after landing, the outflow valve fully opens to ensure that there is no residual cabin pressure. At touchdown, any remaining cabin pressure is released at a cabin vertical speed of 500 feet/minute.

Takeoff (TO)

R To avoid a pressure surge at rotation, the controller pre-pressurizes the aircraft at a rate of 400 feet/minute, until the $\triangle P$ reaches 0.1 PSI. At lift-off, the controller initiates the climb phase.

Climb (CL)

During climb, the cabin altitude varies according to a fixed pre-programmed law that takes into account the aircraft's actual rate of climb.

Cruise (CR)

During cruise, the controller maintains cabin altitude at the level-off value, or at the landing field elevation, whichever is higher.

Descent (DE)

During descent, the controller maintains a cabin rate of descent, such that cabin pressure equals the landing field pressure, just before landing.
The maximum descent rate is 750 feet/minute.

Abort (AB)

If the aircraft does not climb after takeoff, the abort mode prevents the cabin altitude from climbing.
Cabin pressure is set back to the takeoff altitude + 0.1 PSI.

PRESSURIZATION MODES SWITCHING

FOR INFO

	FROM	GN	TO	GN	CL	AB	TO	CL	CR	CR	DE	DE	AB
	TO	TO	CL	CL	AB	GN	GN	CR	CL	DE	CL	GN	CL
CONDITIONS	ENG 1 and ENG 2 TLA ≥ MCT (*)	1					0						
	L/G sys 1 or sys 2 COMPRESSED	1					1						
	One L/G sys UNLOADED and A/C speed above 100 kt		1	1									
	One L/G sys COMPRESSED and A/C speed below 100 kt					1						1	
	A/C ALT. < 8000 FT				1A								
	A/C ALT. ≥ 8000 FT							1					
	A/C ALT. CHANGE SINCE T/O ≤ 5075 SLFT				1A								
	A/C ALT. CHANGE SINCE T/O ≥ 5075 SLFT							1					
	A/C RATE OF CLIMB ≥ 21 SL FPM FOR 60 SEC.										1		1
	A/C RATE OF CLIMB ≥ 100 SL FPM FOR 30 SEC.							0	1				
	A/C RATE OF DESCENT ≥ 200 SL FPM FOR 30 SEC.				1								
	A/C RATE OF DESCENT ≥ 250 SL FPM FOR 30 SEC									1			

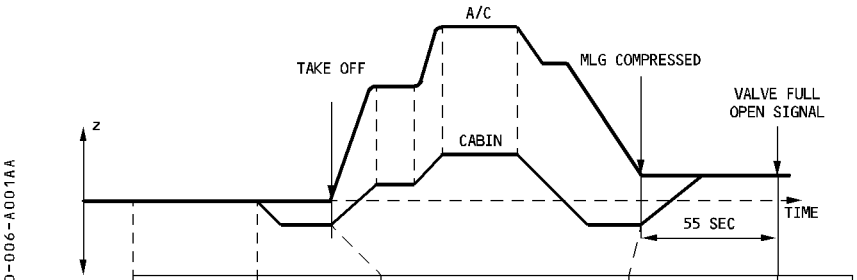
0 : Condition not valid
1 : Condition valid
1A : Only one A condition necessary
(*) : Engine running

Example

The cabin pressure controller switches from CL (climb) mode to AB (abort) mode when:
- the aircraft is below 8000 feet, or the aircraft has changed altitude less than 5075 feet since takeoff and,
- the aircraft rate of descent is greater than 200 feet/minute for 30 seconds.

PRESSURIZATION FLIGHT PROFILE

R



	GROUND	PREPRESSU	PRESSURIZATION	DEPRESS	GROUND
CABIN V/S		-400 ft/min		+500 ft/min	
CABIN Δ P		+0.1 PSI	≤+8.06 PSI	+0.1 PSI	

MANUAL PRESSURE CONTROL MODE

If both automatic systems fail, the flight crew may use the CABIN PRESS control panel to take over manual control of cabin pressurization.
· Press the MODE SEL pushbutton to select MAN, and
· Push the MAN V/S CTL switch UP or DN to increase or decrease cabin altitude.
The first of these actions cuts off power to the AUTO motors, and enables the MAN motor to control the outflow valve.

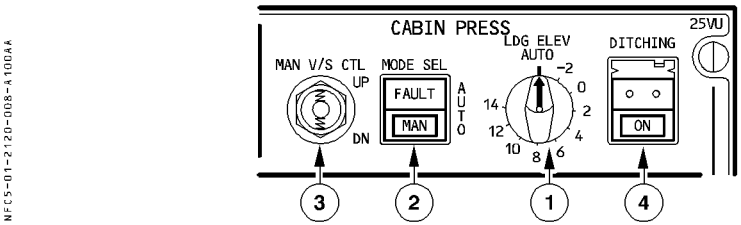
Note : 1. Due to the slow operation of the outflow valves in manual mode, and the limited resolution of the outflow valves' position on the ECAM, the visual ECAM indication of a change in the outflow valves' position can take up to 5 seconds.
2. As the pressurization system is manually-controlled, the outflow valve does not open automatically at touchdown.

DITCHING

To prepare for ditching, the flight crew must press the DITCHING pushbutton on the CABIN PRESS control panel to close the outflow valve, the emergency ram air inlet, the avionics
R ventilation inlet and extract valves, and the pack flow control valves.

CONTROLS AND INDICATORS

OVERHEAD PANEL



① LDG ELEV sel

AUTO : The pressurization system uses the FMGS data to construct an optimized pressure schedule.
To exit the AUTO position, pull out and turn the selector.

Other positions : The pressurization schedule does not use the landing elevation from the FMGS, but instead uses the landing elevation selected with this knob (from – 2000 to + 14000 feet) as its reference.

Note : The LDG ELEV selector scale is only given as an indication ; refer to the ECAM information for accurate adjustment.

② MODE SEL pb

AUTO : Automatic mode is operating. One of the two systems controls the
R outflow valve.

MAN : This legend appears in white, and FAULT does not come on. The flight crew then uses the MAN V/S CTL switch to control the outflow valve.

R *Note : Switching the MODE SEL pushbutton to MAN, for at least 10*
R *seconds, then returning it to AUTO will select the other system.*

FAULT lt : This legend appears in amber and the ECAM caution light comes on only when both automatic systems are faulty.

Note : The pilot may notice a variation in the CAB ALT indication on the ECAM PRESS page, when the system switches from the cabin pressure control AUTO mode to MAN mode, due to the reduced resolution of the backup pressure sensor.

(3) MAN V/S CTL toggle switch

The switch, springloaded to neutral, controls the outflow valve position through operation of the MAN motor, when the MODE SEL pushbutton is in the MAN position.
UP : The valve moves towards the open position.
DN : The valve moves towards the closed position.

Note : The outflow valve operates slowly, so the pilot must hold the toggle switch in the UP or DN position until reaching the target V/S.

(4) DITCHING guarded pushbutton

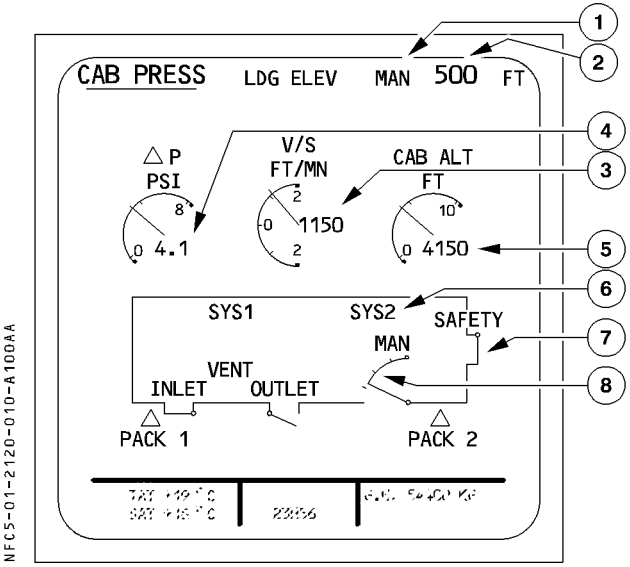
Normal : The system functions normally.
ON : The operating system sends a "close" signal to the outflow valve, emergency ram air inlet, avionics ventilation inlet and extract valves, and
R pack flow control valves.

Note : The outflow valve will not close automatically, if it is under manual control.

CAUTION

If the ditching pushbutton is set to ON, on ground, with the low pressure ground cart connected and all doors closed, a differential pressure will build up.

ECAM CAB PRESS PAGE



(1) LDG ELEV AUTO/MAN

- LDG ELEV AUTO appears in green when the LDG ELEV selector is in AUTO.
- LDG ELEV MAN appears in green when the LDG ELEV selector is not in AUTO.
- Neither appears when the indications from SDAC are not valid.

(2) Landing elevation

The landing elevation selected either automatically by the FMGS or manually by the pilot appears in green (but not when the MODE SEL pushbutton switch is in MAN).

(3) V/S FT/MIN (cabin vertical speed)

The analog and digital presentations appear in green when V/S is in the normal range. The digital presentation pulses when V/S > 1750 feet/minute (resets at 1650 feet/minute).

④ △P PSI (cabin differential pressure)

The analog and digital presentations appear in green when △P is in the normal range.
R They appear in amber when △P ≤ – 0.4 psi or ≥ 8.5 psi.
The digital presentation pulses if △p > 1.5 psi (resets at 1 psi) during flight phase 7. (See page 14 to identify flight phases).

⑤ CAB ALT FT (cabin altitude)

The analog and digital presentations appear in green, in normal range.
They appear in red if the cabin altitude goes above 9550 feet.
The digital presentation pulses if the cabin altitude is at or above 8800 feet (resets at 8600 feet).

⑥ Active system indication (SYS 1 or SYS 2 or MAN)

SYS 1 or SYS 2 appears in green when active and in amber when faulty. When either system is inactive, its title does not appear.
MAN appears in green when the MODE SEL switch is in MAN.

⑦ Safety valve position

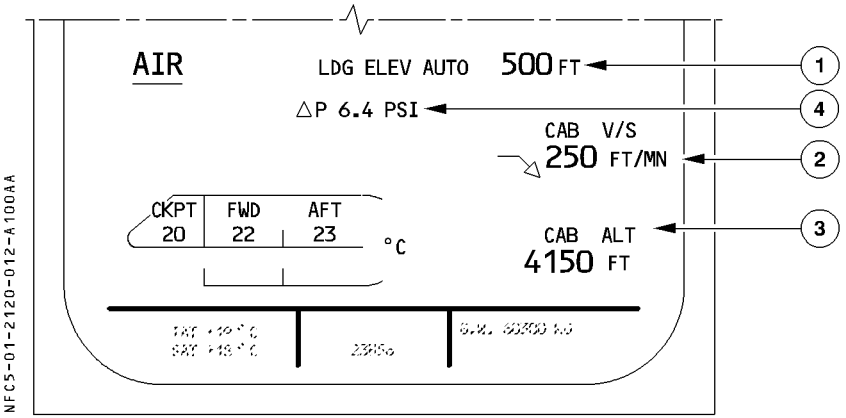
SAFETY appears in white and the diagram in green when both safety valves are fully closed. SAFETY and the diagram appear in amber when either valve is not closed.

Note : The safety valve opens when the cabin differential pressure is between 8.2 and 8.9 psi. The range is due to the reduced accuracy of △P measurements (in MAN mode), combined with the decrease in cabin differential pressure that occurs immediately after the safety valves open.

⑧ Outflow valve position

The diagram is green when the valve is operating normally.
The diagram becomes amber when the valve opens more than 95 % during flight.

ECAM CRUISE PAGE



NFCS-01-2120-012-A100AA

(1) LDG ELEV AUTO/MAN

Identifical to the CAB PRESS page.

(2) CAB V/S FT/MIN (cabin vertical speed)

Green, in normal range.
Amber, when out of normal range : V/S ≥ 2000 feet/minute
Pulses, when the V/S > 1750 feet/minute (resets at 1650 feet/minute).



NFCS-01-2120-012-B100AA

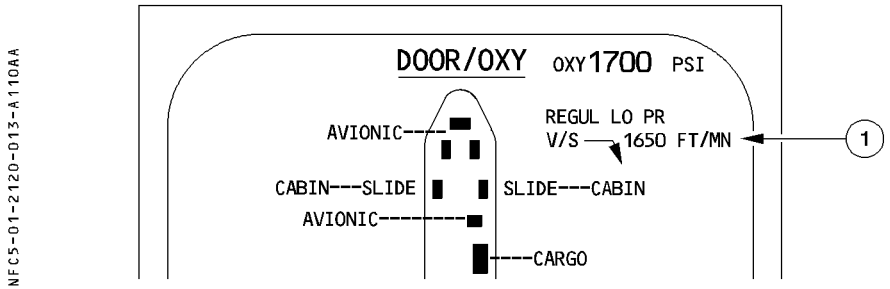
(3) CAB ALT FT (cabin altitude)

Green, in normal range.
Red, for excessive cabin altitude : ≥ 9550 feet.
Pulses for cabin altitude at, or above, 8800 feet (resets at 8 600 feet).

(4) △P indication

It is normally green. Pulses green when CAB △P ≥ 1.5 PSI before landing.
It becomes amber, when out of normal range △p ≤ – 0.4 psi or ≥ 8.5 psi.

ECAM DOOR PAGE

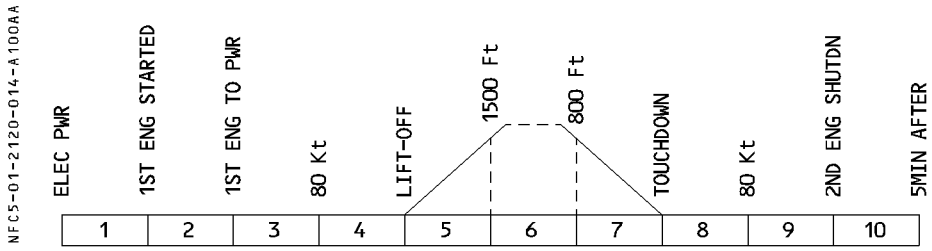


(1) V/S (cabin vertical speed)

This number only appears during flight phases 5, 6 and 7. (See page 14 for flight phase definitions).

- It is normally green.
- R R It pulses, when the V/S is greater than 1 750 feet/minute and stops pulsing, when less than 1 650 feet/minute.
- It becomes amber, when the V/S is greater than 2000 feet/minute, or less than – 2000 feet/minute.

WARNINGS AND CAUTIONS



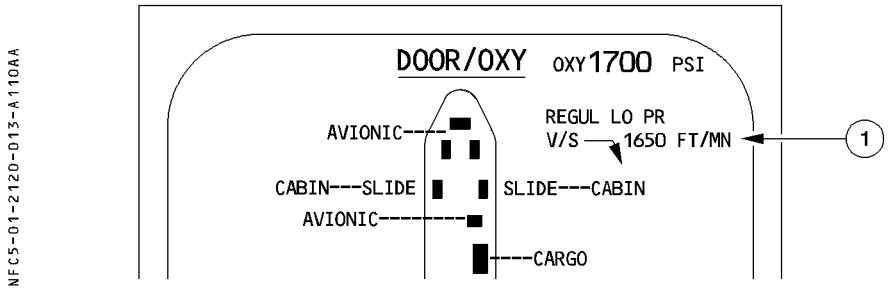
R

E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
EXCESS CAB ALT : Cabin altitude exceeds : – In CLB and DES the higher of : 9550 feet or landing field elevation plus 1000 feet – In CRZ 9550 feet	CRC	MASTER WARN	CAB PRESS	NIL	2, 3, 4 5, 7, 8 9, 10
SYS 1 + 2 FAULT Both pressure controllers fail.	SINGLE CHIME	MASTER CAUT	CAB PRESS	MODE SEL FAULT lt	4, 5, 7, 8
LO DIFF PR Time to reach $\triangle P = 0 < 1.5$ minutes, and time to reach $\triangle P = 0 \leq$ (time for cab alt to reach landing elevation) + 30 seconds and aircraft is at least 3000 ft above landing field. Note : The warning is maintained when the aircraft descends below 3000 ft above landing field.				NIL	2, 3, 4 5, 7, 8 9, 10
OUTFLOW VALVE NOT OPEN Valve not fully open on ground (time delay 3 minutes)					3, 4, 5 6, 7, 8
SAFETY VALVE OPEN Either safety valve not fully closed on ground or not fully closed for more than 1 minute in flight.					4, 5, 7 8, 9, 10
LDG ELEV FAULT No FMGS LDG ELEV data is available.					3, 4, 5 7, 8 9, 10
SYS 1 (or 2) FAULT Pressure controller fault.	NIL	NIL			3, 4, 5 7, 8

MEMO DISPLAY

The "MAN LDG ELEV" message is displayed in green, if the LDG ELEV selector is not in the AUTO position.

ECAM DOOR PAGE

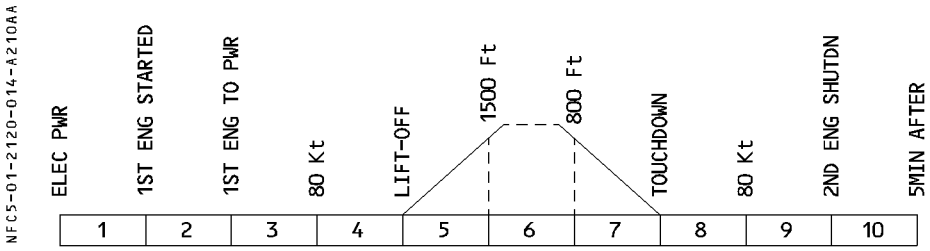


(1) V/S (cabin vertical speed)

This number only appears during flight phases 5, 6 and 7. (See page 14 for flight phase definitions).

- It is normally green.
- R R It pulses, when the V/S is greater than 1 750 feet/minute and stops pulsing, when less than 1 650 feet/minute.
- It becomes amber, when the V/S is greater than 2000 feet/minute, or less than – 2000 feet/minute.

WARNINGS AND CAUTIONS



E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
EXCESS CAB ALT : Cabin altitude exceeds : – In CLB and DES the higher of : 9550 feet or landing field elevation plus 1000 feet – In CRZ 9550 feet	CRC	MASTER WARN	CAB PRESS	NIL	1 to 5 7 to 10
SYS 1 + 2 FAULT Both pressure controllers fail.	SINGLE CHIME	MASTER CAUT	CAB PRESS	MODE SEL FAULT lt	4, 5, 7, 8
LO DIFF PR Time to reach $\triangle P = 0 < 1.5$ minutes, and time to reach $\triangle P = 0 \leq$ (time for cab alt to reach landing elevation) + 30 seconds and aircraft is at least 3000 ft above landing field. Note : The warning is maintained, when the aircraft descends below 3000 ft above landing field.				NIL	2, 3, 4 5, 7, 8 9, 10
FWD (AFT) OFV NOT OPEN Valve not fully open on ground (time delay 70 seconds)					3, 4, 5 6, 7, 8
SAFETY VALVE OPEN Either safety valve not fully closed on ground or not fully closed for more than 1 minute in flight.					4, 5, 7 8, 9, 10
LDG ELEV FAULT No FMGS LDG ELEV data is available.					3, 4, 5 7, 8 9, 10
SYS 1 (or 2) FAULT Pressure controller fault.	NIL	NIL			3, 4, 5 7, 8

MEMO DISPLAY

The "MAN LDG ELEV" message is displayed in green, if the LDG ELEV selector is not in the AUTO position.

GENERAL

The ventilation system includes ventilation for :
- the avionics, controlled by the avionics equipment ventilation controller (AEVC),
- the battery,
- the lavatories and galleys.

Note : For more information about cargo ventilation, Refer to 1.21.40.

AVIONICS VENTILATION

GENERAL

The avionics ventilation system is fully automatic.
It cools the electrical and electronic components in the avionics compartment and on the flight deck, including the instrument and circuit breaker panels. It uses two electric fans to force the circulation of cooling air.
Whatever the configuration of the avionics ventilation system is, a part of the avionics ventilation air is sucked from the cockpit through the different cockpit panels.

MAIN COMPONENTS

FANS

Two electric fans operate continuously as long as the aircraft electrical system is supplied. They make the air circulate around the avionics equipment.

SKIN AIR INLET AND EXTRACT VALVES

These valves admit air from outside the aircraft and evacuate hot air from inside the aircraft.

SKIN EXCHANGE INLET AND OUTLET BYPASS VALVES

These valves permit air to circulate between the avionics bay and the space under the cargo compartment floor.

AIR CONDITIONING INLET VALVE

This valve opens to permit the air conditioning circuit to supply fresh air to the avionics bay.

SKIN EXCHANGE ISOLATION VALVE

This valve connects or isolates the skin heat exchanger.

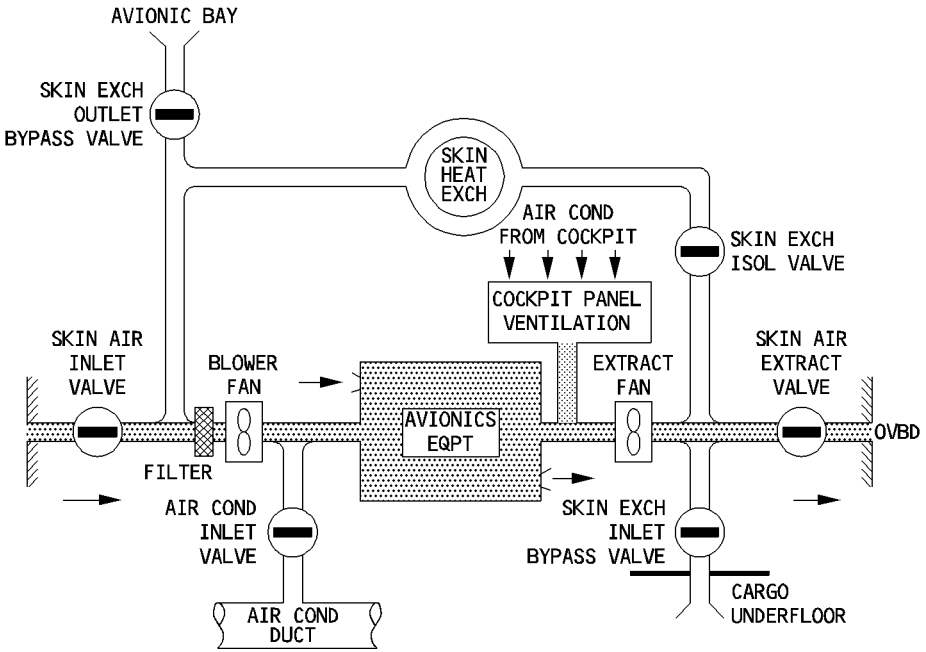
AVIONICS EQUIPMENT VENTILATION COMPUTER (AEVC)

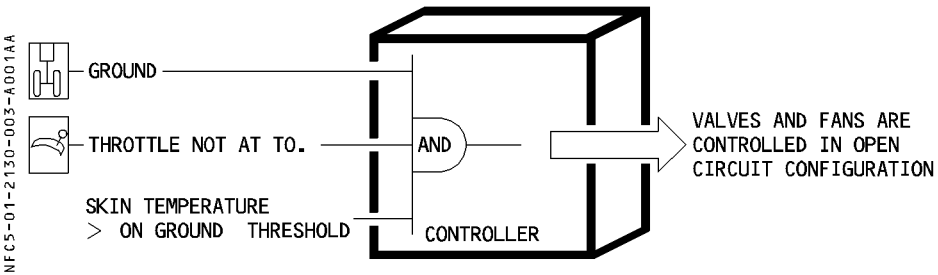
The AEVC controls the operation of all fans and valves in the avionics ventilation system.

NORMAL OPERATION, OPEN-CIRCUIT CONFIGURATION

GROUND OPERATIONS

The open-circuit configuration operates when skin temperature is above the on-ground threshold.
On-ground threshold = + 12°C (53°F), temperature increasing, or
= + 9°C (48°F), temperature decreasing.





NORMAL OPERATION, CLOSE-CIRCUIT CONFIGURATION

Flight operations

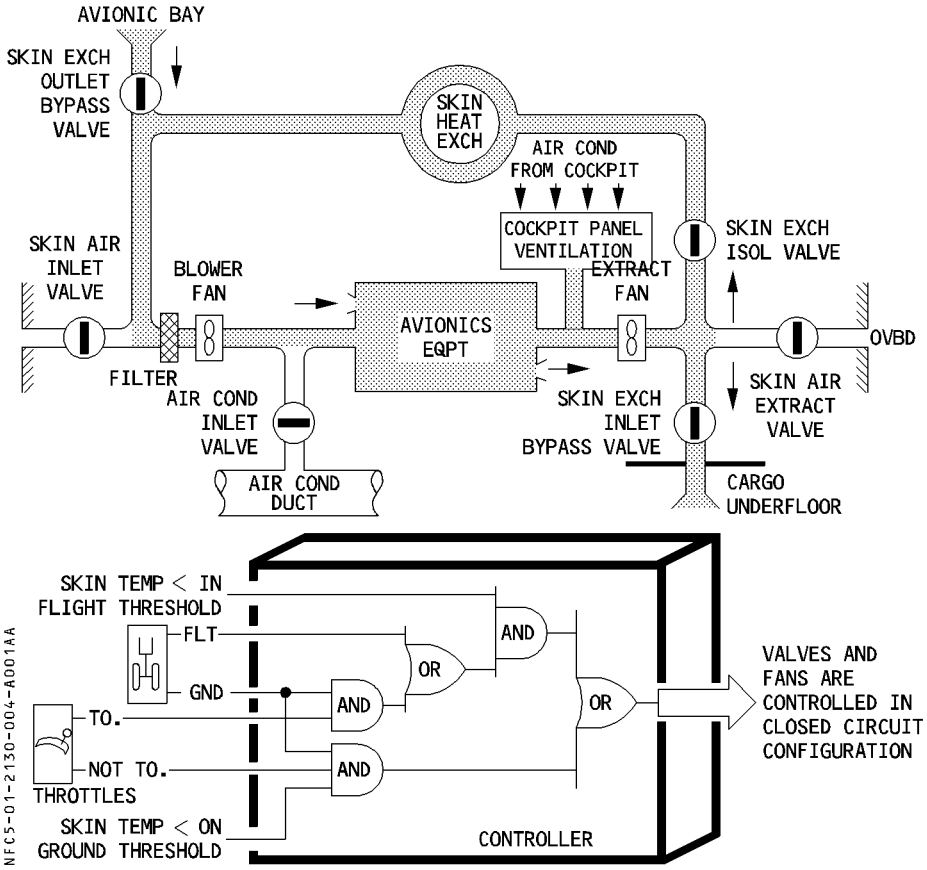
The close-circuit configuration operates when skin temperature is beneath the in-flight threshold.

In flight threshold = + 35°C (95°F), temperature increasing, or
= + 32°C (90°F), temperature decreasing.

Ground operations

The close-circuit configuration operates when skin temperature is beneath the on-ground threshold.

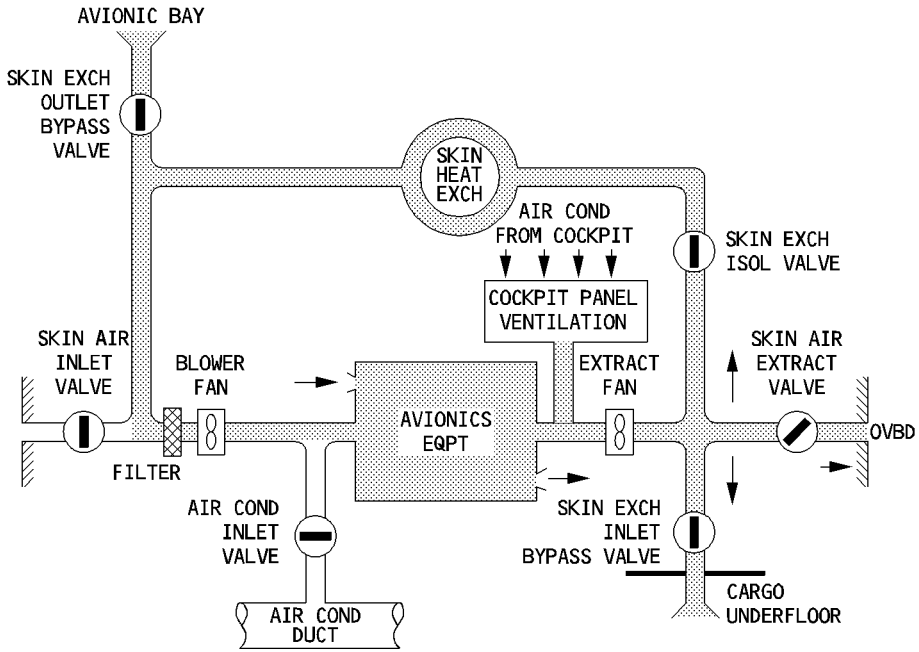
On ground threshold = + 12°C (53°F), temperature increasing, or
= + 9°C (48°F), temperature decreasing.

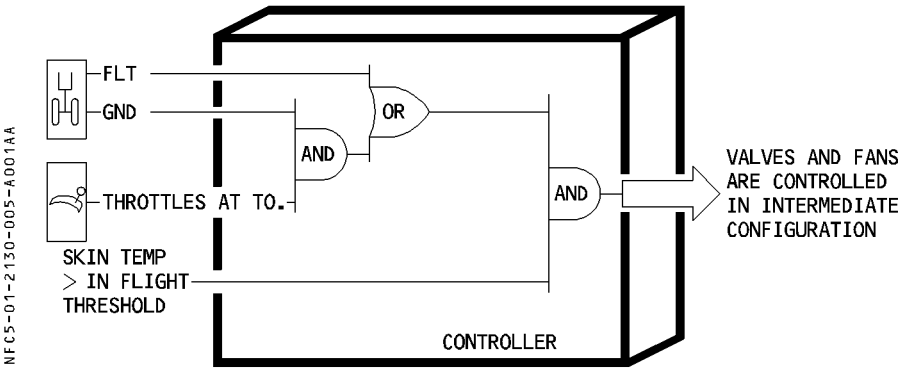


NORMAL OPERATION, INTERMEDIATE CONFIGURATION

Flight operations

The intermediate configuration operates when skin temperature is above the in-flight threshold.
In flight threshold = + 35°C (95°F), temperature increasing, or
= + 32°C (90°F), temperature decreasing.

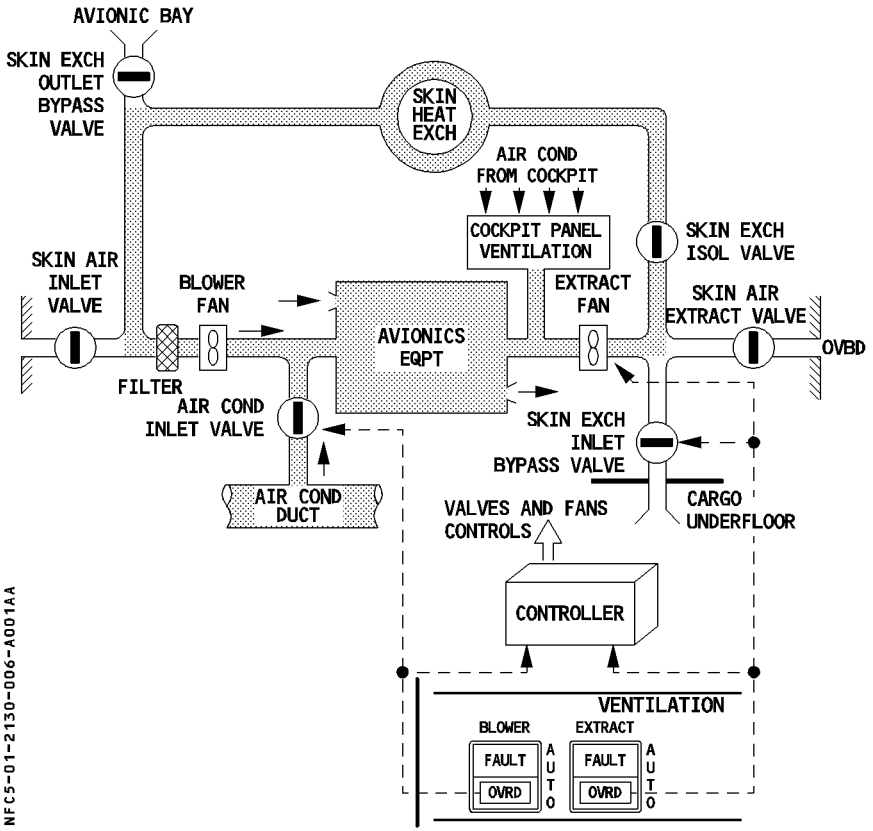




ABNORMAL OPERATION

BLOWER FAULT or EXTRACT FAULT warning

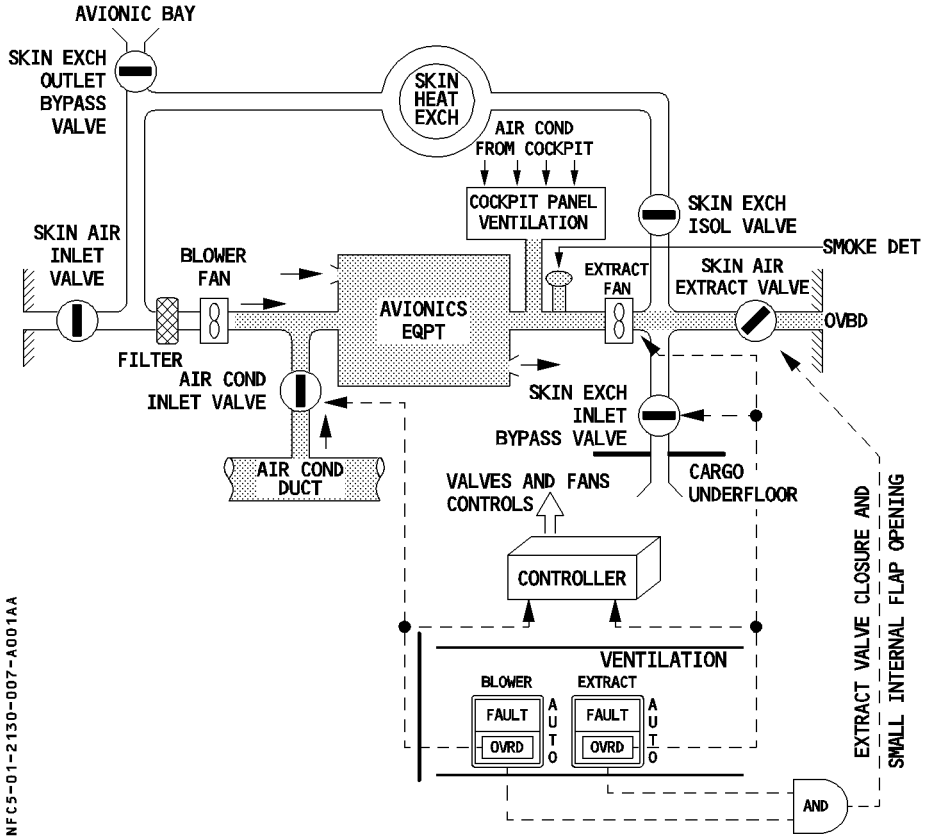
When the BLOWER or the EXTRACT pushbutton switch is set at the OVRD (override) position, the system is in closed-circuit configuration and adds air from the air conditioning system to the ventilation air.



When the BLOWER pushbutton switch is set at OVRD, the blower fan is stopped and the extract fan continues to run.
When the EXTRACT pushbutton switch is set at OVRD, the extract fan is controlled directly from the pushbutton. Both fans continue to run.

Smoke configuration

When the smoke detector detects smoke in the avionics ventilation air the BLOWER and the EXTRACT FAULT lights come on.
When both the BLOWER and the EXTRACT pushbuttons are set to the OVRD position, the air conditioning system supplies cooling air, which is then exhausted overboard. The blower fan stops.



Controller failure

The system goes to the same configuration as above, except that the skin exchange isolation valve stays open.
The inlet valve and the skin exchange inlet bypass valve remain in the position they were in before the failure occurred.
The extract fan keeps running.

AVIONICS GROUND COOLING

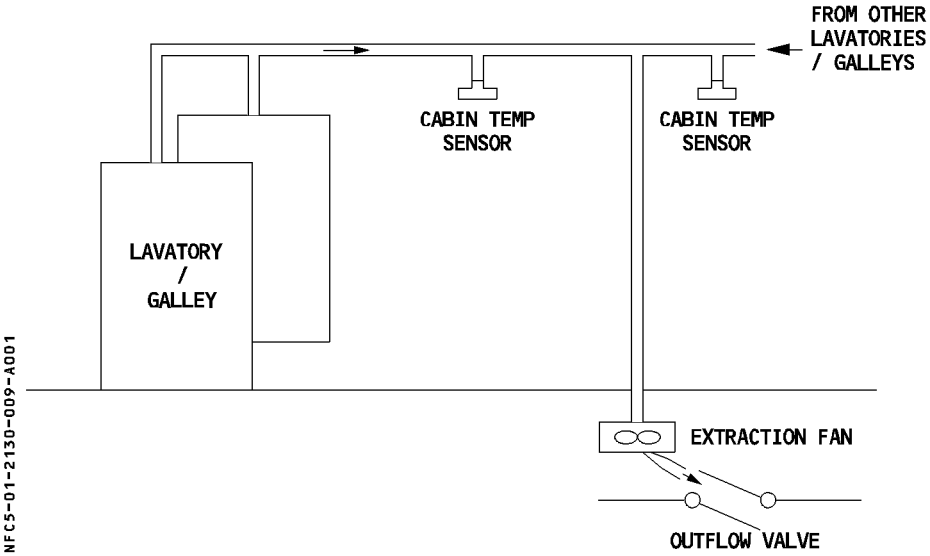
INTENTIONALLY LEFT BLANK

BATTERY VENTILATION

A venturi in the skin of the aircraft draws air from the space around the batteries and vents it overboard. The resulting airflow ventilates the batteries.

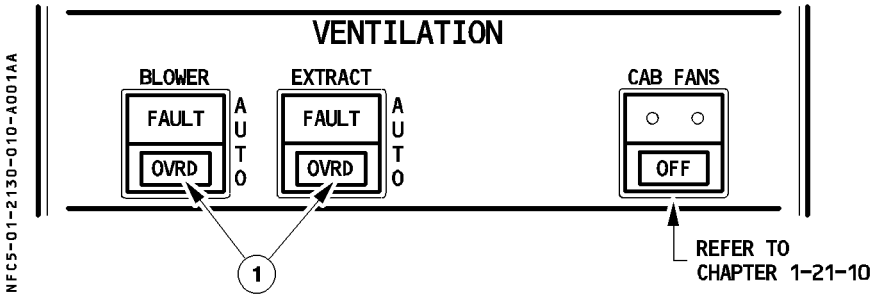
LAVATORY AND GALLEY

An extraction fan draws ambient cabin air through the lavatories and galleys and exhausts it near the outflow valve.
The extraction fan runs continually when electric power is available.



CONTROLS AND INDICATORS

OVERHEAD PANEL



(1) BLOWER and EXTRACT pb sw

AUTO : When both pushbutton switches are on AUTO :
- On the ground before the application of TO power, the ventilation system is in open circuit configuration (closed configuration when the skin temperature is below the ground threshold).
- On the ground after the application of TO power, and in flight, the ventilation system is in closed circuit configuration.

OVRD : When either pushbutton switch is on OVRD :
- The system goes to closed circuit configuration.
- Air from the air conditioning system is added to ventilation air. (The blower fan stops if the BLOWER pushbutton switch is in the OVRD position).

When both pushbutton switches are on OVRD :
- Air flows from the air conditioning system and then overboard.
- The extract fan continues to run.

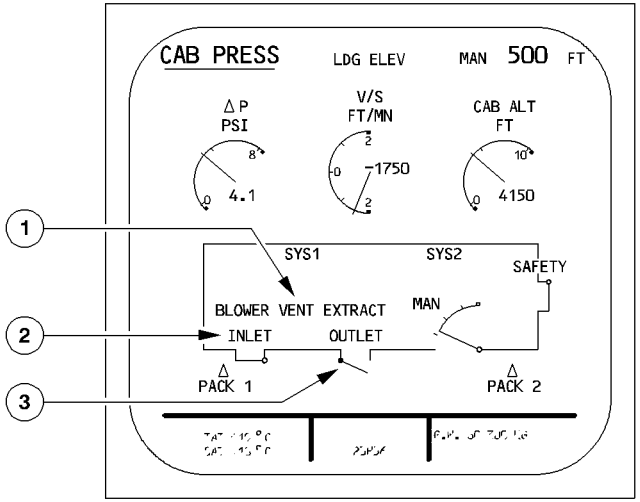
FAULT lt : Lights up amber (and ECAM activates)
in the blower switch, if :
- blowing pressure is low*
- duct overheats*
- computer power supply fails
- smoke warning is activated

in the extract switch, if :
- extract pressure is low*
- computer power supply fails
- smoke warning is activated.

* If the warning occurs on the ground when the engines are stopped, the external horn sounds.

ECAM CAB PRESS PAGE

R



NFC5-01-2130-011-A110AA

R (1) BLOWER, VENT and EXTRACT indications

R VENT message normally appears in white. It becomes amber, if there is a BLOWER FAULT, EXTRACT FAULT, or AVNCS SYS FAULT.

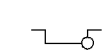
R BLOWER message appears in amber if there is a BLOWER FAULT.

R EXTRACT message appears in amber if there is an EXTRACT FAULT.

(2) INLET and OUTLET indications

Normally white. The corresponding indication becomes amber, in case of a BLOWER FAULT or EXTRACT FAULT.

(3) INLET and OUTLET valve diagrams



This indicates that the valve is fully closed.
It is normally green, but is amber if there is a disagreement.



This indicates that the valve is fully open.
It is normally green, but is amber if there is a disagreement.

NOTE: Because of the accuracy of the temperature sensors, on the ground the closed or open indication may become amber when the temperature is close to the valve opening or closing threshold.



This indicates that the inlet valve is in transit (inlet valve only).
It is amber.



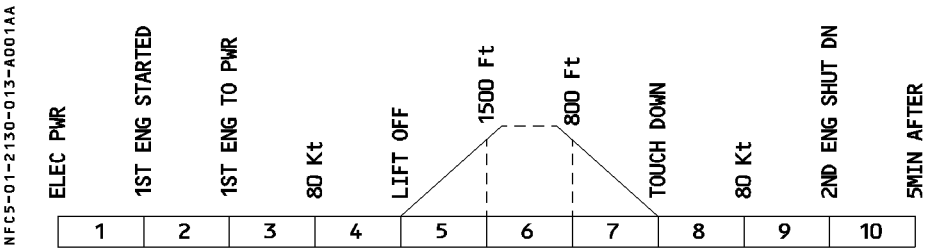
This indicates that the outlet valve is partially open (the outlet valve is closed but a small internal flap is open).



It is normally green, but is amber when the valve failed in transit.

NF65-01-2130-012-A105AA

WARNINGS AND CAUTIONS



R

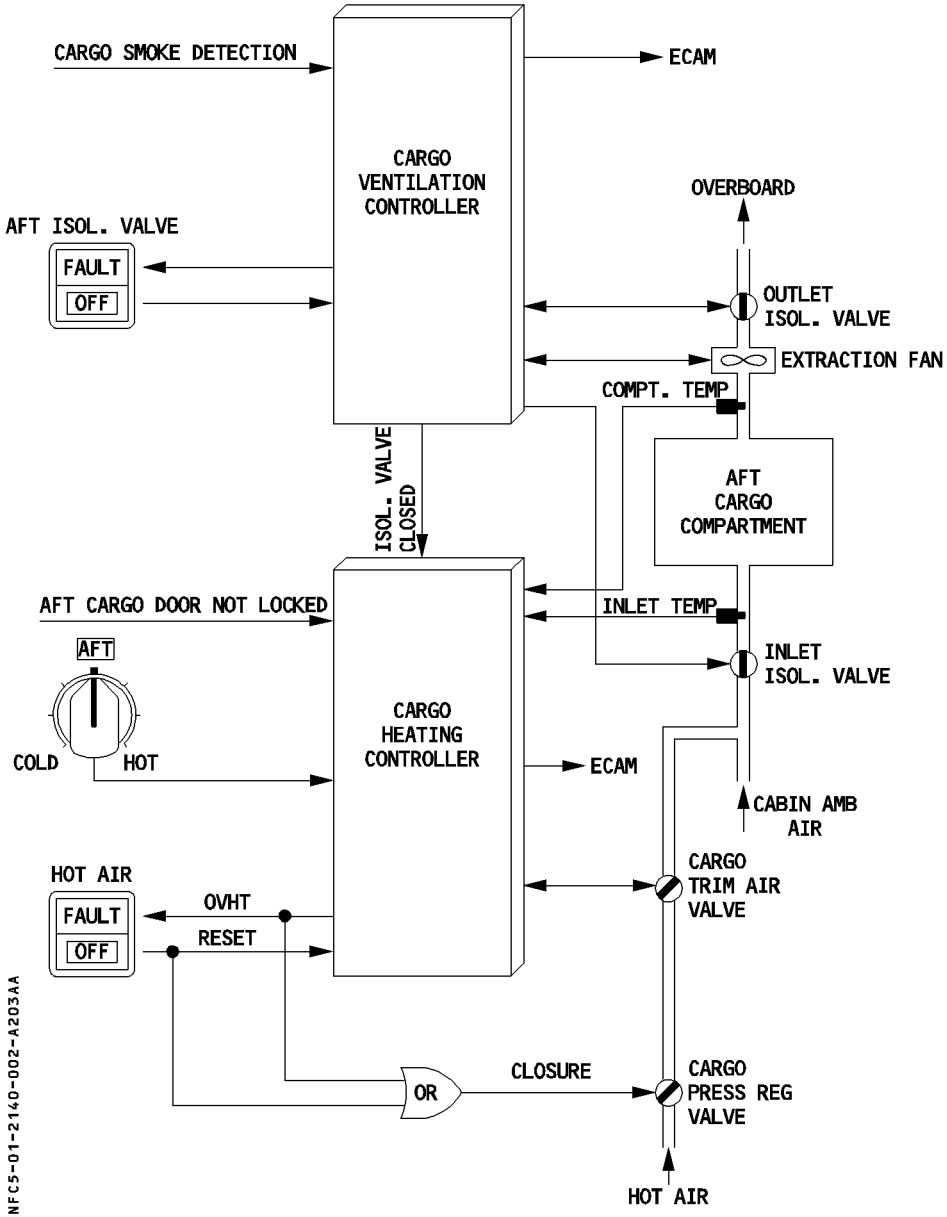
E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
BLOWER FAULT Blowing pressure low or duct overheat	SINGLE CHIME	MASTER CAUT	CAB PRESS	BLOWER* FAULT lt	3, 4, 5, 7, 8
EXTRACT FAULT Extract pressure low				EXTRACT* FAULT lt	
SKIN VALVE FAULT 1. Extract valve fully open in phase 3 or 2. Extract valve fully open in flight or 3. Inlet valve not fully closed in flight				NIL	4, 5, 7, 8
AVNCS SYS FAULT Power up test not satisfactory or AEVC not supplied or valves position disagree				BLOWER and EXTRACT FAULT lts**	3, 4, 5, 6, 7, 8 9

* Associated with ground external call.

** Only in case of AEVC power supply failure on ground.

GENERAL

An extraction fan draws air from the cargo compartments (◁) and exhausts it overboard. Air from the cabin replaces the exhausted air, thus ventilating the cargo compartments. The system can add hot bleed air to the air entering from the cabin, thus giving the flight crew control of the temperature in the forward or aft (◁) cargo compartment.


CARGO SMOKE DETECTION
ECAM
CARGO VENTILATION CONTROLLER
OVERBOARD
AFT ISOL. VALVE
FAULT
OFF
OUTLET ISOL. VALVE
EXTRACTION FAN
COMPT. TEMP
ISOL. VALVE CLOSED
AFT CARGO COMPARTMENT
AFT CARGO DOOR NOT LOCKED
INLET TEMP
AFT
COLD
HOT
CARGO HEATING CONTROLLER
INLET ISOL. VALVE
ECAM
CABIN AMB AIR
HOT AIR
FAULT
OFF
OVHT
RESET
CARGO TRIM AIR VALVE
CLOSURE
OR
CARGO PRESS REG VALVE
HOT AIR
NFC5-01-2140-002-A203AA

SYSTEM OPERATION

AFT CARGO COMPARTMENT VENTILATION

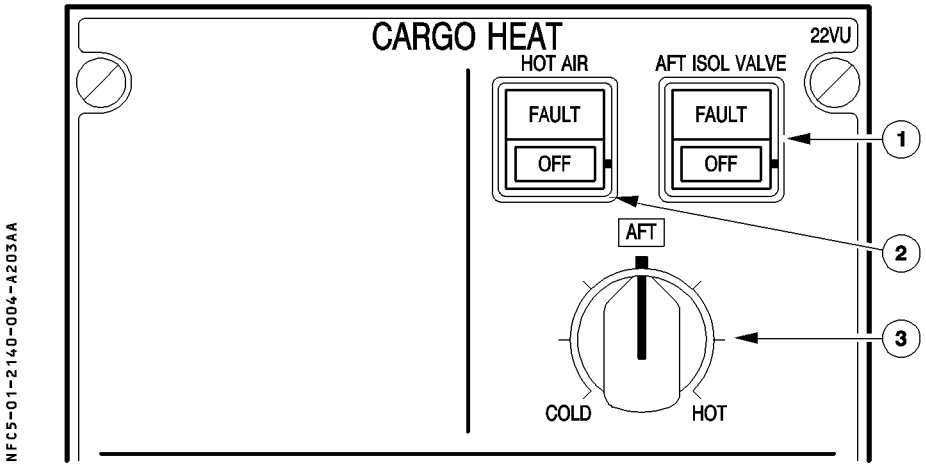
Air from the cabin goes via the inlet isolation valve to the aft cargo compartment, driven by an extraction fan. Air is controlled by the outlet isolation valve and then goes outboard through the outflow valve.
The cargo ventilation controller controls the operation of the inlet and outlet isolation valves and the extraction fan.
When the isolation valves are fully open, the extraction fan operates continuously when the aircraft is on the ground and during flight.
The controller closes the isolation valves and stops the extraction fan when :
– the flight crew turns the AFT ISOL VALVE pushbutton switch OFF.
– The aft cargo smoke detection unit detects smoke.

AFT CARGO COMPARTMENT HEATING

The ventilation system for the aft cargo compartment uses hot engine bleed air (upstream of the packs), mixing it with the ambient cabin air that flows through the cargo compartment.
The cargo regulating valve regulates the pressure of this hot air supply, and the trim air valve, which is modulated electrically by the controller, controls the flow.
The cargo pressure regulating valve is pneumatically operated and electrically controlled from the HOT AIR pushbutton on the CARGO HEAT panel.
The hot air is controlled by the cargo trim air valve which is modulated electrically by the controller.
The hot air is then mixed with air from the cabin and supplied to the cargo compartment through the ventilation inlet isolation valve.
According to the temperature selector demand, the controller regulates the amount of hot air added by the trim air valve, until the desired temperature is reached.
If the inlet temperature exceeds 70° C, the controller closes the trim air valve.
If the inlet temperature exceeds 88° C, the controller interprets this as a duct overheat and closes the pressure regulating valve. This valve then remains closed until the flight crew resets the system by pressing the HOT AIR pushbutton — which it cannot do until the temperature drops below 70° C.

CONTROLS AND INDICATORS

OVERHEAD PANEL



(1) AFT ISOL VALVE pb sw

The switch controls the aft isolation valves and the extraction fan.

Auto : The inlet and outlet isolation valves open and the extraction fan runs if there is no smoke detected in the aft cargo bay.

OFF : The inlet and outlet isolation valves and the trim air valve close, the extraction fan stops.

FAULT lt : The light comes on amber associated with ECAM caution when either inlet or outlet valve is not in the selected position.

(2) HOT AIR pb sw

Auto : The pressure regulating valve regulates hot air pressure.

OFF : The pressure regulating valve closes.
Fault circuit is reset.

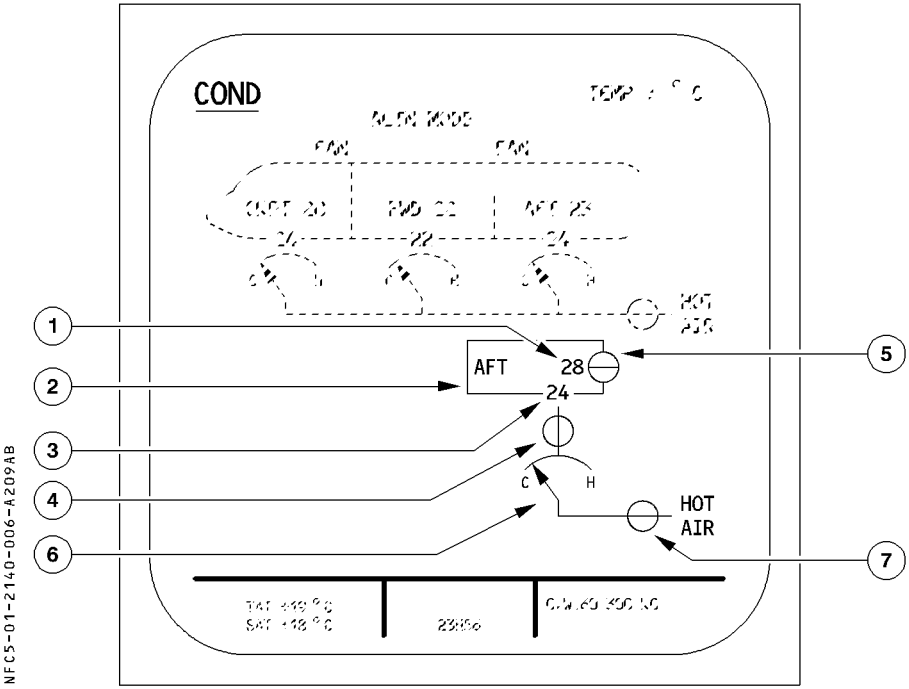
R FAULT lt : The light comes on amber associated with ECAM caution when a duct overheat is detected (88° C – 190° F).
The light goes out when the temperature drops below 70° C (158° F) and OFF is selected. Then, if the pushbutton is set to on, the system is reset.

(3) Temperature selector

R – COLD position : Approximately 5° C (41° F)
R – HOT position : Approximately 26° C (79° F)
R – Middle position : Approximately 15° C (59° F)

R *Note : 1. The cargo compartment temperature may vary, depending on external factors*
R *(flight duration, outside temperature...).*
2. The actual temperature in the bulk cargo compartment may be 10° C (18° F) lower than the selected temperature.

R **ECAM COND PAGE**



(1) Cargo compartment temperature

This indication is green.

(2) Zone indication

This indication is white.

(3) Duct inlet temperature

This is normally green, it becomes amber when T ≥ 80° C.

R (4) Inlet isolation valve

R Vertical and green : valve is open
R Horizontal and amber : valve is closed

R (5) Outlet isolation valve

R Horizontal and green : valve is open.
R Vertical and amber : valve is closed.

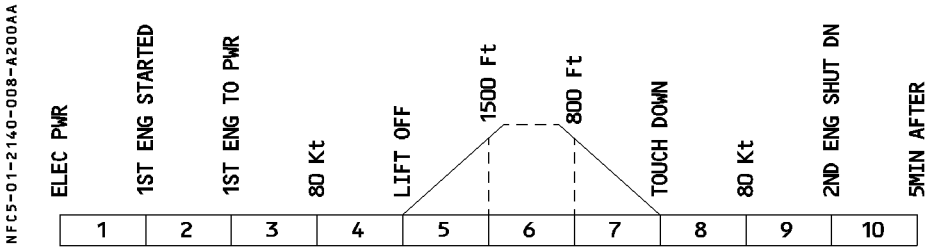
R (6) Trim air valve

R H - Hot (Green) : valve is open.
R C - Cold (Green) : valve is closed.

(7) Hot air pressure regulating valve

In line and green : valve is open.
In line and amber : valve failed open.
Cross line and green : valve normally closed with the pushbutton in ON position.
Cross line and amber : valve is closed and the pushbutton in OFF position.

WARNINGS AND CAUTIONS



E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
AFT (FWD) CARGO DUCT temperature OVHT Duct Temperature > 88° C (190° F)	SINGLE CHIME	MASTER CAUT	COND	HOT AIR FAULT lt	3, 4, 5 7, 8
AFT (FWD) CRG HEAT FAULT Cargo heating controller fault	NIL	NIL		NIL	
AFT (FWD) CRG VENT FAULT Cargo fan fault			NIL		
AFT (FWD) CRG ISOL VALVE Cargo isolation valve disagreement				ISOL VALVE FAULT lt	

BUS EQUIPMENT LIST

R

			NORM		EMER ELEC		
			AC	DC	AC ESS	DC ESS	HOT
AIR COND	PACK CONT	1 PRIM. SEC.	AC1 AC1	DC1 DC1			
		2 PRIM. SEC.	AC2 AC2	DC2 DC2			
	ZONE CONT	PRIM. SEC.	AC1 AC2	DC1 DC2			
	PACK 1 VALVE CLOSURE					SHED	
	PACK 2 VALVE CLOSURE			DC2			
	RAM AIR INLET					X	
PRESS	CAB PRESS CONT	1				X	
		2		DC2			
		MANUAL CTL		DC BAT			
VENT	CABIN FANS	1	AC1	DC1			
		2	AC2	DC2			
	AEVC			DC1		SHED	
	AVIONIC FANS	FAN BLOWER	AC1	DC1			
		EXTRACT	AC2			SHED	
	GND COOL UNIT◁	UNIT FAN CONTROL	AC2 AC1 DC1				
FWD/ AFT CARGO	VENT CONT ◁					SHED	
	HEAT CONT ◁					SHED	
	VENT/HEAT FANS(S) ◁		AC1				

BUS EQUIPMENT LIST

			NORM		EMER ELEC		
			AC	DC	AC ESS	DC ESS	HOT
AIR COND	AIR COND SYS CONT	1 lane 1	AC1	DC1			
		2	AC2			X	
		2 lane 1	AC1	DC1			
		2	AC2	DC2			
	PACK 1 VALVE CLOSURE					SHED	
	PACK 2 VALVE CLOSURE			DC2			
	RAM AIR INLET					X	
PRESS	CAB PRESS CONT	1				X	
		2		DC2			
		MANUAL CTL		DC BAT			
VENT	CABIN FANS	1	AC1	DC1			
		2	AC2	DC2			
	AEVC			DC1		SHED	
	AVIONIC FANS	FAN BLOWER	AC1	DC1			
		EXTRACT	AC2			SHED	
	GND COOL UNIT◁	UNIT FAN CONTROL	AC2 AC1 DC1				
FWD/ AFT CARGO	VENT CONT ◁					SHED	
	HEAT CONT ◁					SHED	
	VENT/HEAT FANS(S) ◁		AC1				

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PREAMBLE

The Auto Flight System is described in Volumes 1 and 4 :
- Volume 1, Chapter 22 gives a general description of the system and the different functions (architecture, modes, FMA, functions...).
- Volume 4 "FMGS PILOT'S GUIDE" is devoted to the FMGS System operation (MCDU pages, MCDU message, Procedures).

DESCRIPTION

The Flight Management Guidance System (FMGS) contains the following units :
- Two Flight Management Guidance Computers (FMGC)
- Two Multipurpose Control and Display Units (MCDU) (third MCDU optional)
- One Flight Control Unit (FCU)
- Two Flight Augmentation Computers

GENERAL PHILOSOPHY

The Flight Management and Guidance System (FMGS) provides predictions of flight time, mileage, speed, economy profiles and altitude. It reduces cockpit workload, improves efficiency, and eliminates many routine operations generally performed by the pilots.
During cockpit preparation, the pilot inserts a preplanned route, from origin to destination, via the Multifunction Control and Display Units (MCDUs). This route includes the departure, enroute waypoints, arrival, approach, missed approach and alternate route, as selected from the NAV database. The system generates optimum vertical and lateral flight profiles and predicted progress along the entire flight path. Either FMGC performs all operations, if one FMGC fails.
The pilot may modify any flight parameter on a short-term basis (SPD, V/S, HDG...) and the FMGS will guide the aircraft to the manually-selected target. This pilot-controlled guidance is referred to as "selected".
There are two types of Guidance :

R — Managed Guidance : The aircraft is guided along the preplanned route, vertical, lateral, and speed/mach profile. This type of preplanned guidance is called "Managed". Predicted targets are computed by the FMGS.

R — Selected Guidance : The aircraft is guided to the selected target, modified by the pilot. Targets are selected on the flight control unit located on the pilot's glareshield. The decision to engage a "selected" or "managed" guidance is always under the control of the pilot.

R Selected guidance has priority over managed guidance.

FLIGHT MANAGEMENT GUIDANCE COMPUTER (FMGC)

Each FMGC is divided into two main parts.

– The Flight Management (FM) part controls the following functions :
  · Navigation and management of navigation radios.
  · Management of flight planning.
  · Prediction and optimization of performance.
  · Management of displays.
– The Flight Guidance (FG) part performs the following functions :
  · Autopilot (AP) command
  · Flight Director (FD) command
  · Autothrust (A/THR) command

Each FMGC has its own set of databases. The individual databases can be independently loaded into their respective FMGC, or independently copied from one FMGC to the other.
Each FMGC contains these main databases :

1. The Navigation database (2.8 Mbytes) contains standard navigation data : Navaids, waypoints, airways, enroute information, holding patterns, airports, runways, procedures (SIDs, STARs, etc.), company routes, alternates.
   The airline updates this part every 28 days, and is responsible for defining, acquiring, updating, loading, and using this data. The updating operation takes 20 minutes to complete or 5 minutes if cross load from the opposite FMGC.
2. The Airline Modifiable Information (AMI, also referred to as the FM Airline Configuration file), contains :
   – Airline policy values : THR RED altitude, ACC altitude, EO ACC altitude, PERF factor, IDLE factor.
   – Fuel policy values : Fuel for taxi, % of route reserve, maximum and minimum values of route reserve, etc.

R – AOC functions customization

3. The Aircraft Performance database, is a set of Engine model, Aerodynamical model, and Performance model. The airline cannot modify this database.
4. The Magnetic Variation database.

In addition, each FMGC contains pilot-stored elements that enable the pilot to create 20 waypoints, 10 runways, 20 navaids, and 5 routes.

MULTIPURPOSE CONTROL AND DISPLAY UNIT (MCDU)

Two MCDUs are installed on the pedestal for flight crew loading and display of data. The use MCDU allows the flight crew to interface with the FMGC by selection of a flight plan for lateral and vertical trajectories and speed profiles. The crew may also modify selected navigation or performance data and specific functions of Flight Management (revised flight plan, engine-out, secondary flight plan, etc.). Additional data from peripherals (Centralized Fault Display System (CFDS), ARINC Communication Addressing and Reporting System
R (ACARS), Air Traffic Service Unit (ATSU)...) can also be displayed. Data that is entered into the MCDU that is illogical or beyond the aircraft capabilities will either be disregarded or will generate an advisory message.

FLIGHT CONTROL UNIT (FCU)

The FCU located on the glareshield, is the short-term interface between the crew and the FMGC. It is used to select any flight parameters or modify those selected in the MCDU. The autopilots and autothrust functions may be engaged or disengaged. Different guidance modes can be selected to change various targets (speed, heading, track, altitude, flight path angle vertical speed).

FLIGHT AUGMENTATION COMPUTER (FAC)

The FAC controls rudder, rudder trim and yaw damper inputs. It computes data for the flight envelope and speed functions. The FAC also provides warning for low-energy and windshear detection if these functions are installed.

OTHER CREW INTERFACES

THRUST LEVERS

The thrust levers are the main interface between the Flight Management Guidance Computer, the Full Authority Digital Engine Control System (FADEC), and the flight crew. They :

- arm the autothrust at takeoff, when “FLX “ or “TOGA” is selected,
- limit the maximum thrust by their position when autothrust is active,
- disconnect the autothrust system when the flight crew sets them to “IDLE”,
- command the thrust manually when autothrust is not active,
- engage the common modes (takeoff or go-around) when TOGA (or “FLX” for takeoff) is set,
- when positionned between IDLE and CL detent (MCT in engine out), set the autothrust to the active mode.

ELECTRONIC FLIGHT INSTRUMENTS (EFIS)

Two Primary Flight Displays (PFD) and Navigation Displays (ND) provide the crew with full-time flight guidance, navigation and system advisory information for all flight phases. An EFIS control panel is located at each end of the glareshield and is used to control both Primary and Navigation Displays. This panel includes controls to select various modes within the PFD. A selector allows the barometric altimeter setting to be displayed on the PFD. Various distance ranges can be selected on the ND, and two toggle switches allow either the left or right VOR/ADF bearing pointers to be displayed on the ND.

PRIMARY FLIGHT DISPLAYS

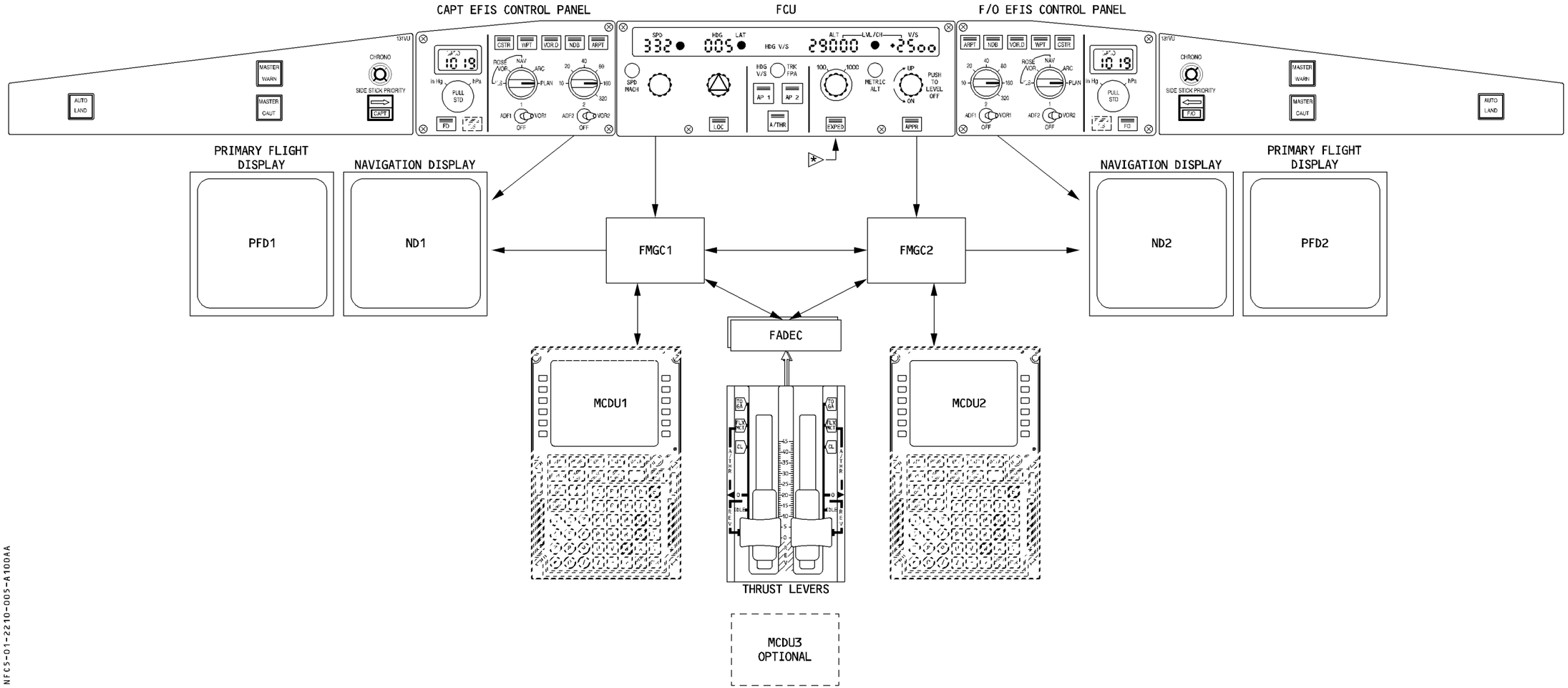
The PFDs combine several conventional flight instrument indications on one color display panel, for centralized reference of flight data.
This centralized color display includes :
– Flight Director attitude guidance targets
– Armed and engaged modes
– Navigation and instrument approach information
– Altimeter setting
– Barometric altitude
– System messages.

NAVIGATION DISPLAYS

Five different color navigation compass displays can be selected :
– ARC (map mode)
– ROSE NAV (map mode)
– ROSE VOR
– ROSE LS
– PLAN
Information displayed on these modes uses the aircraft's position as a reference point for the flight plan navigation data (lateral and vertical information).

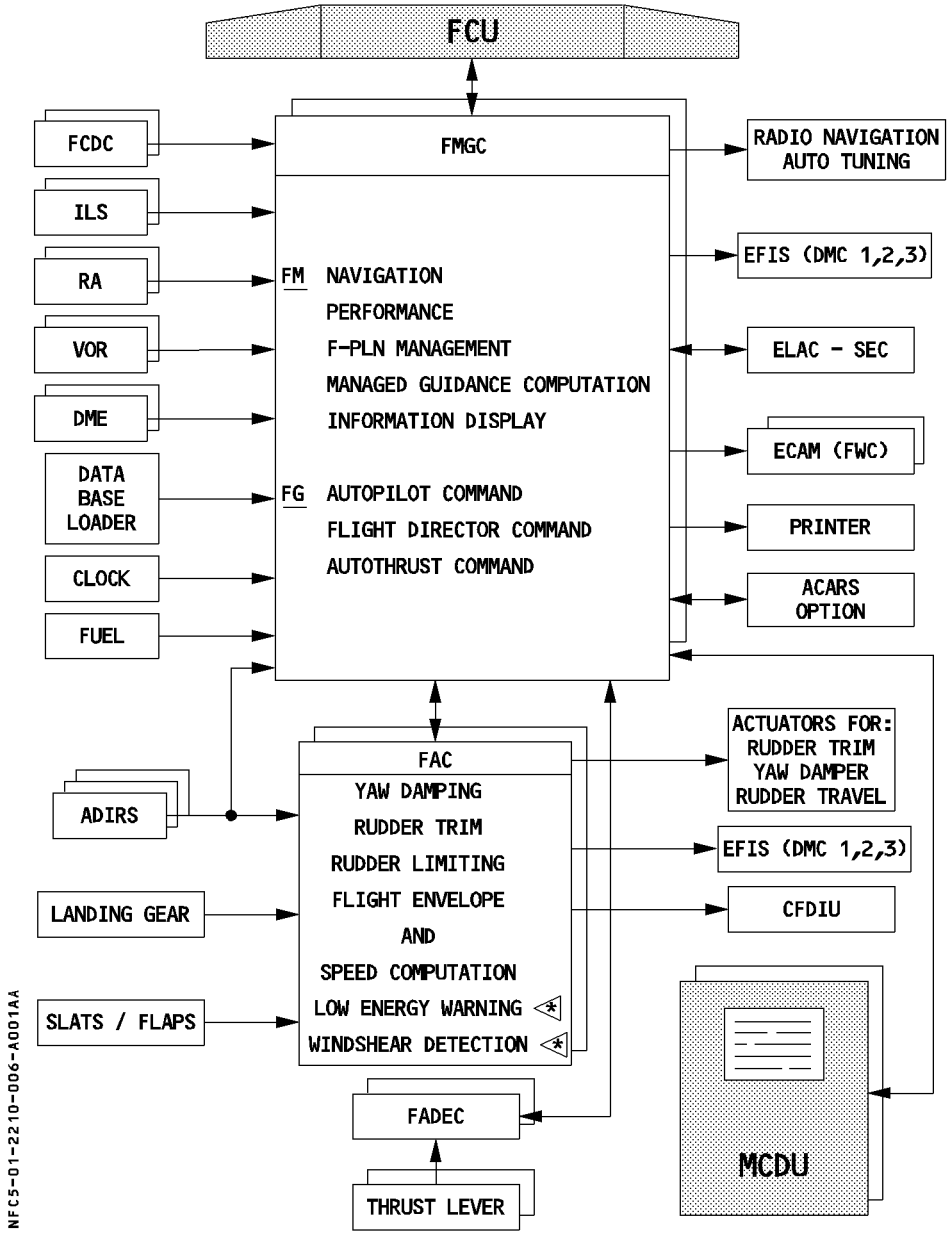
R

CREW INTERFACE WITH FMGC



NFCS-01-2210-005-A100AA

SYSTEM INTERFACE DIAGRAM

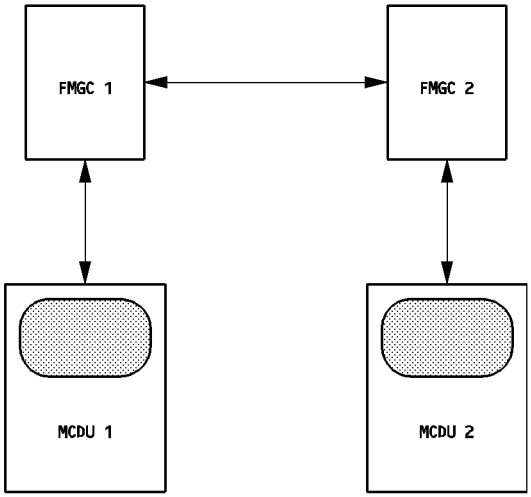


FMGS MODES OF OPERATION

The FMGS has three modes of operation :
- dual mode (the normal mode)
- independent mode. Each FMGC being controlled by its associated MCDU.
- single mode (using one FMGC only)

DUAL MODE

This is the normal mode. The two FMGCs are synchronized : each performs its own computations and exchanges data with the other through a crosstalk bus.
One FMGC is the master, the other the slave, so that some data in the slave FMGC comes from the master. All data inserted into any MCDU is transferred to both FMGCs and to all peripherals.



NFC5-01-2210-007-A001AA

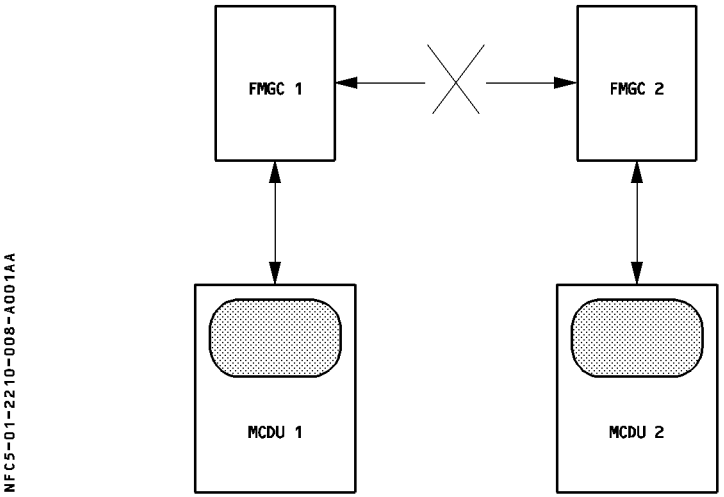
MASTER FMGC LOGIC :

- If one autopilot (AP) is engaged, the related FMGC is master :
  - it uses the onside FD for guidance
  - it controls the A/THR
  - it controls the FMA 1 and 2
- If two APs are engaged, FMGC1 is master.
- If no AP is engaged and
  - the FD1 pushbutton is on, then FMGC1 is master.
  - the FD1 pushbutton is off, and FD2 pushbutton on then FMGC2 is master.

R - if no AP/FD is engaged, A/THR is controlled by FMGC1.

INDEPENDENT MODE

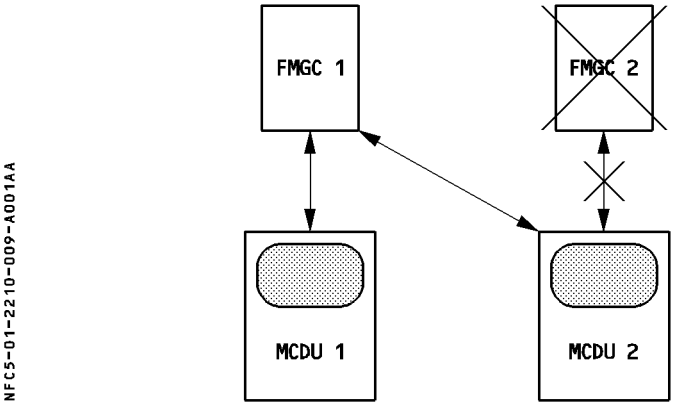
The system selects this degraded mode automatically if it has a major mismatch (database incompatibility, operations program incompatibility . . .). Both FMGCs work independently and are linked only to peripherals on their own sides of the flight deck ("onside" peripherals).
When this occurs, "INDEPENDENT OPERATION" appears on the MCDU scratchpad.
Each MCDU transmits data it receives only to its onside FMGC, and it affects only the onside EFIS (Electronic Flight Instrument System) and RMP (Radio Management Panel).



R For independent mode procedure refer to 4.06.10.

SINGLE MODE

The system selects this degraded mode automatically if one FMGC fails. The remaining FMGC drives all the peripherals, so, for example, any entry on one MCDU goes to both MCDUs.
When one FMGC fails, the corresponding MCDU displays “OPP FMGC IN PROCESS” in white. The ND on the side with the failed FMGC has to be set to the same range and mode as the other ND. Otherwise the ND displays “SELECT OFFSIDE RNG/MODE” in amber.

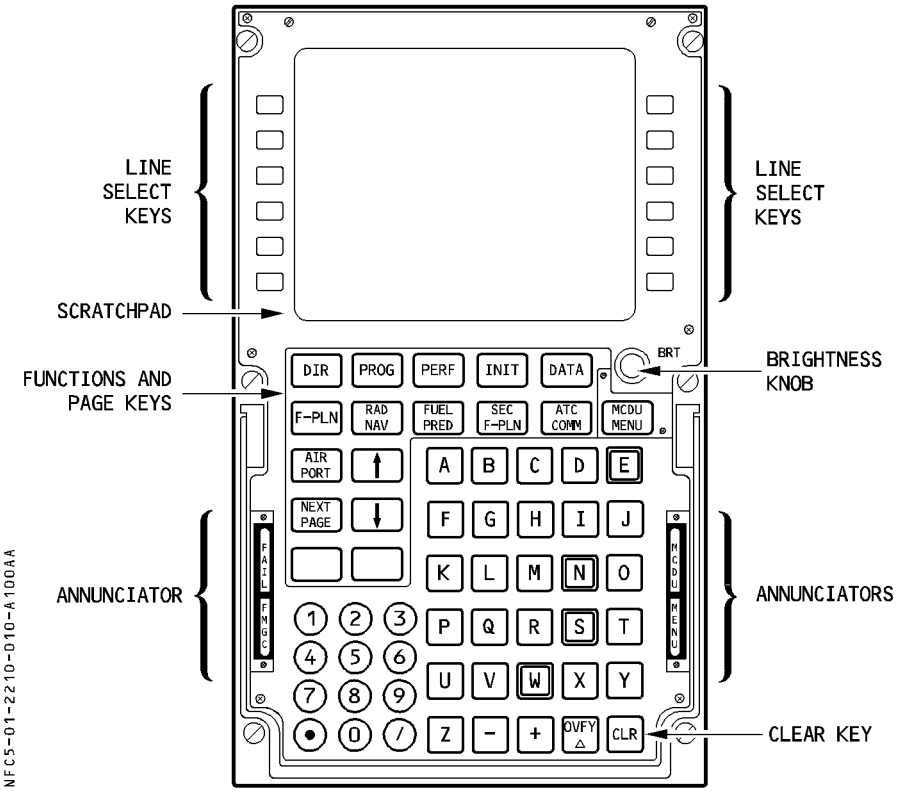


For single mode procedure refer to 4.06.10.

PILOT INTERFACE

R

MULTI CONTROL DISPLAY UNIT (MCDU)



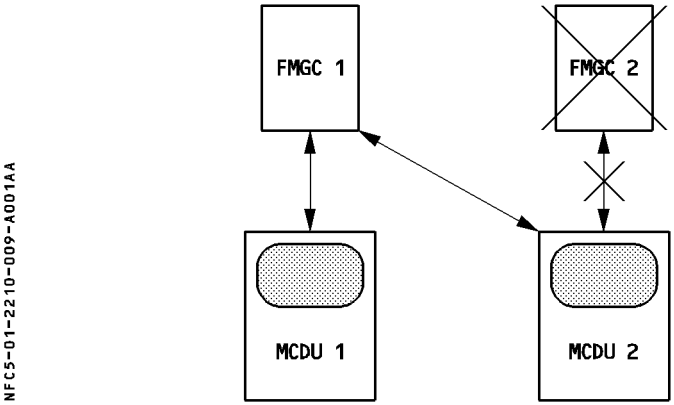
GENERAL

The Multi Control Display Unit (MCDU) is a cathode ray tube that generates 14 lines of 24 characters each, including :

- A title line that gives the name of the current page in large letters ;
- Six label lines, each of which names the data displayed just below it (on the data field line) ;
- Six data field lines that display computed data, or data inserted by the pilot ;
- The scratchpad line which displays :
  - Specific messages
  - Information the pilot has entered by means of the number and letter keys, and which can then be moved to one of the data fields.

SINGLE MODE

The system selects this degraded mode automatically if one FMGC fails. The remaining FMGC drives all the peripherals, so, for example, any entry on one MCDU goes to both MCDUs.
When one FMGC fails, the corresponding MCDU displays “OPP FMGC IN PROCESS” in white. The ND on the side with the failed FMGC has to be set to the same range and mode as the other ND. Otherwise the ND displays “SELECT OFFSIDE RNG/MODE” in amber.

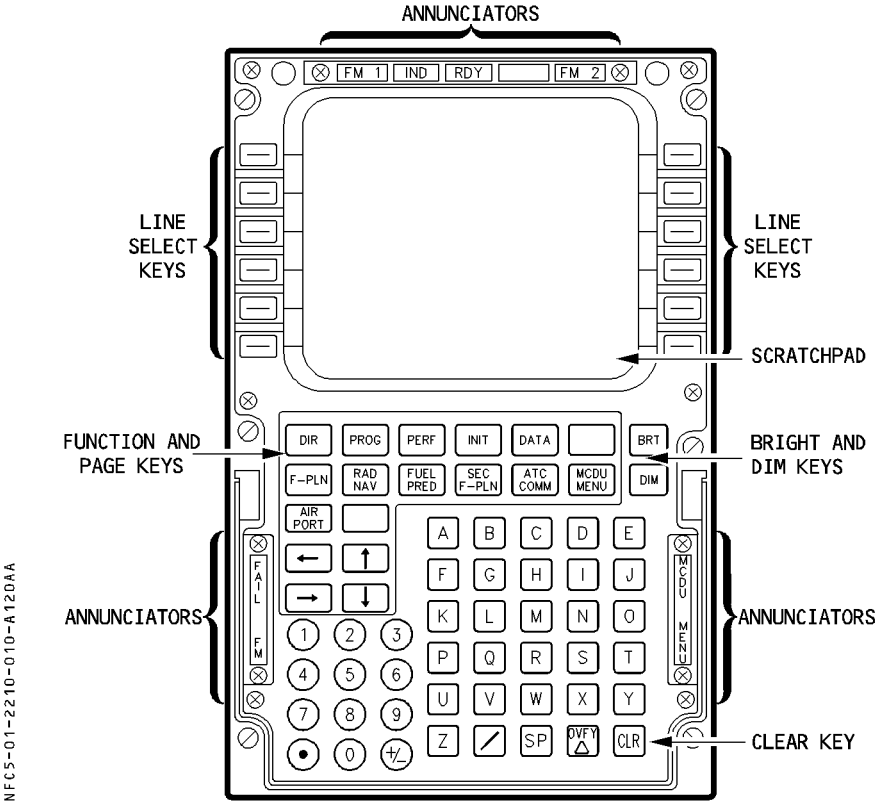


For single mode procedure refer to 4.06.10.

PILOT INTERFACE

MULTI CONTROL DISPLAY UNIT (MCDU)

R



GENERAL

R The Multipurpose Control and Display Unit (MCDU) has a Liquid Crystal Display (LCD) with
R 14 lines, of 24 characters each, including :

- A title line that gives the name of the current page in large letters
- Six label lines, each of which names the data displayed just below it (on the data field line)
- Six data field lines that display computed data, or data inserted by the pilot
- The scratchpad line which displays :
  - Specific messages
  - Information the pilot has entered by means of the number and letter keys, and which can then be moved to one of the data fields.

LINE SELECT KEYS

There is a column of line select keys on each side of the screen. The pilot uses these to:
- Move a parameter he has entered in the scratchpad to the appropriate line on the main screen.
- Call up a specific function page indicated by a prompt displayed on the adjacent line.
- Call up lateral or vertical revision pages from the flight plan page.

KEYBOARD

The keyboard includes :
- Function and
  - Page keys — Call up functions and pages the pilot uses for flight management functions and computations.
  - ↑ ↓ (or SLEW) keys — Move a page up or down to display portions that are off the screen.
  - NEXT PAGE key — Moves to the next page of a multi-page element. An arrow in the top right corner indicates that another page is available.
  - AIRPORT key — Calls up the flight plan page that contains the next airport along the current flight plan. Successive pushes on the key show the alternate airport, the origin airport (before takeoff), and the next airport again.
- Number and letter keys allow the pilot to insert data in the scratchpad so that he can use a line select key to enter it in the main display.
- Two keys have special functions :
  - CLR (clear) key — Erases material (messages or inserted data) from the scratchpad or from certain areas of displayed pages.
  - OVFY (overfly) key — Allows the aircraft to overfly a selected waypoint.

ANNUNCIATORS (on the side of the keyboard)

- FAIL (amber) — Indicates that the Multipurpose Control and Display Unit (MCDU) has failed.
- MCDU MENU (white) — Indicates that the pilot should call up a peripheral linked to the MCDU (such as ACARS, ATSU or CFDS). R
- FMGC (white) — Comes on while the crew is using the MCDU to display peripherals.

BRT KNOB

Controls the light intensity of the entire MCDU.

DATA ENTRY

The pilot enters data by typing it into the scratchpad on the MCDU. Next, pressing the line select key will load the data from the scratchpad into the desired field. An error message appears, if the data is out of range, or not formatted correctly. To correct data, the pilot may clear the message with the clear (CLR) key and then retype the message into the scratchpad. Pressing the CLR key, when the scratchpad is empty, displays "CLR". To clear data from a field, line select CLR from the scratchpad to the data field to be cleared.

MCDU ENTRY FORMAT

The pilot enters information into the MCDU at the bottom line of the scratchpad. When data has lead zeros, they may be omitted if desired. For example, a three-digit wind direction of 060 may be typed as 60. The display will still show 060. To enter an altitude below 1000 feet, the lead zero must be added as 0400 for 400 feet. This differentiates the altitude from a flight level.
To enter a double data entry such a speed/altitude, the separating slash must be used. If entering only the first part of a double entry, omit the slash. To enter only the second part of a double entry, a leading slash must be used i.e./0400 feet.

MESSAGES

The scratchpad displays various messages for pilot information. These messages are prioritized by importance to the pilot as either amber or white.
Amber messages are :
- Navigation messages
- Data entry message
- EFIS repeat messages.

There are two types of amber messages :
- Type 1 messages are a direct result of a pilot action. Type 1 messages are displayed immediately in the scratchpad, ahead of other messages.
- Type 2 messages inform the pilot of a given situation or request a specific action. They are stored in a "last in", "first out" message queue that holds a maximum of 5 messages.
  Type 2 messages are displayed in the scratchpad only if there are no Type 1 messages or other data. They will remain displayed until all the messages have been viewed and cleared with the CLR key.

White messages are advisory only.

LINE SELECT KEYS

There is a column of line select keys on each side of the screen. The pilot uses these to:
- Move a parameter he has entered in the scratchpad to the appropriate line on the main screen.
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  - → ← key — Moves to the next or previous page of a multi-page element. An arrow in the top right corner indicates that another page is available.
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- Three keys have special functions :
  - CLR (clear) key — Erases material (messages or inserted data) from the scratchpad or from certain areas of displayed pages.
  - OVFY (overfly) key — Allows to insert or to cancel an overfly at a given waypoint.
  - SP (space) key — Allows to insert a space in specific messages.

ANNUNCIATORS (on the side of the keyboard)

- FAIL (amber) — Indicates that the MCDU has failed.
- MCDU MENU (white) — Indicates that the pilot should call up a peripheral linked to the MCDU (such as ACARS, ATSU or CFDS). R
- FM (white) — Comes on while the crew is using the MCDU to display peripherals. This light tells the pilot that the FMGC has an important message to deliver. The pilot accesses the message by pressing the MCDU MENU key and the line select key adjacent to the FMGC prompt.

BRT AND DIM KEYS

Controls the light intensity of the entire MCDU. MCDU power up is performed with the BRT key and MCDU shut down is performed with the DIM key.

ANNUNCIATORS (on the top of the keyboard)

FM 1 and FM 2 (amber)	The onside FM is failed
IND (amber)	The onside FM detects an independent mode of operation while both FM are healthy.
RDY (green)	MCDU has passed its power up test after it was turned to OFF using its DIM key.

DATA ENTRY

The pilot enters data by typing it into the scratchpad on the MCDU. Next pressing the line select key will load the data from the scratchpad into the desired field. An error message displays if the data is out of range or not formatted correctly. To correct data, the pilot may clear the message with the clear (CLR) key and then retype the message into the scratchpad. Pressing the CLR key when the scratchpad is empty displays "CLR". To clear data from a field, line select CLR from the scratchpad to the data field to be cleared.

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Amber messages are :
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Amber messages are categorized into two types :
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  Type 2 messages are displayed in the scratchpad only if there are no Type 1 messages or other data and will remain until all the messages have been viewed and cleared with the CLR key.

White messages are advisory only.

CHARACTERS

Small and large fonts are displayed according to the following rules :

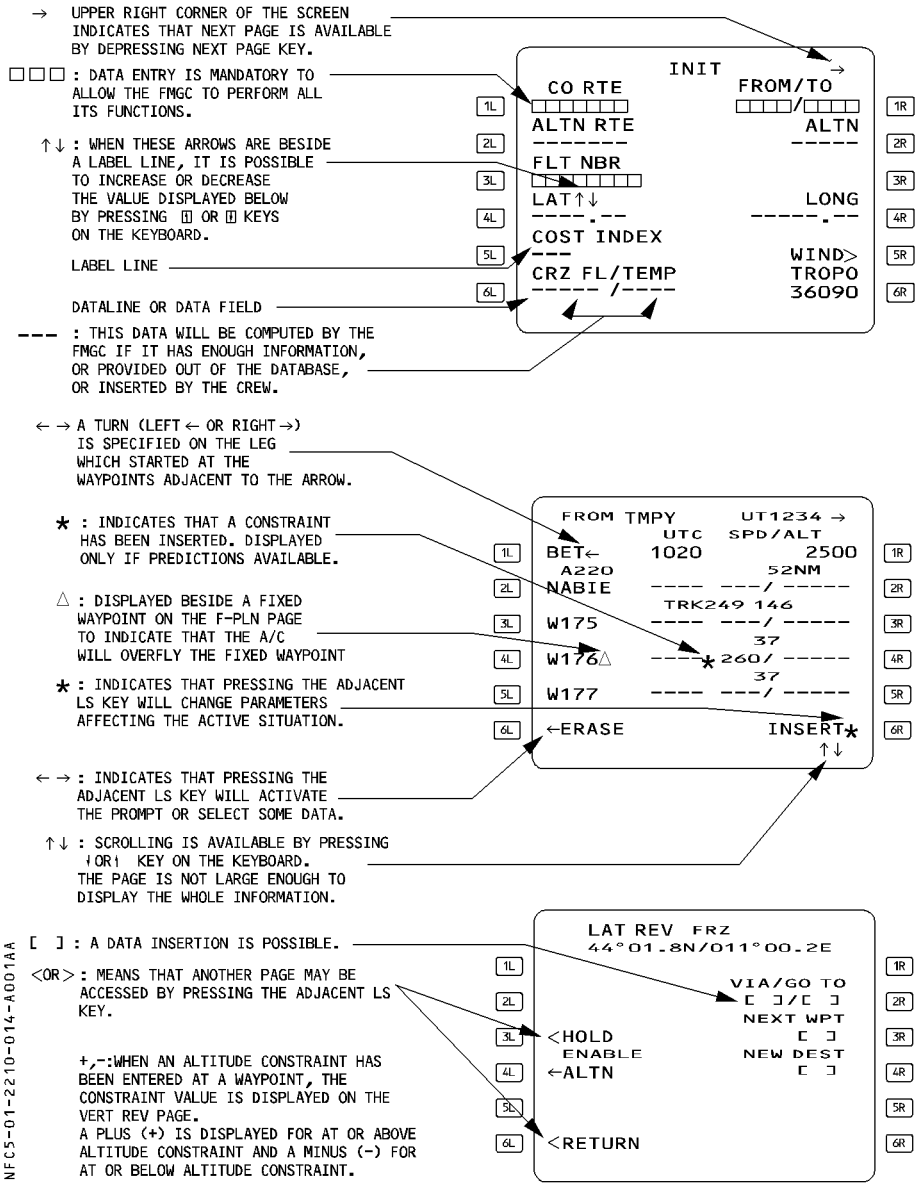
- The title line and the scratchpad are displayed in large font.
- Datafields are usually displayed in large font.
- Label lines are displayed in small font.
- Pilot entries and modifiable data are displayed in large font.
- Defaulted/computed and non modifiable data are displayed in small font.

COLORS

DATA	MCDU COLOR
TITLES, COMMENTS <, >, ↑ ↓ ← → DASHES, MINOR MESSAGES	WHITE
MODIFIABLE DATA SELECTABLE DATA BRACKETS	BLUE
NON MODIFIABLE DATA ACTIVE DATA	GREEN
– MANDATORY DATA (BOXES) – PILOT ACTION REQUIRED – IMPORTANT MESSAGES – MISSED CONSTRAINT	AMBER
CONSTRAINTS MAX ALTITUDE	MAGENTA
PRIMARY F-PLN	GREEN WAYPOINTS, WHITE LEGS
TEMPORARY F-PLN	YELLOW WAYPOINTS, WHITE LEGS
SECONDARY F-PLN	WHITE WAYPOINTS AND LEGS
MISSED APPROACH (not active)	BLUE WAYPOINTS, WHITE LEGS
ALTERNATE F-PLN (not active)	BLUE WAYPOINTS, WHITE LEGS
OFFSET	GREEN WAYPOINTS, WHITE LEGS OFST DISPLAYED IN THE TITLE OF F-PLN PAGE
TUNED NAVAID	BLUE
"TO" WAYPOINT AND DESTINATION	WHITE

SCREEN PROMPTS

R



MCDU FUNCTION KEYS

The function keys on the Multipurpose Control and Display Units allow the pilot to call up MCDU pages quickly.

The following is a summary of the purpose of each key. (Volume 4, FMGS Pilot's Guide provides a full description of the pages.

R DIR — Calls up the DIR TO page, and allows the pilot to proceed directly from present position to any waypoint entered manually or selected in the active flight plan.

PROG — Calls up the progress page corresponding to the phase of the active flight plan that is in progress.

This page displays navigation information and active data such as the optimum and maximum recommended cruise flight levels. It allows the pilot to update the FMGS position and to get a bearing and distance to any location.

PERF — Calls up the performance pages, which display the optimum speed or Mach number for each phase. The pilot can amend these pages. The first page to be displayed is the one corresponding to the current flight phase (except for preflight and done phases).

The pilot can then use the appropriate 6L or 6R LSK to call up pages corresponding to future flight phases.

INIT — Calls up the flight plan initialization A page, which also gives the pilot access to the B page. The pilot uses the INIT pages to initialize Flight Management for the flight.

The pilot uses the INIT A page primarily to insert his flight plan and to align the inertial reference system.

The pilot uses the INIT B page to insert aircraft weight, fuel on board, CG and various fuel requirements. The FMGS uses this data to compute predictions and fuel planning parameters.

The pilot has access to the INIT A page only in the preflight phase.

INIT B page (not accessible after engine start) is called up by pressing the "NEXT PAGE" key.

DATA — Calls up the data index page. This gives the pilot access to various reference pages that show aircraft position, aircraft status, runways, waypoints, navaids, routes and data stored by the pilot.

F-PLN — Calls up the flight plan A and B pages, which contain a leg-by-leg description of the active primary flight plan.
The pilot can use the slewing keys to review the entire active flight plan. He can make all lateral and vertical revisions to the flight plan through these pages, using the left LSKs for lateral revision and the right keys for vertical revision.

RAD NAV — Calls up the Radio Navigation Page. This page displays The Radio Navaids tuned automatically or manually through the FMGC.

FUEL PRED — Calls up the fuel prediction page. Once the engines are started, this page displays the fuel predicted to be remaining at the destination and the alternate, as well as fuel management data.

SEC F-PLN — Calls up the index page for the secondary flight plan.The pilot can use this page to call up the secondary flight plan and all the functions related to it (copying, deleting, reviewing, activating, and the INIT and PERF pages).

ATC COMM — Calls up the ATC applications. (not activated).

MCDU MENU — Calls up the MCDU MENU page, which displays the subsystems currently addressed via the MCDU. The key next to the name of a subsystem enables the crew to select that subsystem.
When the MCDU MENU annunciator lights up, the pilot should press the MCDU MENU key. The menu will have [REQ] displayed next to the name of the subsystem that requires attention.

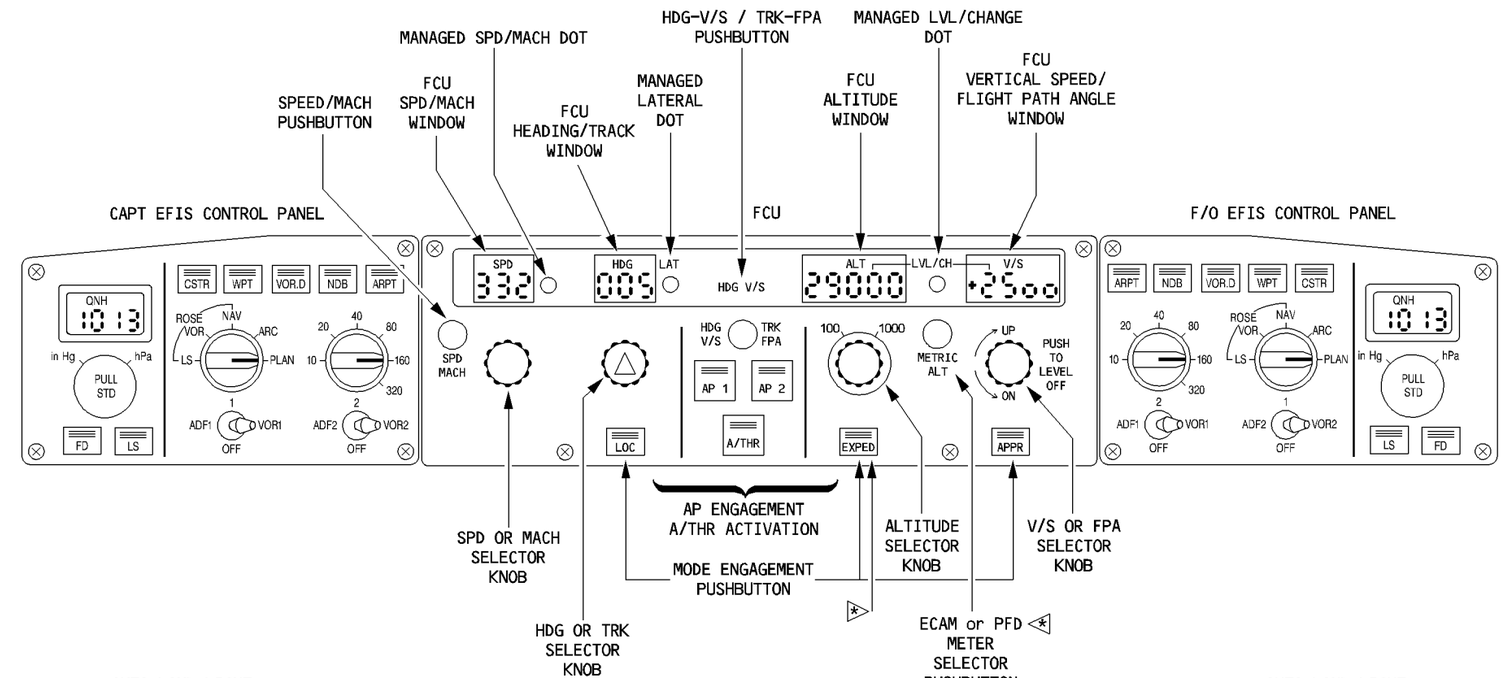
MCDU PAGES

R (Refer to FCOM 4.03).

FLIGHT CONTROL UNIT (FCU)

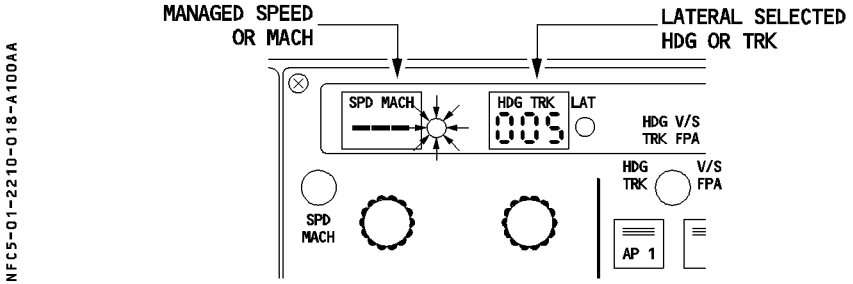
The FCU, which is on the glareshield, is actually three control panels : One for the automatic flight controls and two for the Electronic Flight Instrument System (EFIS).
For a description of the EFIS control panel, see Chapter 1.31.
The FCU has two channels each of which can independently command the central panel. If one channel fails, the other channel can control all the functions.

R



FCU PHILOSOPHY

The pilot can use two types of guidance to control the aircraft in auto flight. One type is managed by the Flight Management Guidance System (FMGS). The other uses target quantities which are manually entered by the pilot.
When the aircraft uses target quantities from the FMGS (managed guidance), the FCU windows display dashes and the white dots next to those windows light up.
When the aircraft uses target quantities, entered by the pilot (selected guidance), the windows display the selected numbers and the white dots do not light up.



Note : The altitude window always displays an altitude selected by the pilot (never dashes).

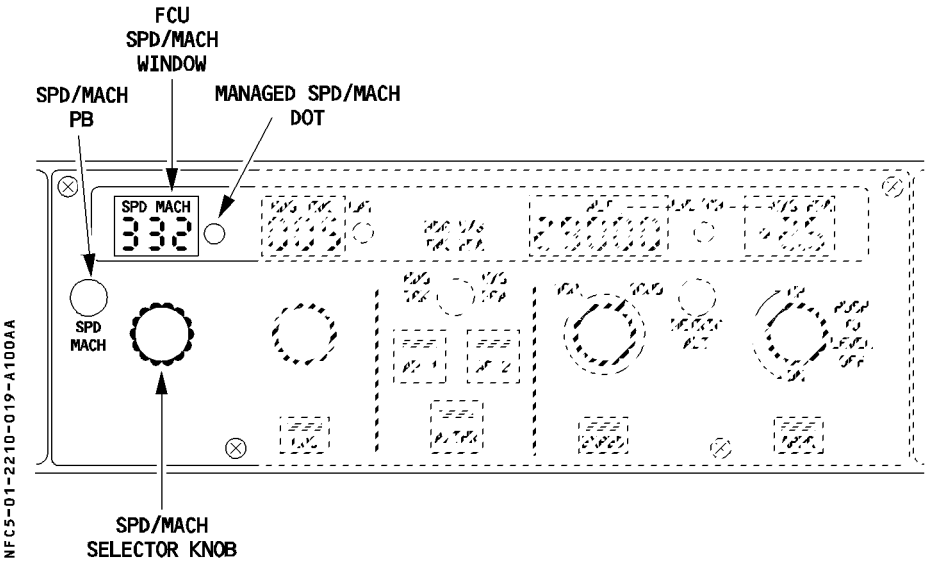
The FCU has four selector knobs :
- SPD-MACH
- HDG-TRK
- ALT
- V/S-FPA

The selector knobs can be rotated, pushed in, and pulled out.

- In order to arm or engage managed guidance for a given mode, the pilot pushes in the associated selector knob. If, for example, he pushes in the HDG selector knob, he engages
R or arms the NAV mode.
- In order to engage a selected guidance mode, the pilot turns the selector knob to set the desired value, then pulls the knob out to engage the mode with a target value equal to the selected value.

R *Note : In managed guidance (lateral, vertical guidance or managed speed), the*
R *corresponding window is dashed. Turning a selector knob without pulling it,*
R *displays a value that is the sum of the current target and the turn action value. The*
R *display remains 45 seconds on the HDG/TRK and V/S windows and 10 seconds on*
R *the Speed/Mach window before the dashes reappear. This rule does not apply to*
R *the ALT selector knob/window.*

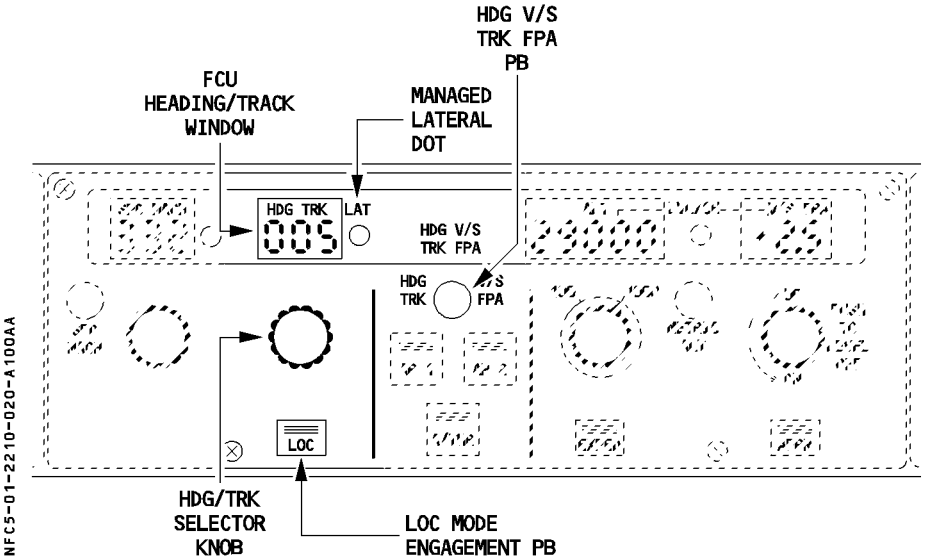
SPEED/MACH CONTROL AREA



- **SPD/MACH selector knob**
  Display range : between 100 and 399 knots for speed, between 0.10 and 0.99 for Mach number.
  One rotation of the knob corresponds to approximately 32 knots or 0.32 Mach.

- **SPD/MACH pushbutton**
  Pushing this pushbutton changes the SPD target to the corresponding MACH target and vice versa.

LATERAL CONTROL AREA



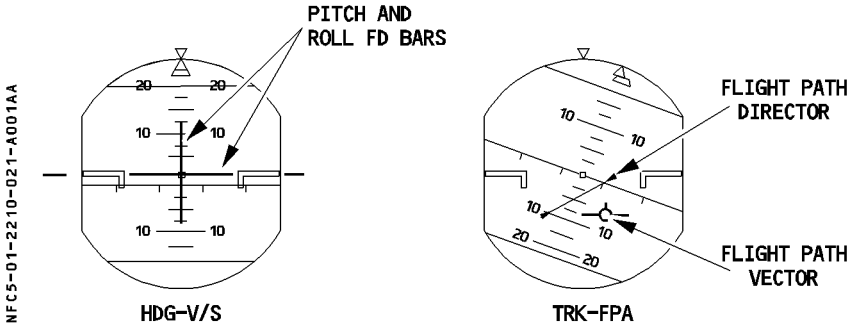
- **HDG/TRK selector knob**
  Display range : between 0° and 359°.
  One rotation of the knob corresponds to 32° (1° per click).

- **LOC pushbutton**
  Pushing this pushbutton arms, engages, or disengages the LOC mode.

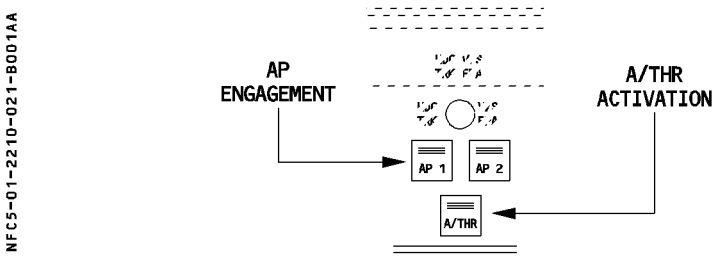
· **HDG V / S - TRK FPA pushbutton**

R The pilot uses this pushbutton to select HDG (associated with V/S) or TRK (associated
R with FPA). Pushing it :

- Displays the Flight Path Vector (FPV) on the Primary Flight Display (PFD) or deletes it.
- On the PFD, changes the FD crossbar display (with the aircraft attitude as its reference) to the aircraft Flight Path Director (with the flight path vector as its reference) and vice versa.
- Changes heading reference into track reference in the HDG/TRK window and vice versa.
- Changes vertical speed reference target into flight path angle reference target in the V/S-FPA window and vice versa.



AP-A/THR CONTROL AREA



· **AP1 AP2 pushbuttons**

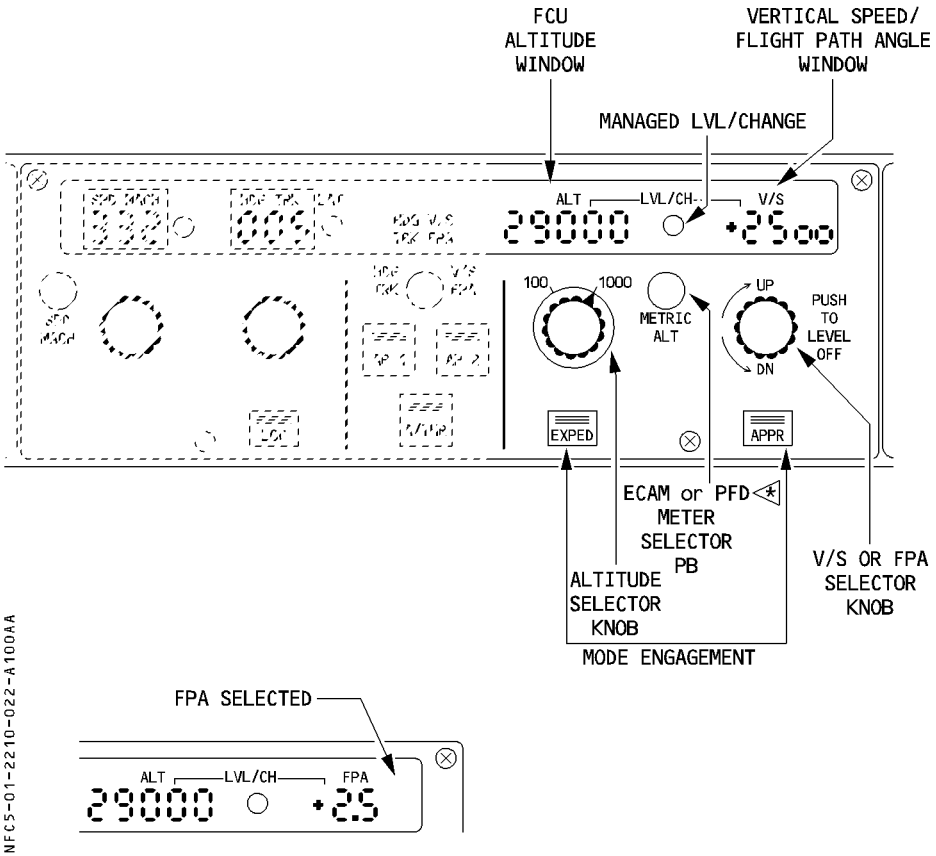
R The pilot uses these pushbuttons to engage or disengage the autopilots. The buttons
R illuminate green when the autopilot is engaged.

· **A/THR pushbutton**

The pilot uses this pushbutton to arm, activate, or disconnect the autothrust (A/THR).
R This button illuminates green if the A/THR is armed or active.

R

VERTICAL CONTROL AREA



VERTICAL CONTROL AREA (Cont'd)

The FCU altitude window always displays a target value selected by the pilot. It never displays dashes.

· **Altitude selector knob (inner and outer)**
Display range : 100 to 49000 feet
– The outer knob has two positions : 100 and 1000.
– The inner knob sets the altitude in the FCU windows in increments of 100 or 1000 feet, depending upon the position of the outer knob.

R · **EXPED pushbutton**
R This pushbutton is used to engage the expedite mode. (See the EXPEDITE, 1.22.30).

· **METRIC ALT pushbutton**
This pushbutton is used to display the FCU altitude target in meters on the ECAM, or the current altitude and FCU/FM altitude target in meters on the PFD ◁.

· **V/S or FPA selector knob**
Range (V/S) : – 6000 to + 6000 feet/min
2 clicks = 100 feet/min
If the pilot turns the knob slowly, each click equals 100 feet/min.
Range (FPA) : – 9.9° to + 9.9°
1 click = 0.1°
The pilot turns this knob to set the value of the vertical speed (V/S) or flight path angle (FPA) to be displayed in the V/S or FPA window. (He chooses which, V/S or FPA, is to be displayed by pushing the HDG V/S/TRK FPA pushbutton, as discussed previously).
One rotation of the knob corresponds to 32 clicks. One complete rotation sets :
FPA = 3.2°
V/S = 1600 ft/min
When the pilot pushes in the V/S or FPA knob the system commands an immediate level-off by engaging the V/S or FPA mode with a target of zero. The flight mode annunciator (FMA) then displays "V/S = 0" in green when V/S or FPA is nulled. If the pilot now turns the knob to put in a new setting for V/S or FPA, the aircraft changes flight path accordingly.

· **APPR pushbutton**
This pushbutton arms, disarms, engages, or disengages the approach modes :
LOC and G/S modes, if an ILS approach is selected in the active F-PLN.
APP NAV-FINAL modes, if a non precision approach is selected in the active F-PLN.

GENERAL

The Flight Management part of the FMGC performs four main functions :
- Navigation
- Flight planning (lateral and vertical)
- Prediction and optimization of performance
- Management of the displays (MCDU, ND, PFD).

NAVIGATION

Essential navigation functions are :
- Computation of position.
- Evaluation of position accuracy (also see FCOM Vol 4 for a detailed description of pilot's procedure).
- Radio navigation tuning.
- Alignment of Inertial Reference System.

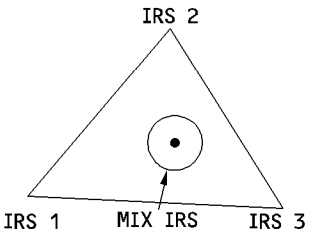
POSITION COMPUTATION

Each FMGC computes its own aircraft position (called the "FM position") from a MIX IRS position (see below), and a computed radio position or GPS position.
The FMGS selects the most accurate position, considering the estimated accuracy and integrity of each positioning equipment.
GPS/INERTIAL is the basic navigation mode provided GPS data is valid and successfully tested. Otherwise, navaids plus inertial or inertial only are used. (Refer to Navigation modes).

MIX IRS POSITION

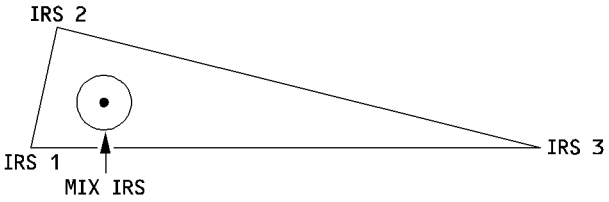
Each FMGC receives a position from each of the three IRSs, and computes a mean-weighted average called the "MIX IRS" position.

NFC5-01-2220-002-A220AA



– If one of the IRSs drifts abnormally, the MIX IRS position uses an algorithm that decreases the influence of the drifting IRS within the MIX IRS position.

NFC5-01-2220-002-B220AA



– If one of the IRSs fails, each FMGC uses only one IRS (onside IRS or IRS3). Each IRS position and inertial speed are continuously tested. If the test fails, the corresponding IRS is rejected.
– When the CHECK IRS (1, 2 or 3)/FM POSITION message appears on the MCDU, refer to FCOM 4.03.

R

GPS POSITION

R Each IRS computes a hybrid position that is a mixed IRS/GPS position called GPIRS. For this, each IRS can independently select their GPS source in order to maximize GPS data availability. Among these 3 GPIRS positions received by each FMGC, one is selected according to a figure of merit and priority. The selection is performed using the following hierarchy :

- Onside GPIRS position
- GPIRS 3
- Opposite GPIRS position

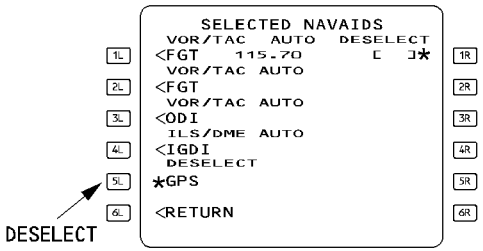
If the GPIRS data does not comply with an integrity criteria, the GPS mode is rejected, and radio position updating is used, the "GPS PRIMARY LOST" message is displayed on the ND and on the MCDU scratchpad.

During non ILS approach, the loss of the GPS primary function triggers a triple click aural warning.

When the GPS primary function is recovered, the "GPS PRIMARY" message comes up on the ND and on the MCDU scratchpad. It means that GPIRS data again complies with the required integrity criteria.

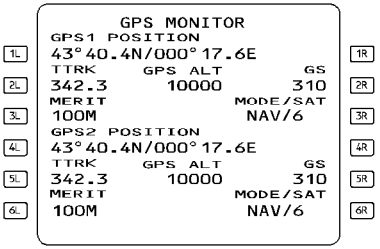
As long as GPS primary is in use, all usual navigation performance requirements are met. The crew can deselect/select the GPS on the SELECTED NAVAIDS page, if necessary.

NFC5-01-2220-003-A110AA



Information concerning the GPS position is displayed on the GPS MONITOR page.

NFC5-01-2220-003-B110AA



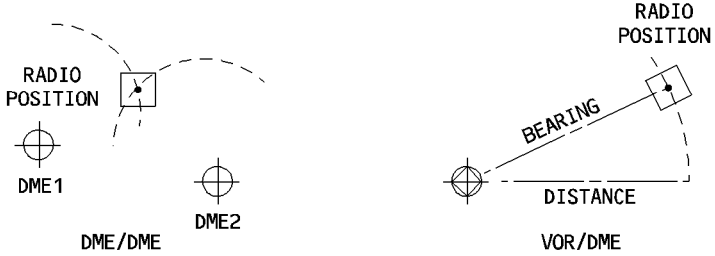
R *Note : In normal operations, all ADIRUs may elect the same GPS source. As a result, data*
R *of the non-elected GPS may be dashed on the GPS MONITOR page, without any*
R *detected GPS failure or triggered "GPS PRIMARY LOST" message.*

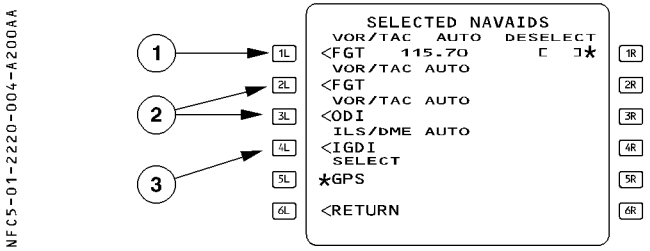
RADIO POSITION

Each FMGC uses onside navaids to compute its own radio position. These navaids are displayed on the SELECTED NAVAIDS page. The available navaids are :

– DME/DME
– VOR/DME
– LOC
– DME/DME-LOC
– VOR/DME-LOC

It uses LOC to update the lateral position, using LOC beam during ILS approach.
LOC is also used for quick update, when in GPS/IRS mode.
If one or more navaids fail, each FMGC can use offside navaids to compute the VOR/DME, or the DME/DME radio position.
The radio navaid selection is displayed on the DATA "SELECTED NAVAIDS" page.





NFC5-01-2220-004-A200AA

(1) VOR/DME selection (auto or manual) for display (onside VOR)

(2) DMEs automatic selection for DME/DME onside radio position.

(3) ILS selection auto or manual for LOC update computation.

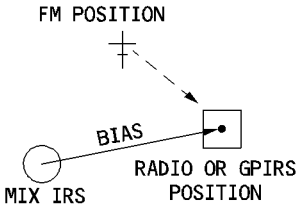
FM POSITION

At flight initialization, each FMGC displays an FM position that is a mixed IRS/GPS position (GPIRS).

- At takeoff, the FM position is updated to the runway threshold position, as stored in the database, possibly corrected by the takeoff shift entered on the PERF TO page.
- In flight, the FM position approaches the radio position, or the GPS position, at a rate that depends upon the aircraft altitude.

Note : The FM position update at takeoff is inhibited when GPS PRIMARY is active.

NFCS-01-2220-005-A205AA

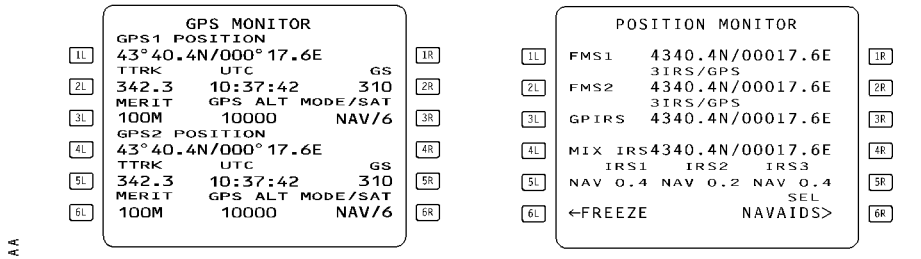


Bias

Each FMGC computes a vector from its MIX IRS position to the radio or GPIRS position. This vector is called the "bias". Each FMGC continuously updates its bias, if a radio position, or a GPIRS position is available.
If an FMGC loses its radio/GPIRS position, it memorizes the bias and uses it to compute the FM position, which equals the mix IRS position plus the bias.
Until the radio or the GPIRS position is restored, the bias does not change.
The crew can manually update the FM position. This also updates the bias.

POSITION MONITOR

The crew may check the position computation using the "GPS MONITOR" or "POSITION MONITOR" page.



NFC5-01-2220-006-A210AA

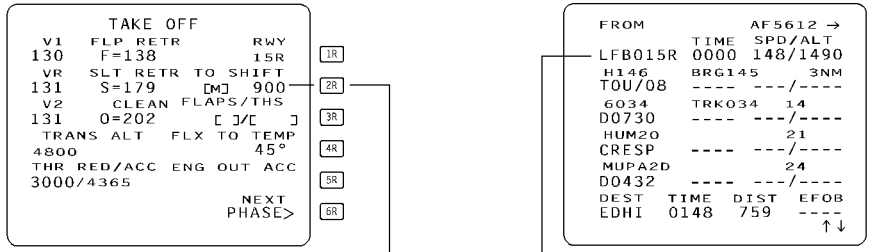
1L	FM POSITION (ONSIDE FMGC)
2L	FM POSITION (OFFSIDE FMGC)
3L	GPIRS OR RADIO POSITION (ONSIDE FMGC), WHICHEVER IS USED FOR POSITION UPDATING
4L	MIX IRS POSITION (ONSIDE FMGC)

TAKEOFF UPDATE (GPS PRIMARY not active)

A takeoff update requires that the takeoff runway be part of the flight plan. This provides the most accurate position update.
If the takeoff run starts at an intersection, enter a takeoff shift on the PERF TO page to refine the takeoff update.
An accurate takeoff update ensures a precise aircraft position during departure.

PERF TO PAGE

F-PLN A PAGE
(WITHOUT PREDICTIONS)



NFC5-01-2220-006-B210AA

NAVIGATION MODES

The FMGS updates the FM position using GPS or radio navaids if the GPS function in inoperative.
It can use 4 main different FM navigation modes to make this update. The decreasing priority order is:
- IRS-GPS
- IRS-DME/DME
- IRS-VOR/DME
- IRS only

During ILS approaches the system performs, a lateral temporary updating using one of the following modes :
- IRS-GPS/LOC
- IRS-DME/DME-LOC
- IRS-VOR/DME-LOC
- IRS-LOC

EVALUATION OF POSITION ACCURACY

The FMGS computes an Estimated Position Error (EPE) continually.
It is an estimate of how much the FM position has drifted, and is a function of the navigation mode the system is using.

CURRENT NAV MODE	EPE (RATE or THRESHOLD)	REMARK
IRS/GPS	$\sqrt{(FOM^2 + 100^2)}$ in meters	FOM = Figure of Merit of GPS If above 0.28 NM the GPS position is rejected.
IRS/DME/DME	Tends towards 0.28 NM	EPE decreases from initial value to 0.28 Nm.
IRS/VOR/DME	0.1 NM + 0.05 X DME DIST minimum : 0.28 NM	EPE increases or decreases as the distance between the a/c and the VOR/DME.
IRS ONLY	+ 8 NM/h during the first 30 min. 0 NM/h during the following 60 min. + 4 NM/h during the following 30 min. 0 NM/h during the following 60 min. + 2 NM/h after	EPE increases continuously

Note : After an IRS alignment or at takeoff the EPE is set at 0.2 NM.

The system displays the EPE to the crew, and compares it with the required navigation performance (RNP).

– If the EPE does not exceed the appropriate criteria, accuracy is HIGH.
– If the EPE exceeds the appropriate criteria, accuracy is LOW.

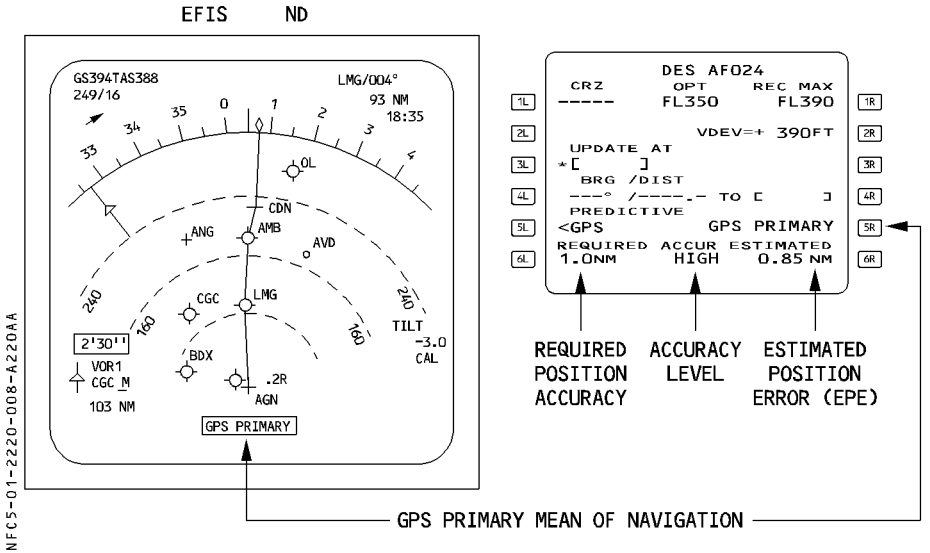
The number displayed in the REQUIRED NAVIGATION PERFORMANCE (RNP) field is (in decreasing order of priority) : The pilot-entered value, the database procedure value, or the system's default value. When a pilot enters a RNP that is larger than the published value, one of the following messages is displayed : "PROCEDURE RNP is XX.XX", or "AREA RNP IS XX.XX". When this occurs, the crew should check the entered value, and modify it, if necessary.

The RNP value shall be in accordance with the specified RNP values of the navigation/approach charts (if a RNP is specified).

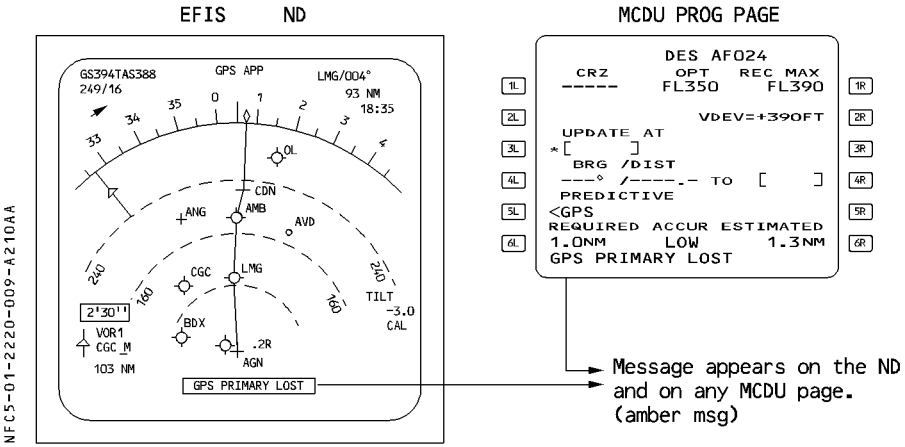
This message is also displayed upon a flight area change, if the new required criteria (default value) is smaller than the displayed manually-entered value.

DEFAULT AREA RNP VALUES	
EN ROUTE	2.0 NM
TERMINAL	1.0 NM
APPROACH	GPS 0.3 NM OTHER CASES 0.5 NM

When the position computation uses IRS/GPS mode, the EPE is always smaller than any airworthiness required value. As a result, accuracy is HIGH and GPS is the primary mean of navigation. "GPS PRIMARY" is displayed on PROG page and temporarily on ND.



When the GPS function is lost, or when the navigation accuracy is downgraded (low accuracy), a "GPS PRIMARY LOST" message is displayed on the ND and MCDU scratchpads. The MCDU message can be cleared ; the ND message cannot.
During a non ILS approach, a triple click aural warning is also triggered.
When the GPS is lost, NAV accuracy does not immediately downgrade ; but only when the EPE exceeds the required criteria.



CAUTION

"HIGH" or "LOW" indicates FM position accuracy, based upon estimated drift.
This is why the flight crew must periodically check position accuracy, when the GPS function is lost.

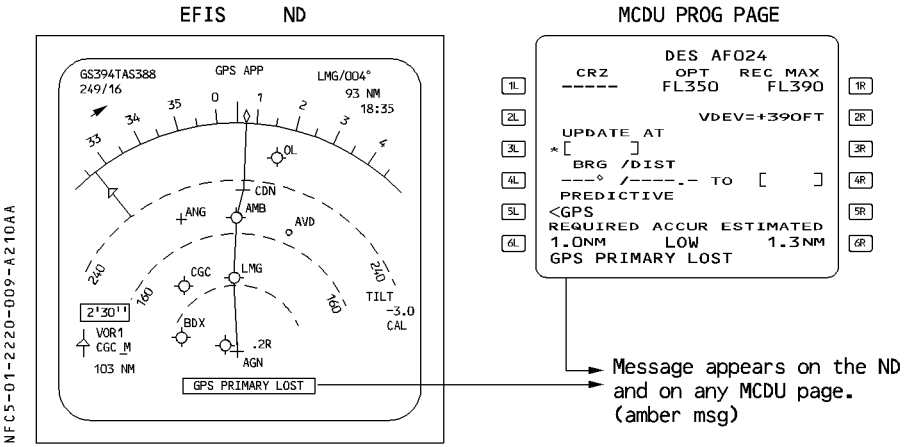
When the GPS is manually deselected, the "GPS IS DESELECTED" message is displayed on the MCDU, 80 NM before T/D or at approach phase transition.

GPS/FMS POSITION DISAGREEMENT

When GPS primary is active, and either of the FMGC positions deviate from the GPS positions 1 or 2 by more than 0.5 minutes of latitude or longitude, then the lower ECAM display unit displays the NAV FMS/GPS POS DISAGREE amber message and A/C POS... CHECK in blue.
The master caution light comes on, and the single chime sounds.

INTENTIONALLY LEFT BLANK

When the GPS function is lost, or when the navigation accuracy is downgraded (low accuracy), a "GPS PRIMARY LOST" message is displayed on the ND and MCDU scratchpads. The MCDU message can be cleared ; the ND message cannot.
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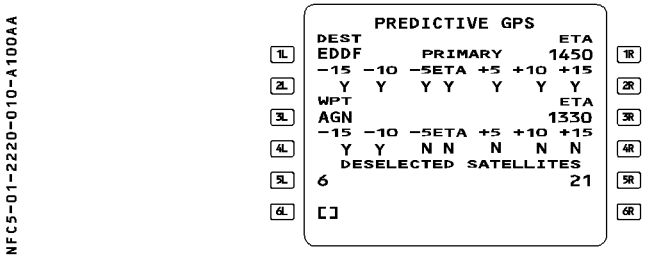
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PREDICTIVE GPS

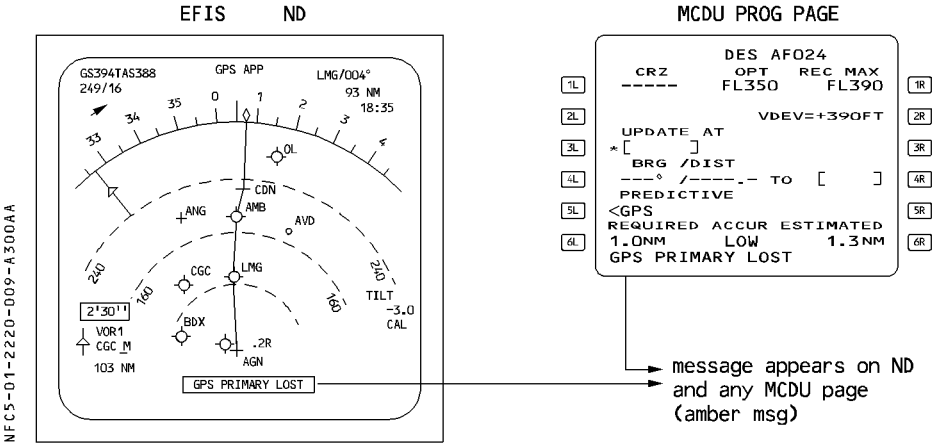
R The predictive GPS page is only operative with the Honeywell ADIRS equipment.
The predictive GPS function predicts the availability of the GPS within ± 15 minutes of ETA at destination, or at any waypoint entered by the crew.



NFC5-01-2220-010-A100AA

Predictions are displayed on the predictive GPS page at time intervals of 5 minutes (+15 and –15 minutes of ETA).
To access this page, press the 5L key of the PROG page.
This page also enables the deselection of up to 4 satellites at a time.

When the GPS function is lost, or when the navigation accuracy is downgraded (low accuracy), a "GPS PRIMARY LOST" message is displayed on the ND, and on the MCDU scratchpad. The MCDU message can be cleared, the ND message cannot.
During a non ILS approach, a triple click aural warning is also triggered.
When the GPS is lost, NAV accuracy does not immediately downgrade ; it only downgrades when the EPE exceeds the required criteria.



CAUTION

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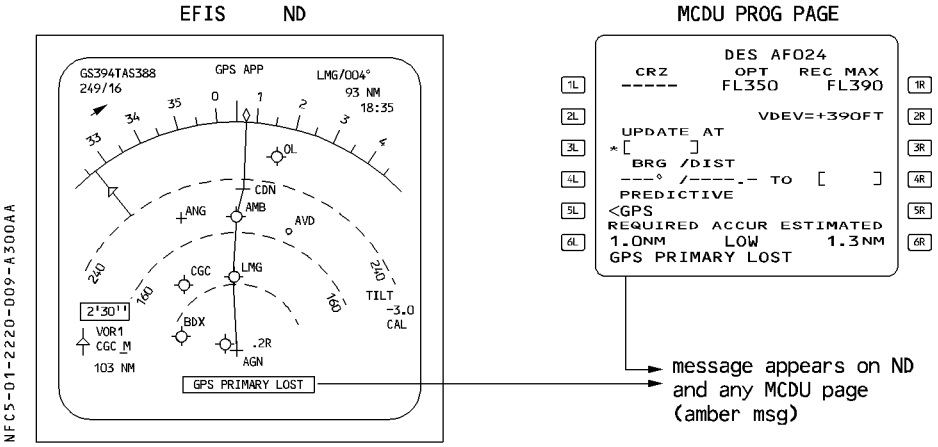
When the GPS is manually deselected, the "GPS IS DESELECTED" message is displayed on the MCDU, 80 NM before T/D or at approach phase transition.

FM/GPS POSITION DISAGREEMENT

When the GPS PRIMARY function is operative, and either of the FM positions deviate from GPS position 1 or 2 by more than :
– A longitude threshold that depends on the latitude :
  · 0.5 minutes for latitudes below 55°,
  · 0.9 minutes for latitudes at or above 55°, and below 70°
– A latitude threshold of 0.5 minutes, regardless of the latitude.
The lower ECAM displays the "NAV FM/GPS POS DISAGREE" amber caution.
The master caution light comes on and the single chime sounds.
This amber caution is inhibited during the takeoff phase.
Above 70° of latitude, a longitude difference does not trigger the alarm.

INTENTIONALLY LEFT BLANK

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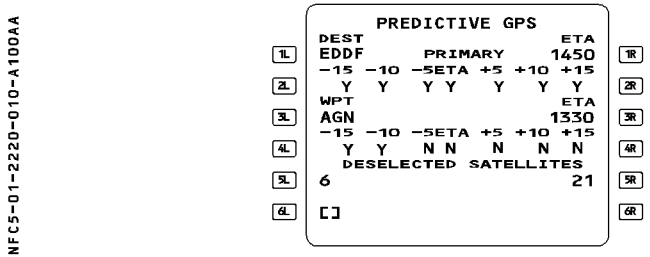
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NFC5-01-2220-010-A100AA

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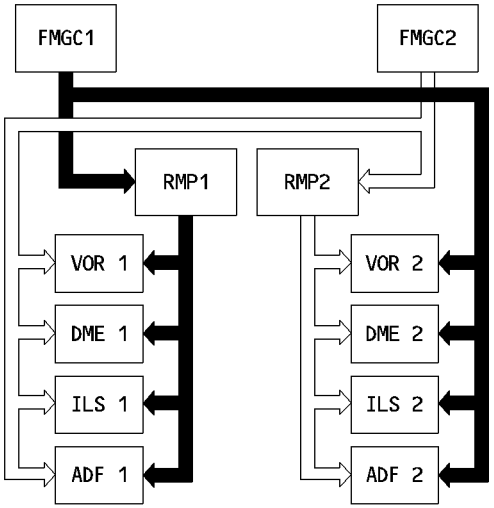
RADIO NAVIGATION TUNING

Radio navaids are tuned for two different purposes : display and computation.
Tuning for display may be performed in three different ways :
– automatic tuning (FMGC software)
– manual tuning through the MCDU RAD NAV page
– manual tuning through the Radio Management Panel (RMP) if both FMGCs or both MCDUs fail.

The FMGS automatically tunes the radio navaids for the computation of radio position.

Note : The manual selection of a VOR or VOR/DME may prevent the FMGS from tuning a VOR/DME automatically to compute position. If so, the relevant MCDU will display "TUNE BBB FFF.FF" (BBB = ident, FFF.FF = frequency).

ARCHITECTURE



NFCS-01-2220-011-A102AA

– In dual mode and independent mode each FMGC tunes the navaids on its side of the console (one VOR, 4 DMEs, one ILS, and one ADF) simultaneously. In these modes, the pilot can also tune the VOR (and associated DME), ILS, and ADF manually.
– In single mode, the valid FMGC will tune both side navaids. The pilot can also use the RAD NAV page to tune both VORs, both ADFs and the ILS manually.

Manual tuning has priority over autotuning.

Note : If one radio receiver fails, both FMGCs use the operative radio receiver to compute the aircraft position.

VOR

Each FMGC may tune only one VOR (manual or automatic).
Autotuning follows the following VOR tuning priorities :
1. The navaid specified for the approach.
2. The navaid to be used for computing the present radio position.
3. For display purposes :
   – A navaid specified for the active leg ;
   – The "to" waypoint (TO WPT), if it is a navaid ;
   – The "from" waypoint (FROM WPT), if it is a navaid ;
   – A waypoint farther along the flight path, if it is a navaid ;
   – The navaid closest to the aircraft's present position.

The scratchpad displays "SPECIFIC VOR-D UNAVAIL", if the VOR or VOR/DME required for tuning has been deselected.

DME

Each FMGC automatically uses its four DMEs as follows :
– One DME for display. It may be manually or automatically tuned. This DME is also used for VOR/DME position computation.
– Two DMEs in DME/DME mode for calculating the aircraft's radio position. The FMGC autotunes these as a function of their best accuracy. The flight crew receives no indication that this process is going on.
– One DME is linked to the ILS/DME.

ADF

The FMGC autotunes one ADF, when the flight plan specifies an NDB approach and a fix in the approach is the "TO" waypoint.
The scratchpad displays "SPECIFIC NDB UNAVAIL", if the NDB required for autotuning has been deselected.

ILS

Each FMGC autotunes one ILS frequency :
– In the PREFLIGHT or TAKEOFF phase, when the takeoff runway has an associated ILS.
– In the CLIMB-CRUISE-DESCENT, APPROACH, or GO-AROUND phase, when the type of approach in the flight plan is ILS.

The scratchpad displays "RWY/ILS MISMATCH" when the pilot has manually tuned the ILS and the entered frequency does not match the ILS or LOC IDENT/FREQ requested for autotuning. The FMGS logic does not allow the crew to modify the course of an ILS when its frequency is identical to the ILS selected in the F-PLN.

SELECTION OF NAVAIDS ON MCDU PAGES

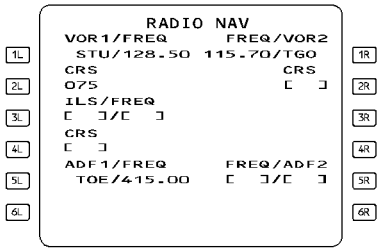
The MCDU displays the navaids tuned by the FMGC on two pages :

– RADIO NAV page
– SELECTED NAVAIDS page

· RADIO NAV page

This page shows which navaids have been tuned automatically or manually for display purposes.

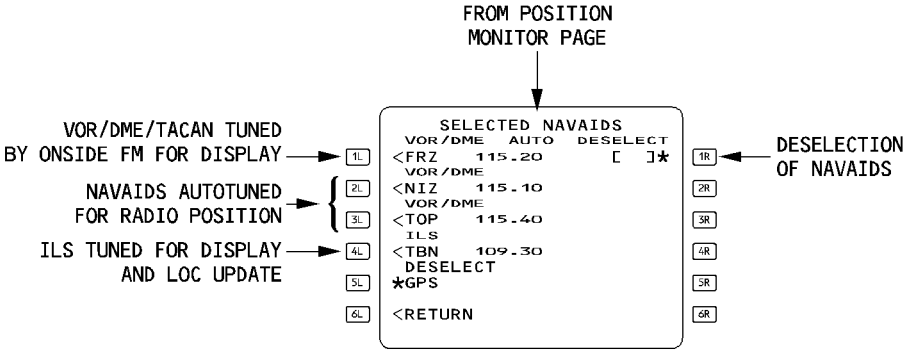
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· SELECTED NAVAIDS page

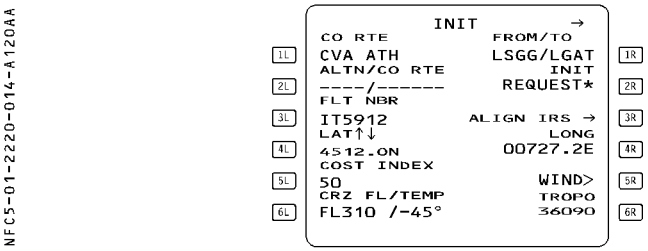
This page lists the navaids tuned by the onside FMGC. No navaids can be modified on this page. The pilot may deselect as many as six unreliable navaids for the whole flight (using 1R key).

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ALIGNMENT OF INERTIAL REFERENCE SYSTEM

The FMGS uses the reference point coordinates of the departure airport to align the IRS. It automatically calls these up from the database after the flight crew has entered a company route, or an origin-destination city pair, and pressed the ALIGN IRS key. The flight crew can manually adjust these coordinates to the gate position. A normal alignment takes ten minutes ; a fast alignment takes 30 seconds.
Fast alignment is used to refine a position, when time is limited.



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Note : If the ADIRS overhead CDU flashes "ALIGN" during the alignment process, it indicates one of the following :

- *It has detected excessive motion. (It automatically restarts the alignment).*
- *It has detected a mismatch between the position the MCDU has sent to the IRS, and the last memorized IRS position. The pilot must enter new coordinates in the MCDU, and realign the IRS.*
- *It has detected a mismatch between the latitude the MCDU has sent to the IRS, and the latitude the IRS has computed during the alignment.*
- *The IRS has not received a position from the MCDU or the ADIRS overhead CDU.*

FLIGHT PLANNING

For flight planning, the pilot inserts the following into the FMGS via the MCDU :
- the intended lateral trajectory (lateral flight plan)
- the intended vertical trajectory, which is a speed and altitude profile (vertical flight plan)

The system must have this information in order to compute performance and guidance commands.

GENERAL

The FMGS can contain two different flight plans :
- the ACTIVE flight plan, which is the basis for :
  - · lateral and vertical guidance
  - · MCDU and ND display
  - · radio navigation autotuning
  - · performance predictions
  - · fuel planning
- the SECONDARY flight plan which the pilot may use :
  - R · when an alternate takeoff runway is probable
  - · to plan a diversion
  - · to prepare the next flight
  - R · to compare predictions or evaluations

Each flight plan is composed of the same elements :
- the primary flight plan, from origin to destination and missed approach
- the alternate flight plan, from destination to alternate destination

The pilot enters the flight plan in either of two ways :
- automatically by selecting a company route. Such a selection will call all the elements of the route out of the database.
- manually by selecting an ORIGIN/DEST pair, and then selecting all successive waypoints, procedures, and vertical constraints on the MCDU.

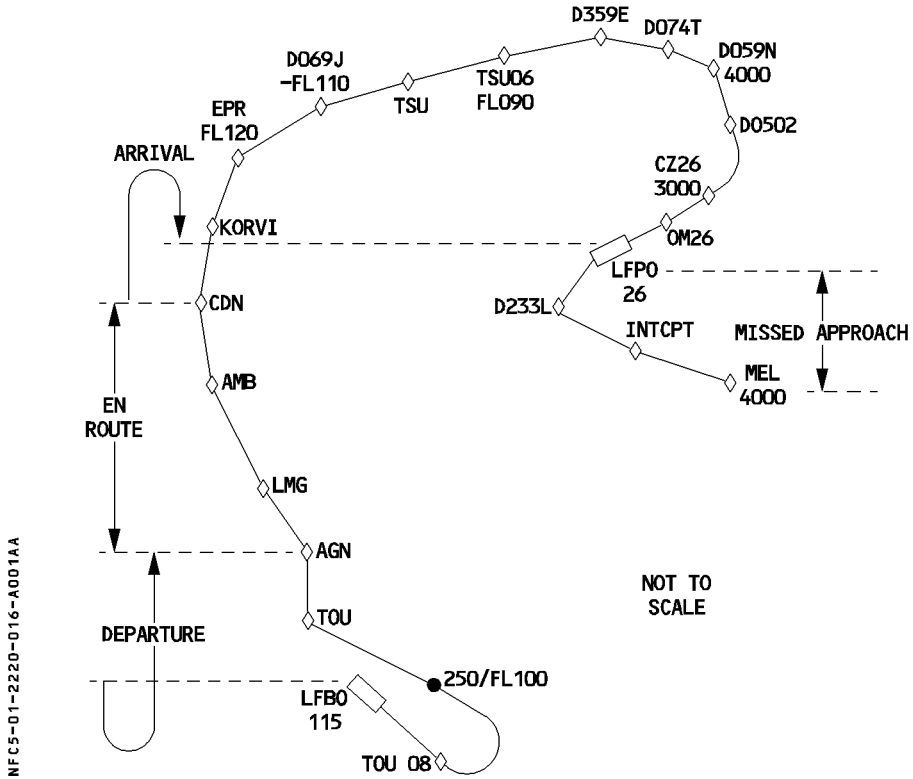
The pilot may then modify the flight plan on the ground or in flight, by making lateral and vertical revisions.

LATERAL FLIGHT PLAN

The lateral flight plan includes the following elements :

- Departure
  - Takeoff runway
  - SID
  - En route transition
- En route
  - En route waypoints and airways
- Arrival
  - En route transition
  - STARs/VIAs
  - Landing runway with selected approach
  - Missed approach
- Alternate flight plan

These elements are defined by waypoints and legs between the waypoints.



The FMGC automatically strings the legs in sequence.
The flight plan has a discontinuity if any two waypoints do not have a leg defined between them.
The computer assumes that the aircraft will fly a direct leg between the two waypoints that define the discontinuity.

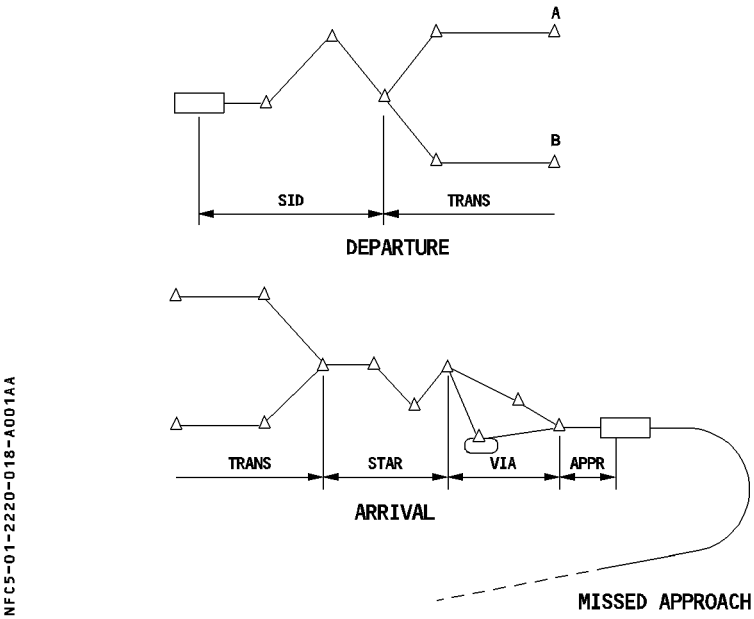
Note : When the aircraft enters a flight plan discontinuity, the NAV mode automatically switches to the HDG (TRK) mode.

R *Note : In HDG/TRK mode, a waypoint is sequenced when it passes behind the aircraft, and*
R *the aircraft is less than 7 NM from it, and also when the difference between the*
R *track of the aircraft and the track of the leg is less than 90 degrees.*
R *The same conditions apply in NAV mode, except that no distance to the waypoint*
R *is taken into account.*

The FMGS automatically strings additional types of legs, when departure or arrival procedures (SID-STAR-TRANS) are defined. Some of these legs are specific legs, such as:
- DME arc leg
- Holding pattern to a fix, or reverse turn
- Course-to-fix leg
- Heading leg
- MANUAL leg

The pilot cannot create these types of legs : They are part of the stored departure/arrival procedures he has selected.
The pilot can only create direct legs between manually-defined geographic points (navaids, airports, waypoints).

Note : The departure and arrival procedures are defined in the database to minimize the amount of memory required. They are divided, as follows :
DEPARTURE = SID + EN ROUTE TRANSITION
ARRIVAL = APPR VIA + STAR + EN ROUTE TRANSITION
The SID is the central common part of the departure procedure, as the STAR is of the arrival procedure. Enroute transitions (TRANS) are the various possible trajectories defined between the last SID point and the first enroute waypoints, and between the last enroute waypoint and the first fix of the STAR.
"APPR VIAs" are the possible trajectories, defined between the last STAR point and the first point of the approach.

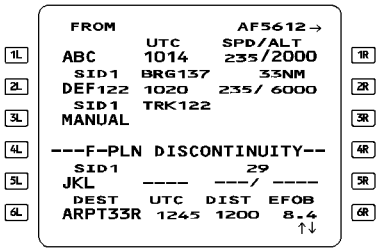


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MANUAL LEGS

A MANUAL leg stays on a constant TRK or HDG and has no termination point. You cannot insert it into a flight plan manually : it is part of a given procedure such as a SID or a STAR. When the aircraft is flying a MANUAL leg, the NAV mode remains engaged and predictions assume that the aircraft will fly a direct leg from its present position to the next waypoint
R (DIR TO). When the aircraft is cleared to fly to the next waypoint of the flight plan, the pilot
R performs a DIR TO.

Note : — *In NAV mode a MANUAL leg is sequenced only by performing a DIR TO.*
— *The use of the descent mode (DES) on a MANUAL leg is not recommended.*



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LATERAL REVISIONS

There are two types of lateral revisions :

— Lateral revisions that have an immediate effect on the active flight plan
  · The pilot inserts, deletes, or changes an individual waypoint on the flight plan page.
  · The pilot creates a direct leg (DIR TO) from his present position to a selected waypoint.
— Lateral revisions that lead to a temporary flight plan (TMPY) before they take effect. For these, you can select, delete, or modify waypoints that belong to an airway or to a procedure (SID, STAR, HOLD, TAKEOFF or LANDING RWY). This modification is made on specific "LAT REV" pages from the flight plan page.

Possible revisions are :

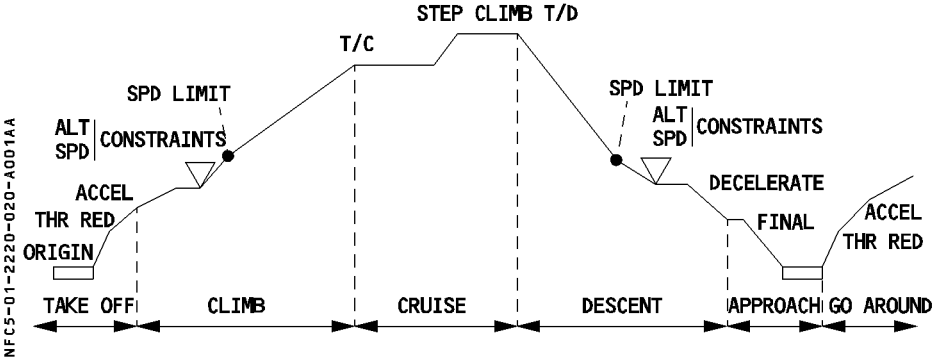
· Insert or modify departure procedure.
· Insert or modify arrival procedure.
· Insert a waypoint.
· Change the destination.
· Insert an airway.
· Insert an offset.
· Insert a holding pattern.
· Select or enable an alternate flight plan.
· Fix information.

TEMPORARY FLIGHT PLAN

The purpose of the temporary flight plan is to allow the pilot to check a revision on the MCDU and EFIS ND before inserting the changes into the active flight plan. It is a copy of the active flight plan that has been changed according to the pilot revision. While it is displayed the aircraft will continue to follow the original active flight plan.
No predictions are computed or displayed on the pages of the temporary flight plan.
For details, refer to the TEMPORARY F-PLN chapter (FCOM 4.04).

VERTICAL FLIGHT PLAN

The vertical flight plan is divided into the following flight phases.
Preflight - Takeoff - Climb - Cruise - Descent – Approach - Go Around - Done.
All but preflight and done are associated with speed and altitude profiles.



Each phase has an assigned profile of target speeds. For each phase the FMGS computes an optimum (ECON) speed as a function of the strategic parameters (CI, CRZ FL, ZFW, ZFWCG, block FUEL) and performance criteria.

ECON speed is the basis of the managed speed profile.

The ECON speed can be modified by presetting a speed or Mach number on the MCDU (PERF page) for the next phase, or by selecting on the FCU a speed or a Mach number for the active phase, or by inserting speed constraints or speed limits on the MCDU vertical revision (VERT REV) page.

The vertical flight plan includes vertical constraints (altitude, speed, time) that may be stored in the data base or entered manually by the crew through vertical revision pages. The crew may also define step climbs or step descents for cruise purposes. If the crew plans to climb to a higher flight level or descend to a lower level, it can use a vertical revision at any waypoint to insert the new level.

When all the vertical data has been defined, the FMGC computes the vertical profile and the managed speed/Mach profile from takeoff to landing.

For details, refer to vertical revision pages 4.03.

PERFORMANCE

The performance function includes optimization and predictions.

OPTIMIZATION

The FMGC minimizes cost by optimizing speed. The optimization function computes the following items :

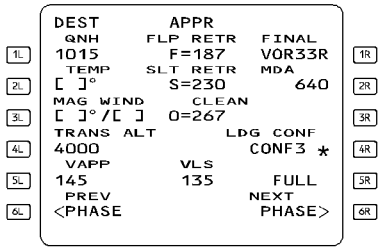
- takeoff, approach, and go-around speeds (F, S, Green Dot, VAPP)
- an optimum target speed for CLB and DES phases (ECON CLB/DES SPD)
- an optimum target Mach number for CRZ phase (CRZ MACH)
- an optimum FL, for information purposes
- an optimum descent profile from CRZ FL down to the destination airport.

These items depend on the data the pilot inserts during lateral and vertical flight planning and revision procedures.
Most are displayed on the PERF pages associated with the appropriate flight phases.

Takeoff, approach and go around speeds

The FMGC computes takeoff speeds (F, S, Green Dot) during the preflight and takeoff phases, using the performance model in the database and the takeoff weight.
The pilot has to insert V1, VR, and V2 in the PERF TO page manually.
The FMGC uses the performance model and either the predicted landing weight or the current gross weight at transition to the approach phase to compute approach speeds (VLS, VAPP, F, S, Green Dot). On the PERF APPR page, the selected LDG CONF determines the applicable VLS and VAPP, the latter being updated by the WIND correction that the pilot enters on the same page.
The FMGC uses the performance model and gross weight to compute go-around speeds (F, S, Green Dot).

R



PERF APPROACH PAGE

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Optimum target speed for CLB or DES phase

The FMGC computes optimum speeds, based on :

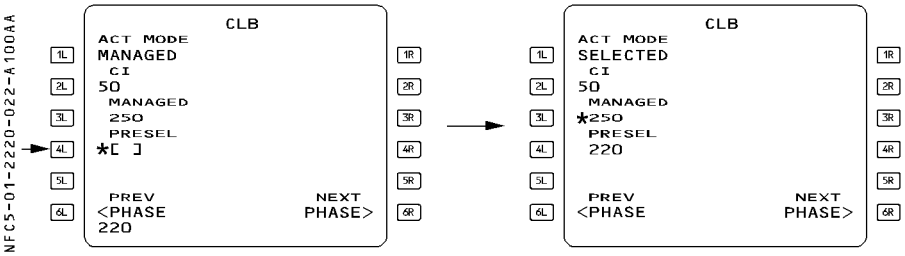
- Gross weight (GW)
- Cost index (CI)
- Cruise flight level (CRZ FL)
- Wind and temperature models
- Performance factor

When there is no time or speed constraint/limit, ECON SPEED is the optimum speed for the selected cost index. It refers to fuel and time cost, and not directly to fuel saving.

The FM calculates ECON CLB, ECON DES and the associated top of climb and top of descent as a function of the cost index, cruise FL, and meteo data.

Preset target speed for CLB phase

The pilot can preselect the climb speed before the CLB phase begins, by inserting a speed in the PRESEL field :

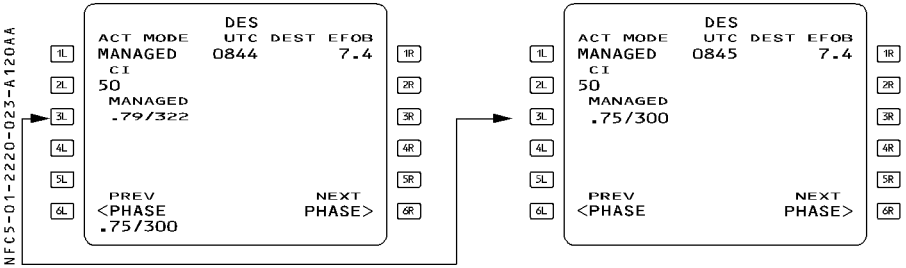


The active mode field changes from MANAGED to SELECTED, and the FM will use the entered speed for climb predictions' computation. The pilot can revert to managed mode by pressing the 3L key.

Preset target speed/Mach for DES phase

The pilot can change the speed and/or Mach displayed in the MANAGED field, before the DES phase begins, by inserting a speed and/or Mach in the MANAGED field.

Although the entered speed is selected by the pilot, the FMGS uses it to compute the descent flight path and the top of descent. It is, therefore, part of the managed descent profile.



The pilot can revert to the optimum speed/Mach by clearing the 3L field.

Optimum target Mach number in cruise

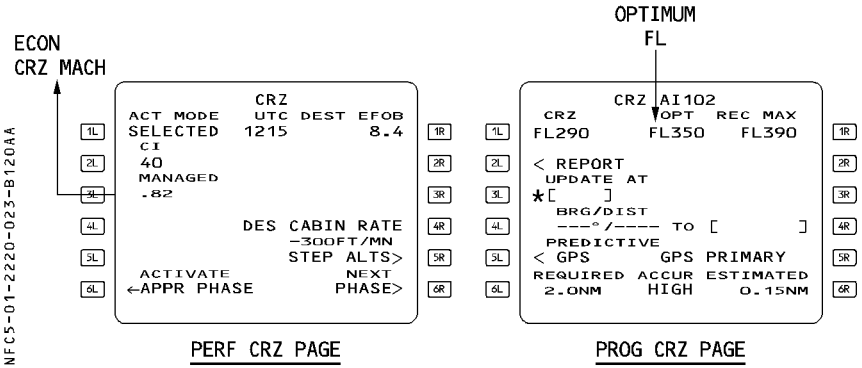
The FM computes ECON CRZ MACH as the optimum speed and continuously updates it, taking into account :

- Current weather conditions
- Modifications to the flight plan

Note : Below FL 250, the FMGS calculates ECON CRZ SPD instead of ECON CRZ MACH.

Optimum flight level in cruise

The optimum flight level is the flight level at which the aircraft incurs the lowest cost for a given flight plan, cost index, and gross weight. The FM continuously updates it during the cruise phase, and displays it on the PROG page. The PROG page displays dashes for this quantity, when the system detects an engine-out condition.



PERF CRZ PAGE

PROG CRZ PAGE

COST INDEX (CI)

CI is the ratio of flight time cost (CT) to fuel cost (CF).
CI = CT/CF KG/MIN or 100 LB/H
The cost index is used to compute the best economic speed and Mach to be flown considering the ratio between the flight time cost and the fuel cost.
CI = 0 Corresponds to minimum fuel consumption (max range).
CI = 999 Corresponds to minimum time.

PREDICTIONS

The FMGC computes predictions for the primary and secondary flight plans and displays them on the Multipurpose Control and Display Units (MCDUs), and on the navigation display (ND) of the Electronic Flight Instrument System (EFIS).
The computations use the current state of the aircraft (GW, CG, position, altitude, speed, engaged mode of the autopilot or flight director, time, wind, temperature) for the active flight plan.
The computations use pilot-entered data for the secondary flight plan when it is not a copy of the active flight plan.
When the secondary flight plan is a copy of the active flight plan, it uses the same data.

PREDICTIONS FOR THE PRIMARY FLIGHT PLAN

The predictions displayed on the MCDU assume that the system will guide the aircraft along the preplanned lateral and vertical flight plans.
The predictions displayed on the ND assume that the aircraft will continue to operate in the modes (selected or managed) that are currently active.
As long as the aircraft is flying the flight plan under managed guidance, the predictions on the MCDU will match those on the ND.

R If the pilot does not fly the flight plan, the MCDU predictions assume that :
R – The pilot will fly back towards the flight-planned route.
R – The pilot will immediately resume flying the FMGC-managed modes.
R If the pilot does not fly the managed speed profile, the MCDU predictions assume that he will maintain the selected speed until he reaches :
R – In the climb or descent phase, the next speed limit or speed constraint if any, or next phase,
R – In cruise, the top of descent.
R Then, the predictions assume that the pilot will revert to managed speed.

UPDATE OF PREDICTIONS

The FMGCs recompute the predictions, whenever there is a modification to the :
- Lateral flight plan
- Vertical flight plan
- Forcasted atmospheric conditions, entered by the crew
- Cost index
- Speed control (managed/selected).

Note : During recomputation, the prediction fields on the MCDU pages display dashes.

WINDS USED FOR PREDICTIONS

Refer to VERTICAL FUNCTIONS, FMGS Pilot's Guide, 04.04.25.

EFIS ND PREDICTIONS

Refer to FLIGHT MANAGEMENT PRINCIPLES, 4.02.20.

MCDU PREDICTIONS

Refer to FLIGHT MANAGEMENT PRINCIPLES, 4.02.20.

Predictions for secondary flight plan
Refer to FCOM 4.04.30 Secondary flight plan.

OTHER COMPUTATIONS

Engine-out case
The FMGS computes an engine-out target speed for each flight phase.
It computes an engine-out maximum altitude at long-range cruise speed, and displays it on the PROG page.
The new speed target becomes green dot in climb, and EO CRZ SPD in cruise.
The system computes the flight plan predictions down to the primary destination. If the aircraft is above EO MAX ALT, the predictions are computed, assuming that a drift down descent will immediately be performed to reach EO MAX ALT.

Recommended maximum altitude (REC MAX)
The recommended maximum altitude is the lowest of the maximum altitude that :
- The aircraft can reach with a 0.3 g buffet margin
- The aircraft can fly in level flight at MAX CRZ rating
- The aircraft can maintain a V/S of 300 feet/minute at MAX CLB thrust
- The aircraft can fly, at a speed higher than green dot, and lower than VMO/MMO for which the aircraft is certified.

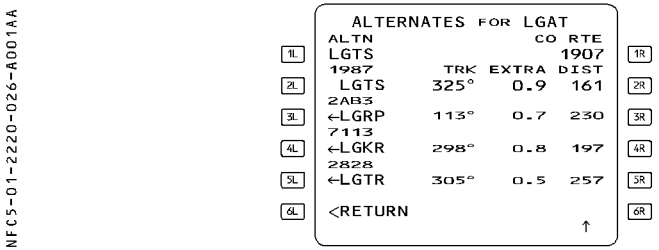
The REC MAX altitude is displayed on the PROG page.

R Anti-ice is not taken into account for this computation. Refer to QRH graphs if icing
R conditions are expected.

A maximum altitude using a 0.2 g buffet margin is also computed. It is not displayed, but the system uses it to limit CRZ ALT entry.

Predictions for alternates

Predictions for alternates are displayed on the ALTERNATES page.



They are based on :

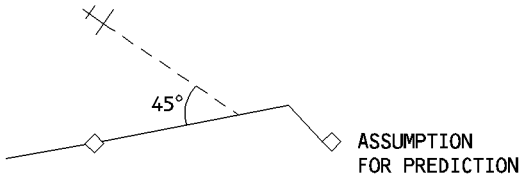
- A default cruise FL equal to 220, if the airway distance is less than 200 NM. Otherwise, it is FL 310.
- Simplified wind/temperature models, based on crew entries :
  - ALT CRZ wind, as entered on the FUEL PRED page.
  - CRZ temperature interpolated from the temperature model for the primary flight plan.
- Airway distance, or direct distance, as provided by the database (manual entry, if not in the database).
- Cost index = 0 (minimum fuel).
- Initial aircraft weight equal to landing weight at primary destination.

Note :
- *No step can be inserted in an alternate flight plan.*
- *No predictions are displayed for the selected alternate on flight plan pages ; but, the pilot can read ALTN trip fuel and time on the INIT B page before engine start, and estimated time and estimated fuel on board at alternate on the FUEL PRED page after engine start.*

RETURN-TO-TRAJECTORY ASSUMPTIONS

If the aircraft is not on the lateral flight plan, predictions assume an immediate return to the active lateral leg with a 45° convergence angle, or that it will fly directly to the "TO" waypoint, when the required convergence angle is greater than 45°. (Refer to 4.02.20).

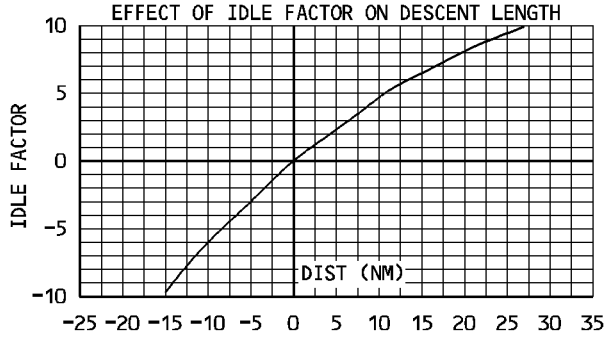
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IDLE FACTOR

IDLE and PERF factors follow the same principle.
The PERF factor is mainly used for prediction during the cruise phase.
The IDLE factor is dedicated to the FM descent segment.
The aim of the IDLE factor is to adjust FM descent predictions. In particular, the Top of Descent (TOD) position, with the actual engine idle thrust used during descent.
A positive IDLE FACTOR gives an earlier Top of Descent (shallower path).
A negative IDLE FACTOR delays the Top of Descent (steeper path).
The following graph provides an example (average values) of the IDLE FACTOR's effect on descent length :

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Example : An IDLE FACTOR of - 3 decreases the computed descent length by 5 NM.

IDLE Factor at delivery :
The IDLE Factor set at delivery is 0 %.

Procedure for modifying the IDLE factor :
Refer to the PERF Factor paragraph.

ENERGY CIRCLE

The energy circle is a green arc, centered on the aircraft's position and oriented towards the current track line. It is displayed on the NDs during descent, when HDG or TRK mode is selected. It represents the required distance to land from the aircraft's position down to airport elevation at VAPP speed, considering all speed constraints on the vertical profile.

PERF FACTOR

The PERF factor is a positive or negative percentage that is used to correct the predicted fuel flow, used for fuel prediction computation within the FMGS. It is necessary when the aircraft's performance differs from the performance model stored in the FMGS database. This difference can be due to one or both of the following cases :

1. The FMS contains a performance database, used to compute the predictions and the performance data. Due to the numerous possible aircraft configurations, the same performance database is sometimes used for aircraft with slightly different behaviors. In these cases, a PERF factor is entered to correct the computations performed with a database not exactly tailored for the given configuration. As a result, the aircraft or engine type identification on the MCDU's A/C STATUS page may not correspond to that of the actual aircraft.
2. Since the actual aircraft drag and engine performance deviate from the nominal model, due to the aircraft's age, airline Flight Operations will periodically apply a correction factor to adapt fuel predictions to actual fuel consumption.

The PERF factor modifies the predicted fuel flow, according to the following formula :
FFpred = FFmodel (1 + PERF FACT/100).
FFpred is the FF used for prediction.
FFmodel is the FF from the aero-engine model.
This correction is applied throughout the flight, and modifies the performance predictions and the ECON speed or Mach. For example : Entering a PERF factor of + 1.5 means that flight operations have evaluated the aircraft fuel deviation as 1.5 %, compared to the basic performance model (0.0).

Procedure for modifying the PERF factor (on ground only) :
On the aircraft status page :
– ENTER "ARM" in the CHG CODE line's [5L] brackets.
– WRITE the new IDLE/PERF factors.
– INSERT using [6L] key.
A manually-entered IDLE/PERF factor is displayed in large blue fonts. Changing an IDLE/PERF factor is usually the responsibility of maintenance, or Flight Operations.

R *Note : "ARM" is the default code. The Operator can customize this code by entering 3*
R *other characters in the AMI file.*

PERF factor to be used on FMS 2, depending on engine type :

– For CFM 56-5B engines only :
Depending on the engine type : CFM 56–5B SAC (Single Annular Chamber) or DAC (Double Annular Chambers), or non/P (without the new LP and HP blade compressor), a positive performance factor has to be entered on the MCDU STATUS page to increase the FMGS' predicted fuel consumption and match the actual fuel burnt.

R

		Non/P		/P	
		SAC	DAC	SAC	DAC
A321-111	CFM56-5B1	2	2	0	1
A321-112	CFM56-5B2	2	2	0	1
A321-211	CFM56-5B3	2	2	0	1
A321-212	CFM56-5B1	2	2	0	1
A321-213	CFM56-5B2	2	2	0	1
A321-214	CFM56-5B4	–	–	1	–
A320-214	CFM56-5B4	3	3	0	1
A320-215	CFM56-5B5	–	–	0	–
A320-216	CFM56-5B6	–	–	0	–
A319-111	CFM56-5B5	4.5	4.5	0	1
A319-112	CFM56-5B6	4.5	4.5	0	1
A319-115	CFM56-5B7	4.5	4.5	0	1
A318-111	CFM56-5B8	–	–	0	–
A318-112	CFM56-5B9	–	–	0	–

– For other engines :

R · A318 "PW" : 0.0 %

R · A319/A320 "CFM" Family fitted with CFM 56-5A engines : 0.0 %

· A319/A320/A321 "IAE" Family : 0.0 %

All these numbers assume that : The aircraft is brand-new, anti-ice is OFF, the air conditioning is on NORMAL for "IAE" engines and on LOW for "CFM" engines, and the conservative Fuel Lower Heating Value (FLHV) is 18400 btu/lb.

When an aircraft ages, fuel consumption degradation will be measured to determine the so-called "monitored fuel factor". This factor corresponds to the deviation of the aircraft's actual fuel consumption from the nominal model. Generally, the FLHV that is used during fuel factor monitoring is higher than the FMS value. In order not to penalize FMS predictions, it is necessary to correct the "monitored fuel factor". For example, add – 1% to the "monitored fuel factor", when an FLHV of 18590 btu/lb is used. Once this factor is established by the airline, it should be arithmetically-added to the above-noted performance factor.

Note : – *At delivery, ENTER the Performance factor (given in the table above) directly in the MCDU (no correction factor is needed).*

– *When replacing an FMS legacy by an FMS2, on any given aircraft model, the performance model that is stored in the FMS2 may be different from the one that was previously stored in the FMS legacy. As a result, DISREGARD the performance factor previously entered in the MCDU. ADD the "monitored fuel factor" (when available) to the performance factor (given above), and ENTER the resulting factor in the MCDU.*

MANAGEMENT OF THE DISPLAYS

The flight management system displays navigation, performance, and guidance information on the :

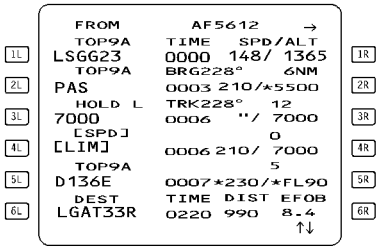
- Multipurpose Control and Display Unit (MCDUs) ;
- Navigation Display (ND) of the Electronic Flight Instrument System (EFIS) ; and
- Primary Flight Display (PFD) of the EFIS.

MCDU DISPLAY

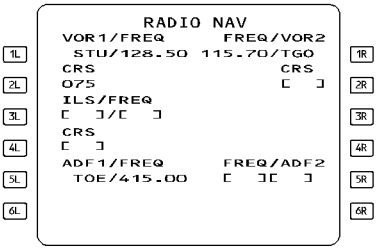
The MCDUs display :

- Position and accuracy information
- Tuned navaids
- Lateral and vertical flight plans (waypoints, pseudo waypoints, constraints)
- Predictions (SPD, TIME, ALT, WIND)
- Fuel predictions and fuel management information (estimated fuel on board, extra fuel)
- Performance data

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F-PLN A page

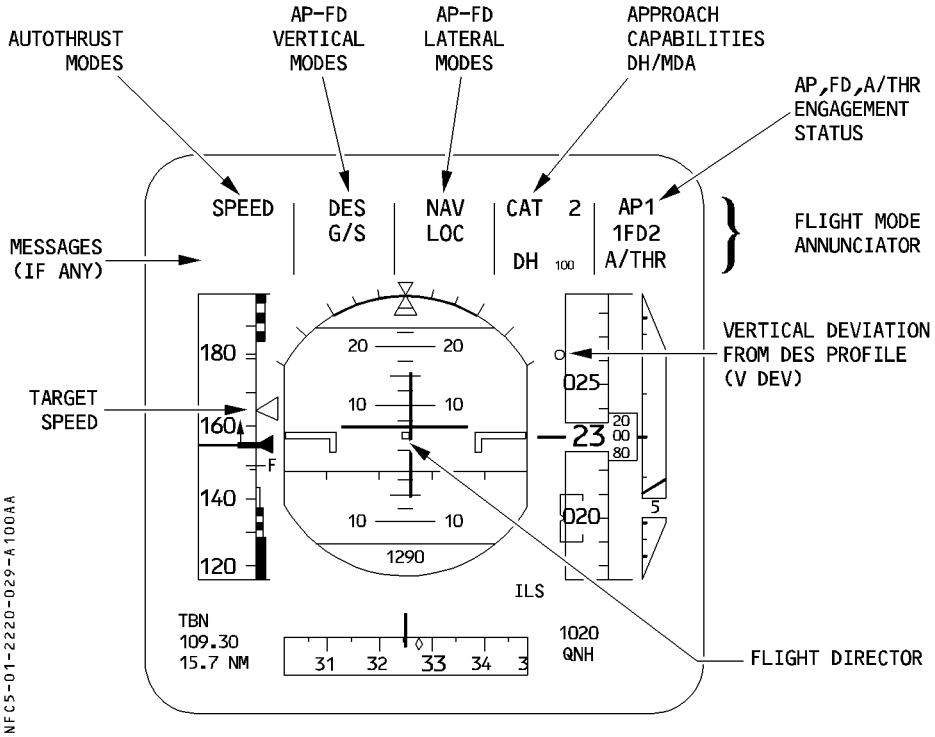


RADIO NAV PAGE

EFIS PRIMARY FLIGHT DISPLAY (PFD)

Flight Management (FM) generates the following information :

- Armed and engaged modes displayed on the Flight Mode Annunciator (FMA) ;
- FMGS guidance targets (SPD, ALT, HDG) ;
- Vertical deviation from descent profile ;
- Messages ;
- Navigation information.

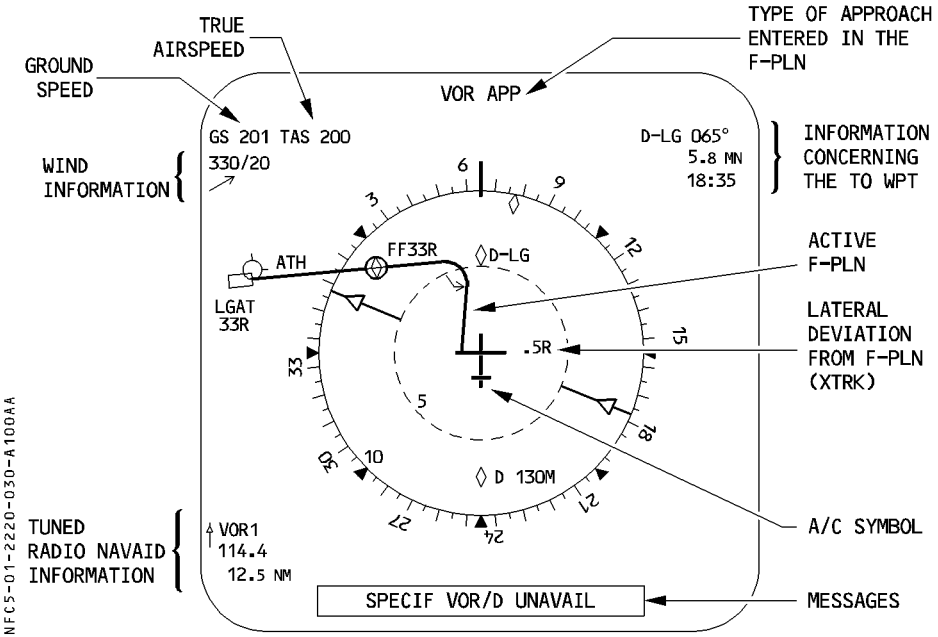


Note : For more details on the EFIS PFD, refer to Chapter 1.31.

EFIS NAVIGATION DISPLAY (ND)

The FMGS generates the following information, displayed on the NDs :
- Flight plan (active secondary, temporary, dashed) ;
- Aircraft position and lateral deviation from the flight plan ;
- Pseudo-waypoints along the flight plan ;
- Raw data from tuned Navaids and type of selected approach ;
- Various display options (waypoints, Navaids, NDBs, airports, constraints) ;
- Wind information and various messages.

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FLIGHT PLAN DISPLAY COLORS

Primary flight plan	Managed mode : Steady green. Selected mode : Dashed green.
Track line	Steady green
Alternate flight plan	Dashed blue
Missed approach	Steady blue
Offset flight plan	Steady green (Original flight plan : Dashed green)
Temporary flight plan	Dashed yellow
Engine-out SID (not inserted)	Steady yellow
Secondary, flight plan	Steady, dimmed white
Abeam/Radial	Dashed blue

GENERAL

The Flight Guidance (FG) part of the FMGS controls the :
- Flight Director (FD)
- Autopilot (AP)
- Autothrust (A/THR).

GUIDANCE MODES

Two types of autopilot and flight director modes are available to guide the aircraft :
- Managed modes, which steer the aircraft along the lateral, vertical, and speed profiles according to the data the pilot inserts into the MCDU. Flight Management (in the Flight Management and Guidance Computer) computes the corresponding guidance targets.
- Selected modes, which steer the aircraft according to target values that the pilot selects and the FCU windows display.

R

GUIDANCE	MANAGED modes	SELECTED modes
LATERAL	NAV, APP NAV LOC*, LOC RWY RWY TRK GA TRK ROLL OUT	HDG-TRK
VERTICAL	SRS (T.O and G.A) CLB, DES ALT CST, ALT CST* ALT CRZ G/S*, G/S FINAL, FINAL APP FLARE	OP CLB, OP DES V/S, FPA ALT*, ALT EXPEDITE ◁
SPEED	FMGC REFERENCE (ECON, Auto SPD, SPD LIM) EXPEDITE	FCU REFERENCE

MODE SELECTION

MANAGED MODES

- At takeoff, the managed modes engage automatically, when the pilot sets the thrust levers at the TO or FLX detent.
- During flight, the pilot can arm or engage the managed modes (if the aircraft meets engagement conditions) by pushing in the appropriate knobs on the Flight Control Unit (FCU).
- The pilot pushes the “DIR TO” key on the MCDU to insert a DIR TO leg. It engages or maintains the NAV mode.
- The pilot pushes the “APPR” pushbutton on the FCU to arm or engage the localizer and glide slope or “ FINAL APP”, depending upon the approach type he had inserted in the flight plan.
- The “LOC” pushbutton arms or engages only the localizer mode.

SELECTED MODES

The pilot can engage the selected modes by pulling out the appropriate FCU selection knobs.

INTERACTION BETWEEN AP/FD AND A/THR MODES

The AP and FD pitch modes can control a target SPD/MACH or a vertical trajectory, and the A/THR mode can control a fixed thrust or a target SPD/MACH. However, the AP/FD and the A/THR cannot both control a target SPD/MACH simultaneously. Therefore the AP/FD pitch modes and A/THR mode are coordinated as follows :

- If an AP/FD pitch mode controls a vertical trajectory, the A/THR mode controls the target SPD/MACH.
- If an AP/FD pitch mode controls a target SPD or MACH, the A/THR mode controls the thrust.
- If no AP/FD pitch mode is engaged, the A/THR mode reverts to controlling the SPD/MACH mode.

  In other words, the selection of an AP/FD pitch mode determines which mode the A/THR controls.

AP/FD pitch modes	A/THR modes
V/S – FPA DES (geometric path) ALT*, ALT ALT CRZ*, ALT CRZ ALT CST*, ALT CST G/S*, G/S FINAL, FINAL APP	SPEED/MACH MODE
AP/FD OFF	
CLB/DES (idle path) OPEN CLB/OPEN DES EXP CLB/EXP DES ◁ SRS	THR (CLB, IDLE) MODE
FLARE	RETARD (IDLE)

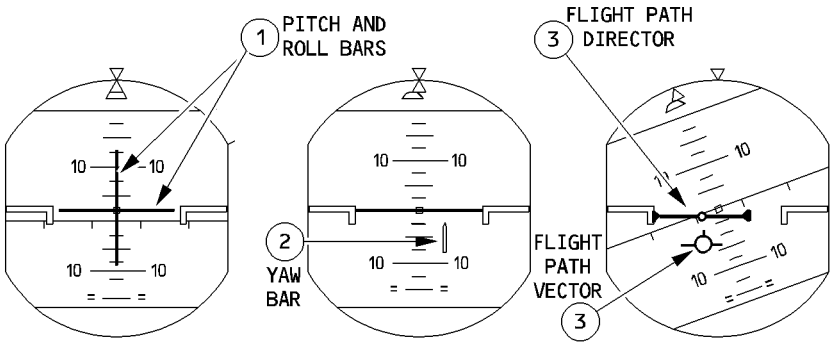
FLIGHT DIRECTOR

GENERAL

The Flight Director (FD) displays guidance commands from the Flight Management and Guidance Computer (FMGC) on the Primary Flight Display (PFD).
You may manually fly the aircraft , following FMGC guidance commands, or crosscheck the FMGC orders when the autopilot is engaged.
In normal operations, FD1 displays FMGC1 orders on the PFD1, and the FD2 displays FMGC2 orders on the PFD2.
The FDs use their respective onside FMGCs.
On the PFD :

1. The FD pitch and roll crossbars show pitch and roll demands.
2. Below 30 feet during landing and takeoff, when a localizer is available, the vertical bar is replaced by a yaw bar that gives lateral orders.
3. The Flight Path Director (FPD) symbol relates to the Flight Path Vector (FPV).

R



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The HDG V/S – TRK FPA pushbutton on the FCU enables the pilot to select either type of reference and display.
The FD pushbutton on the Electronic Flight Instrument System (EFIS) control panel allows the FD bars to be displayed or removed.

FD bars (HDG V/S selected on the FCU)

- The pitch bar is displayed, if a vertical mode is engaged. It gives pitch orders for the vertical guidance.
- The roll bar is displayed, if a lateral mode is engaged. It gives roll orders for lateral guidance.

R **Flight Path Director (TRK FPA selected on the FCU)**

The display is an alternate way of transmitting flight director commands.

- The Flight Path Vector (FPV) symbol illustrates the track and flight path angle actually being flown.
- The Flight Path Director (FPD) symbol shows the pilot how to intercept and fly the vertical and lateral flight path defined by the FMGC.
  When the pilot superimposes the FPV and the FPD symbols, the aircraft is flying the commanded trajectory.

Yaw bar

The yaw bar is displayed in RWY mode on takeoff and in FLARE and ROLL OUT modes at landing.

FLIGHT DIRECTOR (FD) ENGAGEMENT

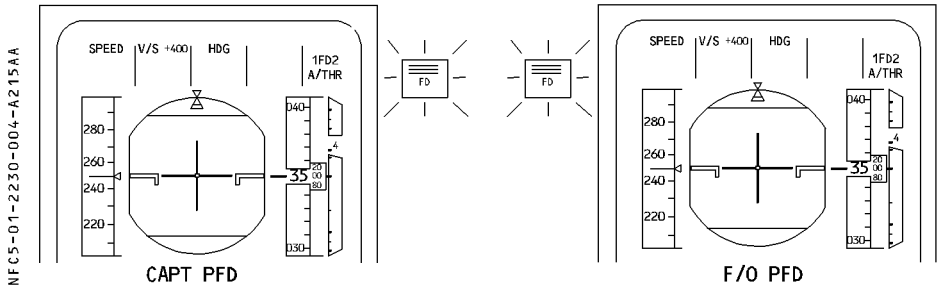
The FDs are engaged automatically whenever the FMGC powers up.

GROUND ENGAGEMENT

- The symbol "1 FD2" appears on both PFDs.
- No FD bars appear on the PFDs. The PFD displays FD orders when a mode is active on the corresponding axis.
- The FCU windows display dashes.

MANUAL FLIGHT ENGAGEMENT

The two FDs engage in the HDG V/S or TRK FPA mode (basic modes).



AUTOMATIC FLIGHT ENGAGEMENT

- FD bars are automatically restored in SRS/GA TRK modes at go around engagement. If FPV/FPD was previously selected, it reverts to FD bars.

FLIGHT DIRECTOR (FD) DISENGAGEMENT

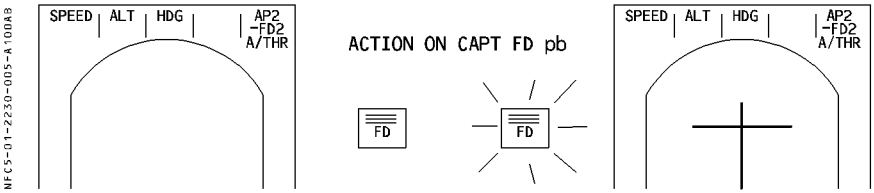
The flight crew may disengage one or two FDs manually, or FDs may disengage automatically if there is a failure.

MANUAL FLIGHT DIRECTOR DISENGAGEMENT

One FD off :

- The FD bars no longer appear on the associated PFD.
- The corresponding FD is disengaged.

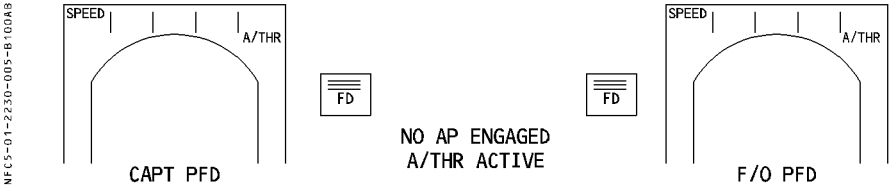
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Both FDs off:

- The FD bars disappear from both PFDs.
- If no AP was engaged, lateral and vertical modes disengage. The A/THR, if active, automatically reverts to (or remains in) SPEED/MACH mode.
- If one AP was engaged when FDs are switched OFF, this AP remains engaged in the active modes but the FDs are no longer displayed.

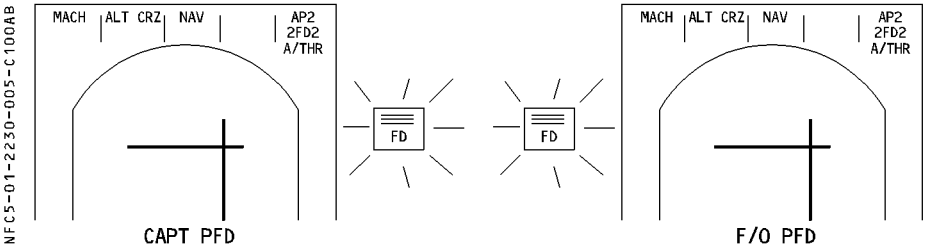
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AUTOMATIC FLIGHT DIRECTOR DISENGAGEMENT

If one FD fails or one FMGC is not valid, both PFDs display the remaining FD.

R



AUTOMATIC DISENGAGEMENT DUE TO SPEED PROTECTION

When APs are not engaged and the pilot does not follow the FD bars to maintain the commanded trajectory, in climb with CLB or OP CLB, (or EXP CLB ◁) engaged or in descent with DES or OP DES (or EXP DES ◁) engaged the FDs will disengage at the activation of the automatic speed mode protection.
Refer to FCOM 1.22.30 AUTOMATIC SPEED MODE PROTECTION for the conditions of activation.

AUTOMATIC FD REMOVAL

- The FD pitch bar is removed when no vertical mode is engaged or when ROLL OUT is engaged.
- The roll FD bar is removed when no lateral mode is engaged or when the RWY or ROLL OUT mode is engaged.
- Both FDs are removed when the aircraft pitch exceeds 25° up or 13° down, or bank angle exceeds 45°.

Note : If from AP/FDs off, FD2 then FD1, are engaged within 180 milliseconds (one computation cycle), a flip flop of master FMGC may occur.
R *As a result, no vertical mode engages, the FMA 1st column, 1st line (A/THR mode)*
R *is blank, or displays dashes.*
Engaging V/S mode manually reselects the correct FMGC and restores the display.

FD WARNINGS

FD WARNINGS	CONDITIONS
Pitch FD bar (or FPV) flashes 10 seconds	– if the ALT* mode is lost further to FCU altitude reference change of more than 250 ft. – when in APPR mode (G/S*, G/S, LAND, FINAL) FD reverts to V/S mode (pilot action or loss of vertical approach mode) – one AP or one FD is engaged while both AP/FD were previously off.
Pitch FD bar (or FPV) flashes permanently	Transmission of the GLIDE data is interrupted when in G/S, G/S* or LAND modes above 100 ft RA.
Roll FD bar (or FPV) flashes 10 seconds	– When in APPR mode (LOC*, LOC, LAND, APP NAV) FD reverts to HDG mode (Pilot action or loss of lateral approach mode). – One AP or one FD is engaged while both AP/FD were previously off.
Roll FD bar (or FPV) flashes permanently	Transmission of the LOC data is interrupted when in LOC, LOC* or LAND modes above 15 ft RA.

AUTOPILOT (AP)

GENERAL

The AP :
- stabilizes the aircraft around its center of gravity
- acquires and tracks a flight path
- flies the aircraft to an automatic landing or go-around.

R The AP commands the :
R - position of the flight control surfaces for pitch, roll, and yaw
R - nose wheel position.

AP ENGAGEMENT

R The flight crew can engage AP1 or AP2 by pressing the corresponding pushbutton on the
R FCU if the aircraft has been airborne for at least five seconds.
R When one AP is engaged, the corresponding FCU pushbutton comes on and AP1 (or 2) is
R displayed on the FMAs.

Note :
- *One AP can be engaged on the ground if the engines are not running. It disengages when one engine is started.*
- *Two APs may be engaged at a time (AP1 active, AP2 in standby), when the localizer/glide-slope or roll out or go-around mode is armed or engaged. Only one AP can be engaged at a time in all other cases.*
- *If one AP pushbutton is set to on with both FDs off, the AP engages in HDG V/S or TRK FPA mode, depending upon which the pilot has selected on the FCU.*
- *If one AP pushbutton is set to on with at least one FD already on, the AP engages in the current active FD modes.*
- *AP engagement increases the break out force on the sidestick controllers and on the rudder pedals.*

AP engagement is indicated by the lighting of the corresponding FCU pushbutton and by the appearance of "AP1" (or 2) on the PFD's Flight Mode Annunciator.

AP DISENGAGEMENT

AP1 or 2 disengages when :

- The pilot presses the takeover pushbutton on the sidestick.
- The pilot presses the corresponding AP pushbutton on the FCU.
- The pilot pushes on the sidestick harder than a certain threshold or moves on the rudder pedals above a threshold.
- The pilot moves the pitch trim wheel beyond a certain threshold.
- The other AP is engaged, except when localizer/glideslope modes are armed or engaged, or when the rollout or go-around mode is engaged.
- Both thrust levers are set above the MCT detent and the aircraft is on the ground.
- The aircraft reaches the MDA- 50 feet (MDH-50 feet), or 400 feet AGL if no MDA/MDH, with APPR mode engaged and a non-ILS approach selected.
- One of the engagement conditions is lost.
  Furthermore, in normal law with all protections available, the AP will disconnect if :
  · High speed protection is active ;
  · Angle-of-attack protection is active (α prot + 1° is reached) ;
  · Pitch attitude exceeds 25° up, or 13° down, or bank angle exceeds 45° ;
  · A rudder pedal deflection is more than 10° out of trim.

The standard way for the flight crew to disengage the AP is to press the takeover pushbutton on the sidestick.
When the AP is OFF, the associated FCU pushbutton goes off, and "AP1" (or AP2) disappears from the PFD's FMA.

AP WARNINGS

When the AP is disengaged, the system warns the pilot.

- If the pilot disengages it with the takeover pushbutton on the sidestick, the warnings are temporary.
- If the disengagement results from a failure, from the pilot pushing the pushbutton on the FCU, or from a force on the sidestick, the visual and audio warnings are continual.

		AP DISENGAGEMENT	
		TAKE OVER PB on SIDESTICK	**BY OTHER MEANS**
CONSEQUENCE	MASTER WARNING	flashing red during 3 sec max	flashing red
	ECAM	red AP OFF message 9 sec maximum	red warning AUTO FLT AP OFF
	AUDIO	cavalry charge 0.5 sec min 1.5 sec maximum	continuous cavalry charge 1.5 sec minimum
	CLR PB on ECAM CONTROL PANEL	extinguished	illuminated
ACTION	MASTER WARNING	extinguishes M.W erases ECAM warning stops audio if pressed within 1.5 sec	extinguishes M.W stops audio after 1.5 sec
	CLR PB on ECAM CONTROL PANEL	No effect	extinguishes CLR pb erases ECAM message calls status
	TAKE OVER PB	extinguishes M.W. erases ECAM warning stops audio if pressed within 1.5 sec.	extinguishes M.W. stops audio after 1.5 sec
ECAM STATUS MESSAGE		NO	YES

AUTOLAND WARNING

The autoland red warning flashes in LAND mode when :

- the radio altitude goes below 200 feet and
- the aircraft gets too far off the beam (LOC or GLIDE)
  or both autopilots fail
  or both localizer transmitters or receivers fail
  or both glide slope transmitters or receivers fail.

R or the difference between both radio altimeter indications is greater than 15 feet.

SPEED/MACH CONTROL

In flight, either the AP/FD pitch control, or autothrust may acquire and hold a target speed or Mach number, depending on the engaged modes.
Speed control is :
– Managed, when the target comes from the FMGS
– Selected, when the target comes from the SPD/MACH FCU window.

MANAGED SPEED/MACH TARGET

When the speed target is managed, the SPD/MACH window of the FCU shows dashes, and the corresponding dot is lit. The PFD speed scale shows the speed target in magenta.

ENGAGEMENT CONDITIONS

The SPD target is managed, whenever AP or FD is engaged, and one of the following occurs:
– The pilot pushes in the SPD/MACH selector knob.
– V2 is inserted in the MCDU.
– The speed reference system (SRS) is engaged (takeoff or go-around mode).
– EXPEDITE mode is engaged ◁.

Note : At takeoff, SRS will not engage, if V2 is not available.

DISENGAGEMENT CONDITIONS

Managed speed disengages any time the pilot selects a speed target on the FCU, or if the speed was preselected.

SPEED PROFILE

The form of the managed SPD profile depends on the lateral NAV mode.
– If NAV mode is engaged, the SPD profile takes into account all the constraints linked to the flight plan.
The SPD profile is :
R V2 - SPD LIM - SPD CSTR (if applicable) - ECON CLB SPD/MACH - ECON CRZ MACH - ECON or preset DES MACH/SPD - SPD LIM - SPD CSTR (if applicable) - HOLD SPD (if applicable) - VAPP

– If NAV mode is not engaged, the SPD/MACH constraints are not considered.
The SPD profile is :
V2 - SPD LIM - ECON CLB SPD/MACH - ECON CRZ MACH - ECON or preset DES MACH/SPD - SPD LIM - VAPP.

Note : – When both AP/FDs are OFF, A/THR reverts to selected SPEED mode, except when the approach phase is activated on the MCDU, where both managed and selected SPD are available.
– When expedite mode is engaged, the system disregards SPD LIM and SPD CSTR, regardless of the lateral mode engaged.
– The managed speed/Mach target may be set below maneuvering speed but, as long as the speed target is managed, the FMGS limits the aircraft to the maneuvering speed of the current slats/flaps configuration (VAPP, F, S, Green Dot).
– If the managed speed/Mach target is set above VMAX (VFE, VMO, MMO), the FMGS automatically limits the speed to VMAX.
R *– If a SPD/MACH constraint has already been taken into account, it remains*
R *applied (until a more restrictive constraint applies).*

MINI GROUND SPEED

In approach phase, the managed speed target is the Mini Ground Speed target computed by the Flight Guidance (FG) part of the FMGS (refer to 1.22.30–Autothrust).

SELECTED SPEED/MACH TARGET

To use a selected speed/Mach target, the pilot uses the knob on the FCU to set the target speed, which is then displayed in the FCU window. It is also displayed on the PFD speed scale in blue.

Note : The selected speed/Mach target may be set below VLS or above VMAX. But, when autothrust is active, the guidance limits the speed to VLS or VMAX.

Selected speed has priority over managed speed. The only automatic changeover from the selected to managed speed target may occur at go-around mode engagement.
In flight, if the situation calls for managed speed, both the PFD and the MCDU display a message proposing a manual change to managed speed (for example, SET MANAGED SPEED), SET HOLD SPEED, or SET GREEN DOT SPEED).

ENGAGEMENT CONDITIONS

The aircraft has a selected speed target under any one of the following conditions :
- The pilot pulls out the SPD/MACH selector knob (5 seconds after lift-off)
- Both AP/FDs are OFF (except in APPR phase)
- The FM speed target is lost (except in SRS, G/S, LAND, and GO AROUND modes).
- The MCDU has a preselected speed for the next phase, and the aircraft transitions into that phase.
- The FMGC is powered up in flight.

DISENGAGEMENT CONDITIONS

The selected speed target disengages :
- when the managed SPD engages
- when the aircraft is on the ground at engine start.

Note : With engine running, the pilot can select a speed on the FCU only after takeoff.

AUTO SPD

The pilot may insert the AUTO SPD (speed or Mach) on the PERF DES page to replace the ECON DES SPD.
In this case, the managed speed profile takes into account the selected value. The top of descent and the descent path are computed on AUTO SPD assumption.

SPEED/MACH SWITCHING

- At the crossover altitude, the FMGC automatically changes the selected speed target to the corresponding MACH target.
  The FCU displays the Mach number corresponding to the speed at the switching altitude.

ALTITUDE							
30500	280						
29500		290					
28500	295		300				
27500		305		310			
26500	300		315		325		
25500		310		325		330	
24500			320		335		350
MACH	0.76	0.77	0.78	0.79	0.80	0.81	0.82

SPEED/MACH CROSS OVER TABLE.

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Note : When the speed is selected the pilot can do the switching manually by pressing the SPEED/MACH pushbutton on the FCU. The FCU then displays the aircraft Mach number.

– When the target speed is managed, the FMGC commands the switchover automatically as a function of the ECON MACH value.

MANAGED SPEED TARGET MEMORIZATION

A dual FM failure has different consequences when it occurs in different phases of the flight. The system handles target speed and SPD mode as follows :

– During approach with LOC and G/S engaged and radio altitude < 700 feet, the target speed is set to VAPP as previously memorized, and managed SPD target is maintained.
– At go-around, the target speed becomes the memorized go-around speed, which is the higher of VAPP or the speed when go-around was initiated. Managed SPD target is maintained.
– In all other cases managed target speed reverts to selected, the value being the speed at the moment of the failure.

SPEED/MACH FCU WINDOW SYNCHRONIZATION

When the target SPD is managed, the SPD/MACH display of the FCU shows dashes. However, the window displays the target SPD or MACH in the following situations.

– The pilot turns the SPD/MACH selector knob.
  If the pilot does not pull the knob within 10 seconds after turning it, the selection reverts to dashes.
– The pilot manually engages a selected SPD target.
– If the flight crew has manually preselected a speed or Mach number for the next phase on the MCDU PERF page, that preselected SPD/MACH engages when the aircraft enters that phase and the FCU window then displays as the target the preselected speed or Mach.
– If the FMGS is powered up in flight, the synchronized speed/Mach value is the current aircraft speed or Mach number.
– If no V2 is entered at takeoff, the V/S mode engages 5 seconds after lift-off (no speed reference system). The FCU speed target is the speed at V/S mode engagement. (A/THR becomes active when the thrust levers are set in the active range).

AP/FD MODES GENERAL

The FMGS has guidance parameters for both AP/FD lateral and vertical modes.

The AP/FD lateral modes are :

RWY, RWY TRK	Runway, Runway track mode
NAV	Nav mode
HDG, TRK	Heading, track mode Also called basic modes
APP NAV	Approach Nav mode
LOC*, LOC	Loc capture, Loc track mode
LOC B/C	Lock back course mode
ROLL OUT	Rollout mode. (Autoland)
GA TRK	Go-around track mode
• LAND	Land mode. Managed submode that includes LOC and G/S modes below 400 feet RA.
• FINAL APP	Final approach mode Managed submode that includes APP NAV and FINAL modes during non precision approaches.

The AP/FD vertical modes are :

	SRS	SRS mode used for takeoff and go-around
	CLB	Climb mode
	DES	Descent mode
	OP CLB	Open Climb mode
	OP DES	Open Descent mode
	EXP CLB ◁	Expedite mode in climb
	EXP DES ◁	Expedite mode in descent
	V/S or FPA	Vertical speed mode or Flight Path Angle mode. Also called basic modes.
	ALT*	Altitude capture,
	ALT	Altitude Hold mode
	ALT CST*	Altitude constraint capture,
	ALT CST	Altitude constraint hold mode
R	ALT CRZ	Altitude hold of the cruise flight level
	G/S*	Glide slope capture
	G/S	Glide slope mode.
	FINAL	Final mode (non precision approach)
	FLARE	Flare mode (Autoland)

AP/FD LATERAL MODES

HEADING OR TRACK : HDG - TRK

These modes guide the aircraft laterally along a heading or track selected by the flight crew.
The HDG/TRK window of the FCU displays the target heading or track.
R The pilot uses the HDG V/S -TRK FPA pushbutton to select heading or track.

ENGAGEMENT CONDITIONS

HDG or TRK is engaged when one of the following conditions is met :
- The pilot pulls out the HDG-TRK selector knob (not sooner than five seconds after lift-off).
- NAV is disengaged, either by the loss of the lateral flight plan or by the pilot entering a flight plan discontinuity.
- FINAL mode (armed or engaged) is lost when the aircraft is in APP NAV mode.
- LOC or LOC* mode is lost.
- The pilot engages the AP/FD with no other mode already engaged (basic mode of AP/FD engagement).
  · LOC mode is armed when APP NAV FINAL were previously engaged.

DISENGAGEMENT CONDITIONS

The engagement of any other lateral mode disengages HDG or TRK.

SYNCHRONIZING THE HDG/TRK WINDOW OF THE FCU

The lateral window of the FCU displays a heading or a track value when :
- The HDG/TRK mode is engaged. The displayed value is the current HDG/TRK or the manually selected value of the target.
- The pilot turns the HDG/TRK selection knob. The value in the window first synchronizes with the current HDG/TRK, then displays the manual selection. It remains displayed for 10 seconds or 45 seconds depending upon FCU standard, then vanishes if the pilot does not pull the knob (except in HDG preset).
- A HDG/TRK is preset (see below).
- AP/FD is lost. The value becomes that of the aircraft current heading or track.

Note : If HDG is switched to TRK (or vice versa), the value displayed in the window switches from heading to track (or vice versa).

HDG/TRK PRESET

The system has a HDG/TRK preset function for takeoff and go around.
If the pilot chooses not to fly the flight plan after takeoff or go around, he may preset a HDG or a TRK on the FCU by turning the HDG/TRK selector knob. The value he sets remains
R displayed in the FCU HDG/TRK window until the knob is pulled.

Operation at takeoff

HDG/TRK preset is available before takeoff and up to 30 feet RA. Turning the HDG/TRK selector knob before 30 feet sets the desired HDG/TRK. As a consequence:

– NAV is disarmed
– At 30 feet, RWY TRK is annunciated until the HDG/TRK knob is pulled.

Operation at go around

Whenever the LOC*, LOC, LAND, FINAL, or GA modes are engaged, the HDG preset is
R available. If the pilot rotates the HDG/TRK knob to set the value, it will remain displayed in
R the window. Pull out the HDG/TRK knob to activate the mode and turn the aircraft on to the preset value.

Cancellation

The pilot can cancel a preset HDG/TRK by :

· engaging the NAV mode (DIR TO)
· pushing in the HDG/TRK knob (arming NAV mode)
· disengaging AP/FD

NAVIGATION (NAV)

NAV mode is a managed mode that steers the aircraft laterally along the flight plan defined in the FMGS. It is designed to have a zero cross-track error. The pilot can arm or engage the NAV mode if the MCDU contains a lateral flight plan.

ARMING CONDITIONS

Satisfying one of the following conditions arms NAV :

– The aircraft is on the ground with no HDG/TRK preset and no other lateral mode except runway mode
– The pilot pushes in the HDG/TRK selector knob, unless the LOC mode is engaged.
– The pilot presses the APPR pushbutton, if a non-ILS approach is selected.

DISARMING CONDITIONS

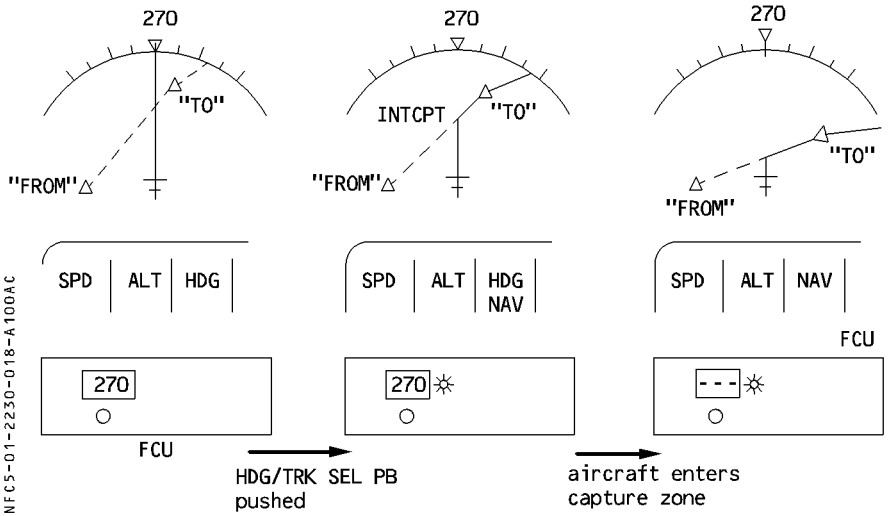
NAV mode disarms if one of the following occurs :

– The pilot pulls out the HDG/TRK selector knob.
– The pilot selects a preset HDG/TRK (TO or GA)
– The pilot arms the LOC mode by pressing the LOC pushbutton.
– The pilot selects GA mode.
– LAND mode has engaged.
– The pilot presses the APPR pushbutton to deselect the non-ILS approach.

ENGAGEMENT CONDITIONS

NAV mode engages :
- Automatically at 30 feet RA after takeoff (if armed on the ground).
- When the pilot orders “DIR TO” (except below 700 feet RA in LOC mode).
- When the pilot pushes in the HDG/TRK select knob when the aircraft is close to (within ~ 1 NM of) the active flight plan leg.
- Automatically in flight when NAV is armed and the aircraft reaches the capture zone for the active flight plan leg.

R



CAUTION

When NAV is armed, it will automatically engage if :
* the aircraft track line intercepts the flight plan before the TO waypoint and
* the intercept waypoint (INTCPT) is displayed on the ND and
* the aircraft reaches the active flight plan leg.

Note : The TO waypoint is displayed in white on NDs and MCDUs.

DISENGAGEMENT CONDITIONS

The NAV mode disengages when :
- Any other lateral mode is engaged.
- The flight plan is lost or the aircraft enters a flight plan discontinuity.

INTERACTIONS WITH VERTICAL MODES

R When NAV mode is engaged, the vertical managed modes CLB or DES or FINAL take into
R account altitude and speed constraints linked to waypoints on the lateral flight plan. If NAV
R mode is disengaged the vertical managed modes are not available and all downpath
R altitude and speed constraints are ignored.

LOCALIZER MODE THROUGH THE LOC PUSHBUTTON

This mode captures and tracks a localizer beam independently of the glide path beam. Pilots use it to fly localizer-only approaches or to initiate an ILS approach when intercepting the glide slope from above.

ARMING CONDITIONS

The pilot arms the LOC mode by pressing the LOC pushbutton, provided that :
- An ILS is tuned (frequency and runway course).
- The aircraft is above 400 feet RA.
- TO or GA mode is not engaged.

DISARMING CONDITIONS

R LOC mode is disarmed by :
R - Pressing the LOC pushbutton when LOC is armed.
R - Arming the NAV mode.
R - Engaging the GA mode.

Note : Engaging NAV mode by selecting DIR TO does not disarm the LOC mode.

ENGAGEMENT CONDITIONS

The LOC mode engages automatically when capture conditions are met.

DISENGAGEMENT CONDITIONS

The LOC mode disengages :
- When another lateral mode is engaged.
- When the pilot presses the LOC pushbutton again (engaging the HDG/TRK mode on the current HDG/TRK).

AP/FD VERTICAL MODES

Vertical modes guide the aircraft in the vertical plan.

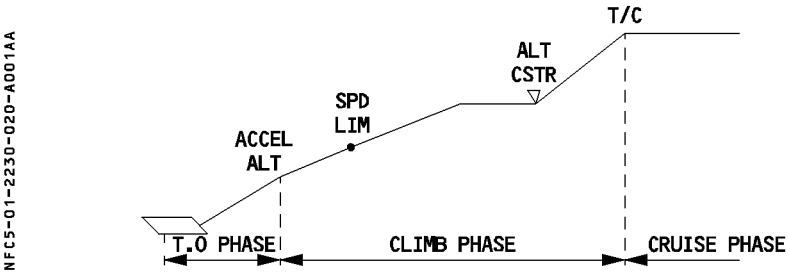
PRINCIPLES

R To leave an FCU selected altitude for another target altitude, two things must happen : the pilot must turn the altitude (ALT) selector knob in order to display the new target altitude and either :
- pull out the ALT selector knob to engage the OPEN CLB/DES mode, or
- push in the ALT selector knob to engage the CLB/DES mode, or
- select a target vertical speed (V/S) and pull out the V/S FPA selector knob to engage V/S mode, or
- select EXPEDITE ◁.

This arms ALT mode.

R CLIMB MODE (CLB)

CLB mode guides the aircraft in a managed climb, at either a managed or a selected target speed, to an FCU selected altitude, taking into account altitude constraints at waypoints. The system also considers speed constraints if the target speed is managed.
The vertical flight path may include several segments :



The pilot can arm the CLB mode during the takeoff, go around, climb, and cruise phases and engage it during the climb and cruise phases.

ARMING CONDITIONS

The CLB mode is armed :
- on the ground or when SRS mode is engaged (TO or GA) if the following conditions are met :
  - No other vertical mode is engaged.
  - The ACCEL ALT (defined on the MCDU PERF TO or GA pages) is below the FCU selected altitude and the lowest altitude constraint.

– In flight, when the climb or go-around phase is active, and the following conditions are met :
  – The lateral NAV mode is engaged, and
  – The FCU-selected altitude is above the aircraft's present altitude and the aircraft captures or flies an altitude constraint.

DISARMING CONDITIONS

The CLB mode is disarmed, if one of the following conditions is met :
– Another vertical mode is engaged.
– The FCU-selected altitude is lower than the present aircraft level.
– The FCU-selected altitude is set at the altitude constraint while ALT CSTR* or ALT CSTR mode is engaged.
– The aircraft transitions to DES or APPR phase.
– Arming requirements are no longer met.
– Vertical flight path validity is lost, or NAV mode is lost while ALT CSTR*, ALT CSTR, ALT* or ALT mode is engaged.

ENGAGEMENT CONDITIONS

The CLB mode can be engaged, if the following conditions are all met :
– The aircraft has been in flight for more than 5 seconds.
– The selected FCU level is above the present aircraft level.
– The descent, approach, or go-around phase is not active.
– NAV mode is engaged.
– Glideslope (G/S) mode is not engaged.

CLB mode automatically engages when the aircraft reaches ACC ALT, or sequences a waypoint with an altitude constraint while the CLB mode is armed.
CLB mode manually engages when the pilot pushes in the ALT select knob, with the CLB mode not armed and the current altitude is not an effective altitude constraint of the flight plan.

Note : When CLB mode is engaged :
  – The V/S (FPA) window of the FCU shows dashes.
  – The managed LVL/CH dot on the FCU lights up.
  – The Flight Mode Annunciator displays "CLB" in Column 2.

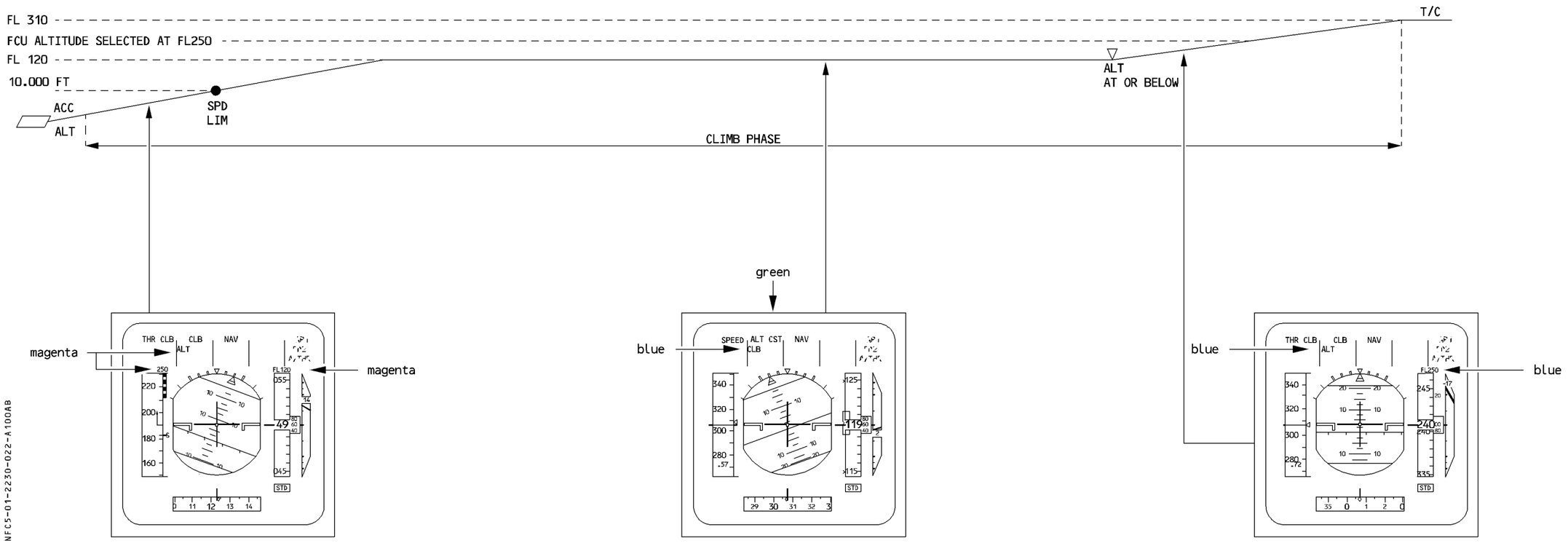
DISENGAGEMENT CONDITIONS

The CLB mode disengages, if one of the following conditions is met :
– NAV mode is lost or disengaged (OP CLB engages). In this case, the reversion to OP CLB is accompanied by a triple click aural warning.
– Another vertical mode engages.
– The pilot selects an altitude on the FCU that is lower than the present aircraft altitude. V/S (FPA) engages on the current V/S (FPA).

GUIDANCE

Climb mode gives the aircraft managed vertical guidance to the FCU selected altitude. It meets altitude constraints at waypoints either with managed speed incorporating speed constraints or with selected speed as target speed. The AP/FD pitch controls the speed or Mach number target and the A/THR is in thrust mode (CLB) corresponding to maximum climb thrust. The flight path may include several segments.

R



· When CLB mode is engaged :
The system arms ALT and displays the applicable target altitude on the ALT scale.
– If the next predicted level-off is an ALT CSTR, ALT is magenta on the FMA and the ALT CSTR is displayed in magenta on the altitude scale.
– If the next predicted level-off is the FCU altitude, ALT is blue on the FMA and the FCU-selected altitude is displayed in blue on the altitude scale.
· The guidance does not modify the target speed in order to satisfy an altitude constraint. Therefore the constraint may not be met and may be predicted as missed.
· When the aircraft levels off at the ALT CSTR, CLB mode arms automatically, then engages when the aircraft passes the constrained waypoint (if the FCU altitude is above the constraint altitude).

OPEN CLIMB MODE (OP CLB)

The OPEN CLIMB mode is a selected mode. It uses the AP/FD pitch mode to maintain a SPD/MACH (selected or managed), while the autothrust, if active, maintains maximum climb thrust.

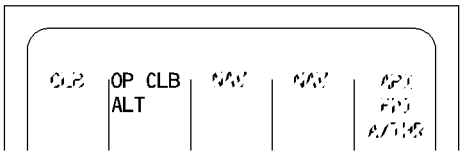
ENGAGEMENT CONDITIONS

The OPEN CLB mode can only be engaged, if all of the following conditions are met :
- The aircraft is in flight for more than five seconds.
- The LAND mode is not engaged.
- The FCU-selected altitude is higher than the aircraft's present altitude.

The OPEN CLB mode is engaged, if one of the following conditions occurs :
- The pilot pulls out the ALT selector knob.
- The pilot pulls out the SPD/MACH selection knob, when TOGA mode or EXPED CLB ◁ is engaged.
- Acceleration altitude is reached, with CLB armed, and NAV mode not engaged.
- Guidance reverts to ensure speed protection. (Refer to 1.22.30 reversions).
- NAV mode is lost (or disengaged), when previously in CLB mode. Reversion to OPEN CLB is accompanied by a triple click aural warning (see mode reversions).

When OPEN CLB is engaged : "OP CLB" is displayed on the FMA and the managed LVL/CH dot on the FCU goes out.

NFCS-01-2230-023-A100AA



Typical FMA in OPEN CLIMB

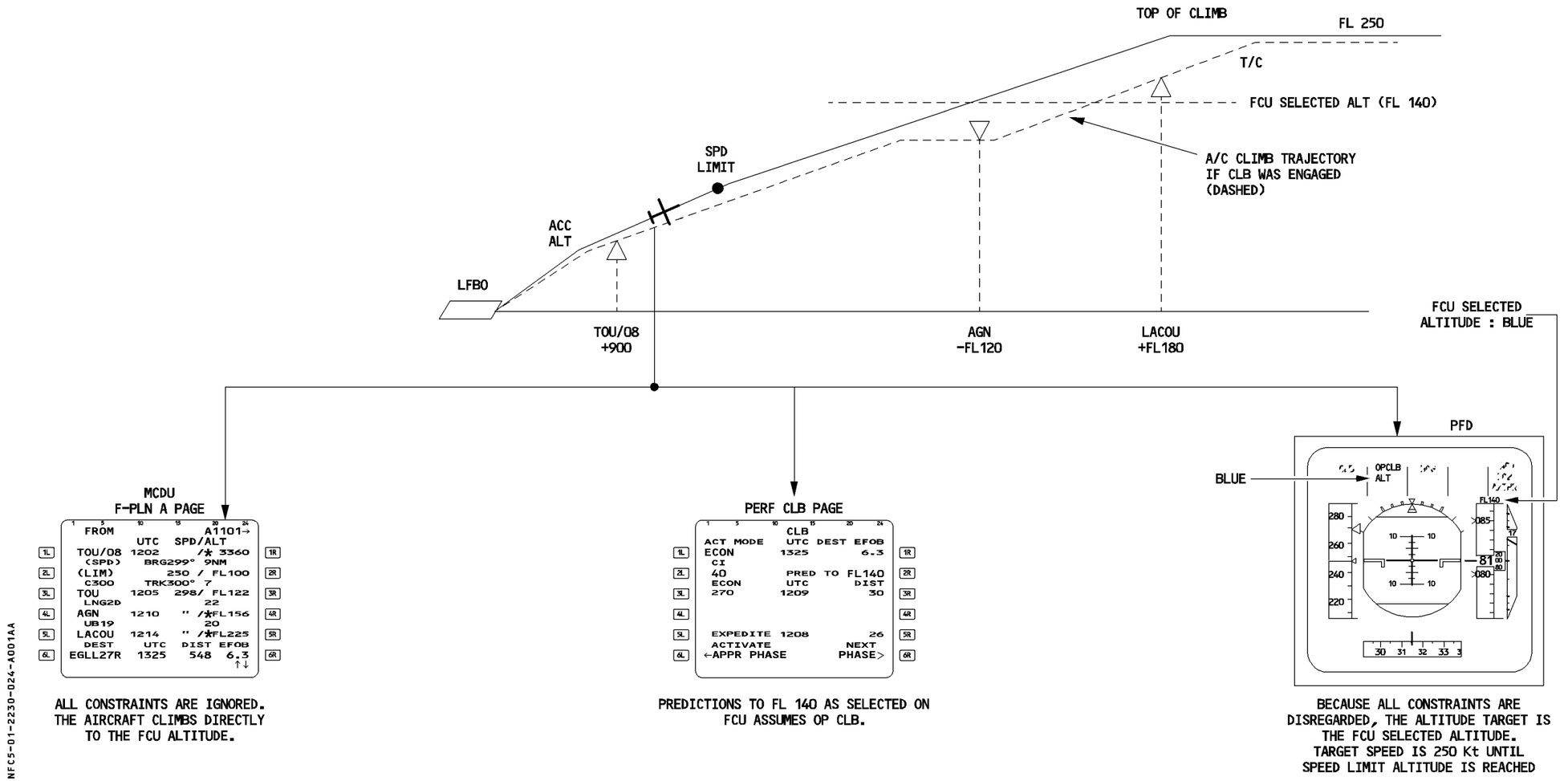
DISENGAGEMENT CONDITIONS

The OPEN CLB is disengaged by one of the following conditions :
- Engagement of any other vertical mode.
- Reversion to V/S mode (Refer to 1.22.30 reversions).
- Selection of a lower altitude than the current aircraft altitude. V/S (FPA) engages on the current V/S (FPA).

GUIDANCE

When OPEN CLB is engaged, the target speed/Mach is maintained by adjusting the pitch with the elevator, whereas thrust is maintained either by the A/THR, or manually by the pilot. Speed target may either be selected or managed.
The OPEN CLB mode disregards all altitude constraints up to the FCU-selected altitude.

OPEN CLB modes, MANAGED SPEED



ALL CONSTRAINTS ARE IGNORED.
THE AIRCRAFT CLIMBS DIRECTLY
TO THE FCU ALTITUDE.

PREDICTIONS TO FL 140 AS SELECTED ON
FCU ASSUMES OP CLB.

BECAUSE ALL CONSTRAINTS ARE
DISREGARDED, THE ALTITUDE TARGET IS
THE FCU SELECTED ALTITUDE.
TARGET SPEED IS 250 Kt UNTIL
SPEED LIMIT ALTITUDE IS REACHED

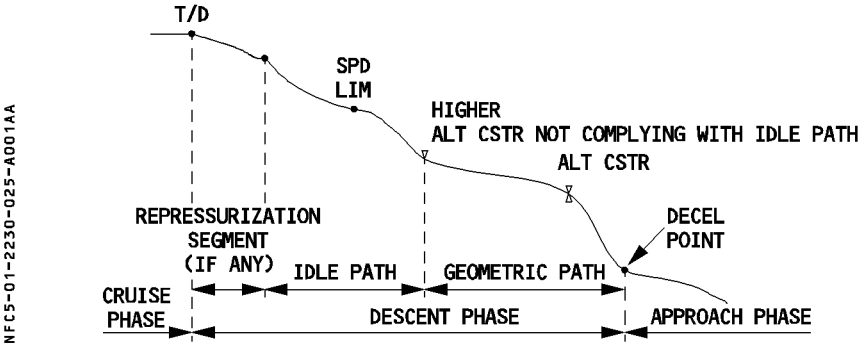
NFCS-01-2230-024-A001AA

Note : If the change is less than 1200 feet in OPEN CLB mode, the aircraft responds with a rate of climb of 1000 ft/min.

DESCENT MODE (DES)

DES mode provides managed vertical guidance along a computed descent profile. The profile is computed from "Top of Descent" at the cruise flight level down to the "Decel" point, where guidance begins the deceleration to VAPP, to be reached at 1000 feet above touchdown on the final descent path.
The descent profile takes into account wind data and data from the lateral and vertical flight plans, and it is based upon the managed descent speed profile. It does not take holding patterns into consideration.
The descent profile has several segments :

- A repressurization segment. When necessary, this produces a repressurization rate for the cabin during descent. It is a function of the destination airport altitude and the selected cabin rate (defaulted to – 350 feet/min but this can be modified).
- Idle path segment. The AP/FD controls the speed and autothrust stays at idle thrust. Guidance computes this profile from top of descent or the end of the repressurization segment to the first vertical constraint that cannot be flown at idle thrust.
- Geometric path segments. The AP/FD controls the vertical path, and autothrust controls the speed. These segments take the aircraft from the first constraint to the deceleration point.



The descent mode is a managed mode that may be engaged during cruise. It can be armed or engaged in descent and approach phases (unless the FCU selected altitude is higher than the present aircraft altitude).

R ARMING CONDITIONS

R The DES mode is armed when an altitude constraint is captured and all the following
R conditions are met :
R – FCU-selected altitude is lower than present altitude.
R – NAV, LOC* or LOC mode is engaged.
R – Takeoff or go-around phase is not active.
R – Flight profile is available.

DISARMING CONDITIONS

The DES mode is disarmed, if one of the following conditions is met :
- Engagement of another vertical mode.
- FCU-selected altitude is set above the aircraft's current altitude.
- Loss of NAV, LOC*, or LOC mode.
- Switching to the go-around phase.
- Loss of vertical flight path validity.
- Setting the FCU-selected altitude at an altitude constraint, while ALT CSTR* was engaged. (ALT* engages and DES mode disarms).

ENGAGEMENT CONDITIONS

The DES mode can be engaged, when the following conditions are met :
- The FCU-selected altitude is lower than the present altitude.
- NAV, LOC*, or LOC is engaged.
- Takeoff, climb, or go-around phase is not active.
- Vertical flight path is valid.
- TO, G/S, LAND, FINAL or GA mode is not engaged, and :
  - The aircraft sequences a waypoint, with an ALT CSTR and DES mode armed. The DES mode engages automatically, or
  - The pilot presses the ALT selector knob, while ALT CSTR* or ALT CSTR (ALT* or ALT magenta ◁) is not engaged, or
  - The pilot presses the ALT selector knob, while ALT* or ALT is engaged, and the current altitude is not an effective altitude constraint of the F-PLN.

Note : When DES mode is engaged :
- *The V/S (FPA) window of the FCU shows dashes.*
- *The managed LVL/CH dot on the FCU lights up.*

DISENGAGEMENT CONDITIONS

The DES mode is disengaged, if one of the following conditions is met :
- NAV mode is lost or disengaged, and the V/S (FPA) mode engages. A triple click aural warning will sound. (Refer to 1.22.30, mode reversion).
- Another vertical mode engages.
- The pilot selects an altitude on the FCU that is higher than the aircraft's present altitude, and the V/S (FPA) engages on the current V/S (FPA). Same triple click logic, as for the OP DES case. (Refer to 1.22.30).
- NAV mode is lost due to a discontinuity in the descent profile. AP/FD reverts to basic mode, and a triple click aural warning sounds. The vertical mode is boxed in white for 10 seconds.

GUIDANCE

Descent initiation

To initiate the descent, the pilot :

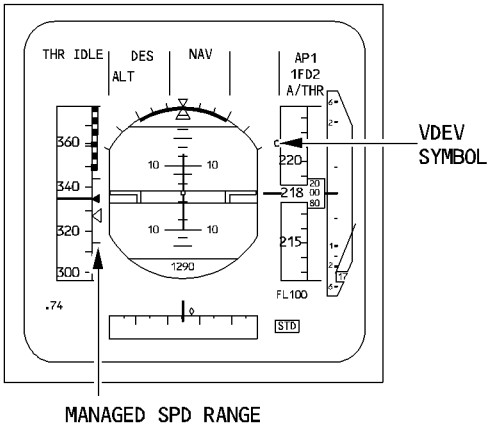
– Turns the ALT selector knob to set the cleared altitude.
– Pushes the ALT selector knob.
  · If the aircraft has not reached the Top of Descent (T/D), it will immediately descend at a constant V/S, converging on the descent profile.
  · If the aircraft is at or beyond T/D, it immediately descends at idle thrust.

During descent :

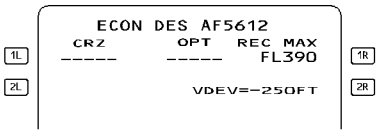
The pilot sees a vertical deviation symbol (VDEV), along the ALT scale on the PFD and on the PROG page, so as to monitor the aircraft's vertical position on the calculated descent profile.

The aircraft may deviate from the DES path, while DES mode is engaged, if :

– Unexpected wind conditions are encountered, or
– Anti-icing is turned on, or
– The lateral flight plan is modified.



PFD display in managed DES mode.

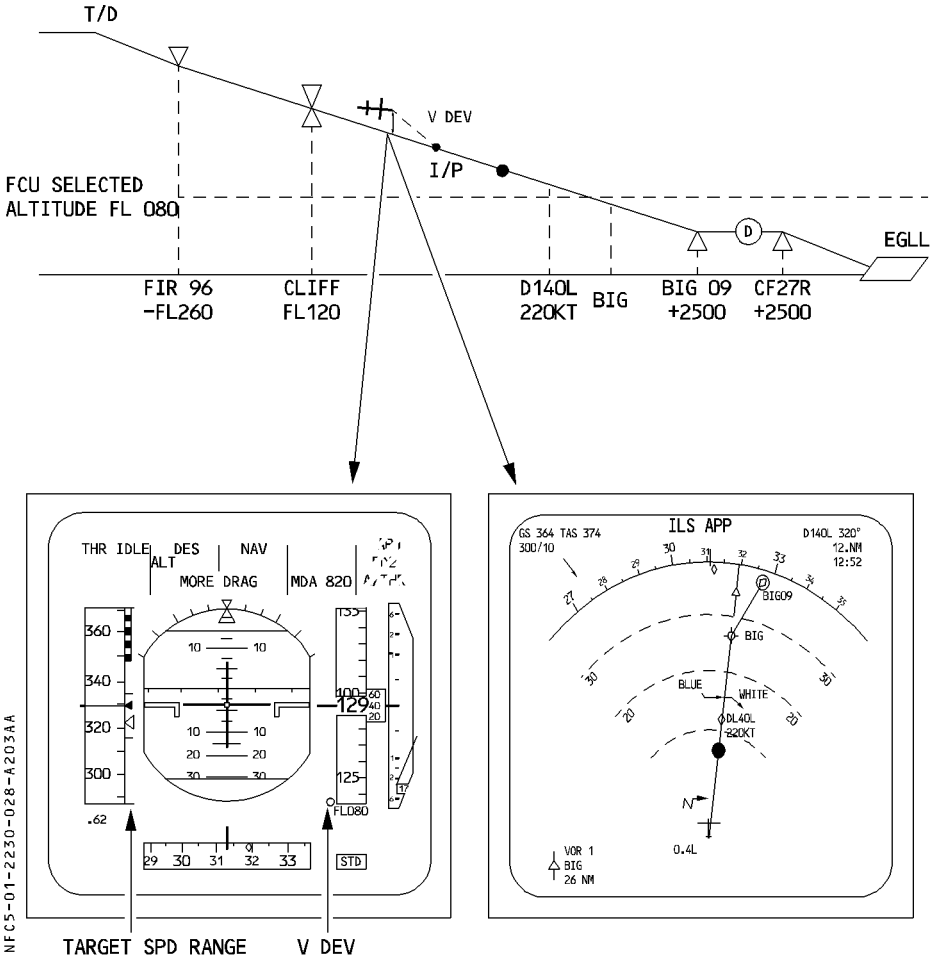


VDEV value on the PROG page

NFCS-01-2230-027-A200AA

When the speed is managed, a managed SPD range, on the PFD displays acceptable speed variations around the nominal descent speed target (limited to ± 20 knots).

Associated with the V DEV displayed on the PFD, the ND shows an intercept point (^v→) on the flight plan. This indicates the position at which the system predicts that the aircraft will intercept the descent profile.



– **Aircraft above the descent profile :**

R If the aircraft is above the descent profile, the speed will increase toward the upper limit
R of the managed speed range. If the speed reaches the upper limit, the aircraft will
R maintain the speed but will deviate from the profile (autothrust at idle).

The navigation display presents a pseudo waypoint ∿↦ (intercept point) along the flight
R plan, that assumes the aircraft will return to the profile using :

· idle thrust
· 1/2 speedbrake extension
· ECON speed plus a margin (until intercepting the profile).

Whenever the intercept point is predicted to be close to a constrained waypoint, the PFD and MCDU display an "AIRBRAKES" or "MORE DRAG" message depending upon the FMGS standard.

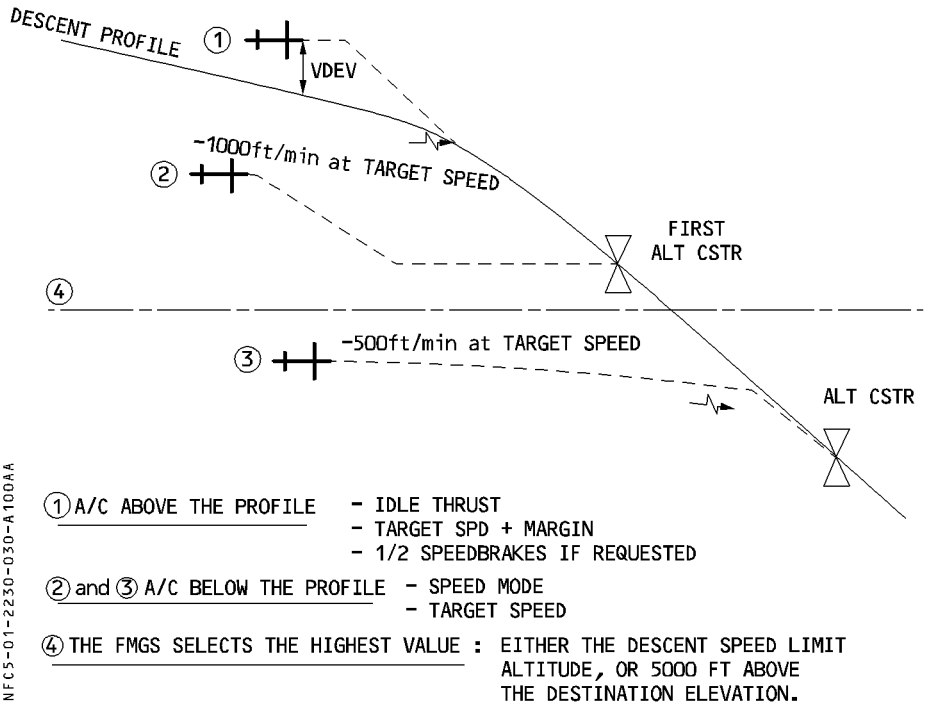
Note : With DES mode engaged, the speedbrakes extension will not necessarily increase the descent rate. It increases only if the aircraft is above path.

– **Aircraft below the descent profile**

If the aircraft is below the DES profile, its speed will be maintained at target speed until it reaches the descent profile.

The intercept point on the navigation display is based on the following assumptions :

R · If the aircraft is flying at an altitude that is higher than both the descent speed limit altitude and the destination elevation + 5000 ft :
R The FMGS maintains the V/S at – 1000 ft/min and the target speed, until the aircraft reaches the altitude constraint, or intercepts the descent profile.
R · If the aircraft is flying at an altitude that is lower than either the descent speed limit altitude, or the destination elevation + 5000 ft :
R The FMGS maintains the V/S at – 500 ft/min and the target speed, until the aircraft reaches the altitude constraint or intercepts the descent profile.
R



① A/C ABOVE THE PROFILE – IDLE THRUST
– TARGET SPD + MARGIN
– 1/2 SPEEDBRAKES IF REQUESTED

② and ③ A/C BELOW THE PROFILE – SPEED MODE
– TARGET SPEED

④ THE FMGS SELECTS THE HIGHEST VALUE : EITHER THE DESCENT SPEED LIMIT ALTITUDE, OR 5000 FT ABOVE THE DESTINATION ELEVATION.

– **Leveling off at a constraint**
  · If the aircraft levels off at an ALT CSTR, the DES mode arms and remains armed until the aircraft passes the constraint, then reengages (if the FCU altitude is set below the altitude of the constraint)
  · If the FCU selected altitude is that of a constraint, the flight crew may continue the descent below that altitude by turning the ALT SEL knob and pushing it in. This arms the DES mode, which reengages when the aircraft passes the constraint waypoint.

– **Guidance in a hold :**

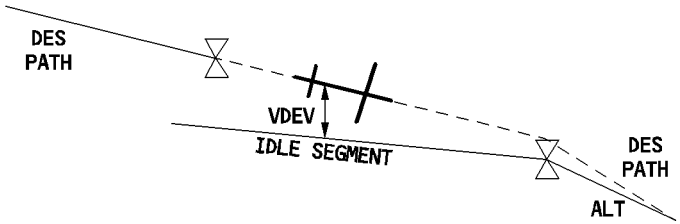
Just before the aircraft enters a holding pattern, the speed target becomes the holding speed. In the holding pattern, the DES mode commands V/S = – 1000 ft/min while autothrust maintains the holding speed. The aircraft will level off at the next altitude constraint if it is reached during the hold.

R The vertical deviation (VDEV) is based on the altitude at which the aircraft is supposed
R to cross the exit fix in order to be properly positioned on the descent profile.

– **Too steep path :**

A segment between two constraints is called "too steep path" when Flight Management predicts that it is impossible to fly it at the preplanned speed with 1/2 speedbrakes extended. The MCDU displays TOO STEEP PATH and FM does not furnish predictions for the waypoints included in the TOO STEEP PATH segment. When the aircraft reaches the beginning of the too steep path segment, the FM recomputes the VDEV using an idle segment from the end of the too steep path segment.

NFC5-01-2230-031-A100AA



– **FMA display**

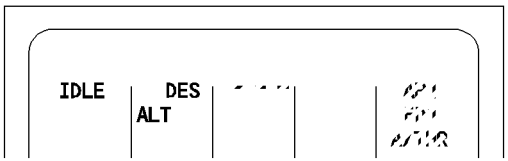
When DES mode is engaged, the system arms ALT and displays the applicable target altitude on the PFD altitude scale.

· If the next predicted level-off is an altitude constraint, ALT is magenta on the FMA second line and the PFD displays the altitude constraint magenta above the altitude scale.

When ALT CSTR (green) is engaged (aircraft flying at ALT CSTR), the system arms DES
R blue. When the aircraft meets the constraint, DES engages again automatically.

· If the next predicted level-off is the FCU altitude, ALT is blue on the FMA and the PFD displays the FCU selected altitude in blue.

NFC5-01-2230-031-B100AA



Typical FMA in DES

OPEN DESCENT

The OPEN DESCENT mode is a selected mode. It maintains a SPD/MACH (selected or managed) with the AP/FD pitch mode, while autothrust (if active) maintains IDLE thrust. It is not to be used for final approach.

ENGAGEMENT CONDITIONS

The OPEN DES mode can only be engaged, if the following conditions are met :
- The aircraft has been in flight for more than five seconds,
- LAND mode is not engaged.
- The FCU-selected altitude is lower than the present altitude.

The OPEN DES mode is engaged by one of the following :
- Pulling out the ALT selection knob.
- Selecting a manual speed when EXP mode is engaged. ◁

Note : When OP DES is engaged :
- *The FMA displays "OP DES".*
- *The managed LVL/CH dot on the FCU goes out.*
- *The system arms the ALT mode.*

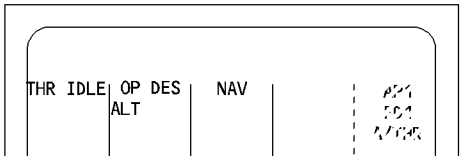
DISENGAGEMENT CONDITIONS

- Manual engagement of another vertical mode.
- Selection of an altitude higher than the present altitude. V/S (FPA) engages on the current V/S (FPA). The vertical mode is boxed white. If within 5 seconds after the reversion to V/S, the pilot does not confirm the altitude target change by another expected action, a triple click aural warning sounds, and the V/S (FPA) is boxed white and flashes for 10 seconds.

GUIDANCE

When OPEN DES is engaged, pitch control maintains the target speed/Mach number, and autothrust maintains idle thrust (or the pilot maintains it manually).
The speed target may either be selected or managed.
The OPEN DES disregards all altitude constraints.

NFC5-01-2230-033-A100AA



Typical FMA in OPEN DES

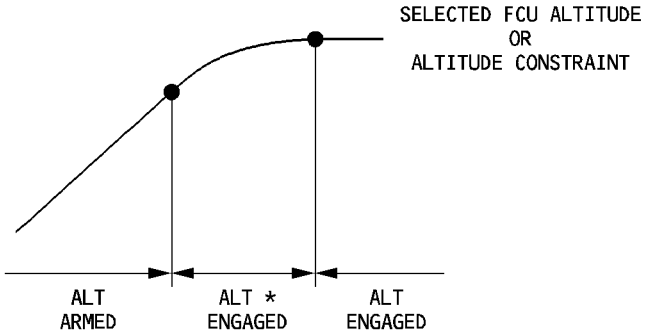
ALTITUDE ACQUIRE MODE (ALT*, ALT CSTR*)

ALT* mode guides the aircraft to acquire the FCU-selected altitude.
R ALT CSTR* guides the aircraft to acquire an altitude constraint, provided by Flight
R Management.
R Once the aircraft has reached the altitude, the altitude mode (ALT or ALT CSTR green) engages.

ENGAGEMENT CONDITIONS

The mode engages when the aircraft reaches the altitude capture zone, defined by the aircraft vertical speed (among other parameters).

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Note : ALT and ALT CSTR* cannot be engaged below 400 feet, if either the takeoff or the go-around mode is engaged.*

DISENGAGEMENT CONDITIONS

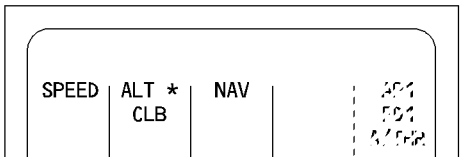
– Engagement of V/S mode on the current vertical speed, by changing the FCU altitude selector knob by more than 250 feet.

If within 5 seconds after reversion to V/S (FPA) the pilot does not confirm the altitude target change by :

– Pulling the ALT knob, or
– Setting a new V/S (FPA) target, or
– Pushing the V/S (FPA) selector knob on the FCU,

a triple click aural warning sounds, and the V/S (FPA) is boxed white for 10 additional seconds.

– Engagement of another vertical mode, provided the FCU altitude has been changed by more than 250 feet.



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Typical FMA in ALT *

GUIDANCE

The ALT* and ALT CSTR* modes have internal V/S guidance that is a direct function of the difference between the present and target altitudes.

ALT * and ALT CSTR * modes have internal protections that decreases the vertical speed when VLS or VMAX is reached (VLS or VMAX becomes the priority target).

The system switches automatically to ALT (altitude hold) when the altitude deviation becomes less than 20 feet.

Note : – *If the baro setting is changed during ALT*, this may lead to an FCU target overshoot due to the change of the current value of the altitude. However ALT* mode will allow the FCU altitude to be regained.*
– *For aircraft equipped with QFE option, a switching from STD to QFE (or vice versa) in ALT CSTR*, will change the target value and a reversion to V/S may occur if the target value is modified of 250 feet or more.*

ALTITUDE HOLD MODE (ALT/ALT CST/ALT CRZ)

The ALT mode maintains a target altitude. This target altitude is either the FCU-selected altitude or an altitude constraint delivered by Flight Management.

ARMING CONDITIONS

The ALT mode arms automatically whenever the aircraft climbs or descends toward the target altitude.

R *Note : The ALT mode arms only if the difference between the current altitude and the*
R *FCU-selected altitude is at least 250 feet.*

When ALT is armed, the FMA displays the ALT message on its second line :
- blue when the target altitude is the FCU-selected altitude
- magenta if the target altitude is an altitude constraint.

ENGAGEMENT CONDITIONS

- The ALT mode is engaged automatically when the difference between present altitude and the target altitude becomes less than 20 feet with ALT* engaged.

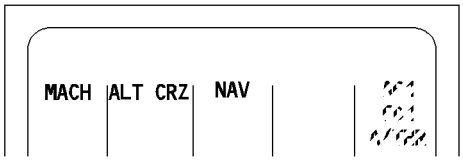
DISENGAGEMENT CONDITIONS

The ALT mode disengages when any other vertical mode engages.

GUIDANCE

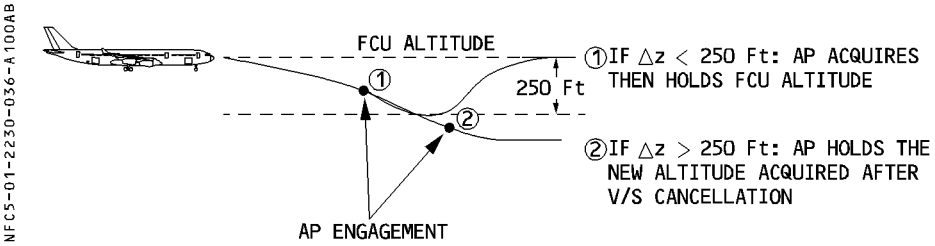
- The altitude that ALT mode holds is the altitude it memorized when engaged. It is not affected by a change of reference in the ALT window or by a change in the barometric correction.
- When ALT is engaged, the FMA displays "ALT" in green (FCU altitude hold) or ALT CSTR in green if it is an altitude constraint.

NFC5-01-2230-035-A200AA



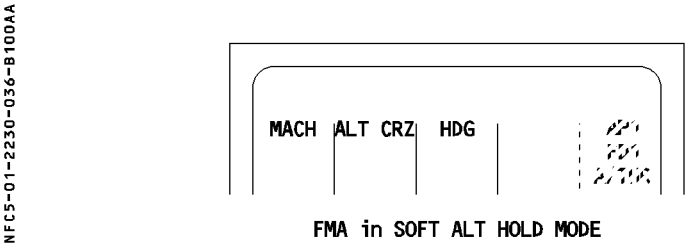
typical FMA in ALT MODE

– If the AP is engaged while FD is already engaged in ALT mode at the FCU-selected altitude, the autopilot :
· acquires and holds the FCU altitude if present altitude is within 250 feet of it, or
· commands a level-off if present altitude is more than 250 feet from the FCU altitude.



SOFT ALTITUDE

R On reaching the planned cruise altitude, ALT CRZ engages and A/THR maintains the
R speed/mach target.
R Two minutes after ALT CRZ engages, if the mach mode is operative, SOFT ALT mode
R engages. This allows the aircraft to deviate ± 50 feet from the target altitude, thereby
R minimizing thrust variations and reducing fuel consumption.

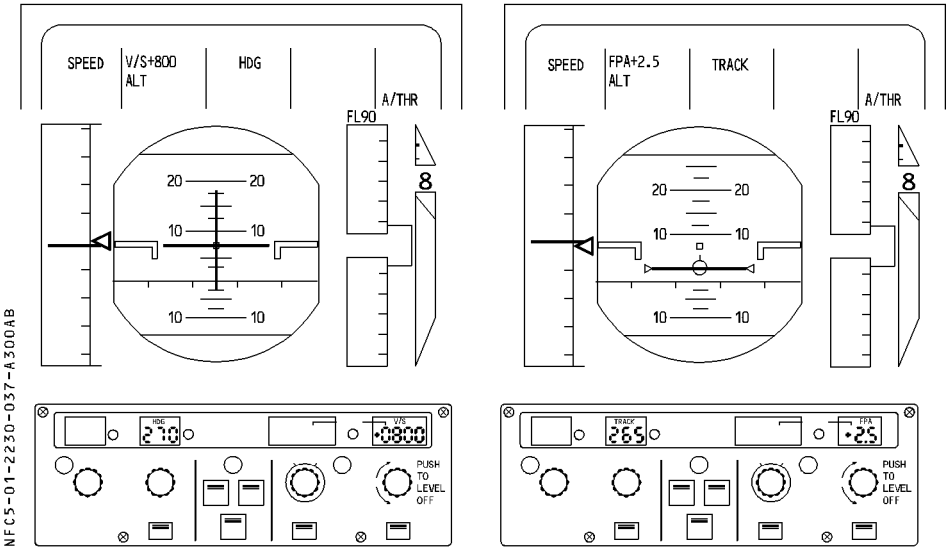


FMA in SOFT ALT HOLD MODE

VERTICAL SPEED MODE — FLIGHT PATH ANGLE MODE (V/S - FPA)

The V/S - FPA is a selected mode. It acquires and holds the vertical speed or the flight path angle displayed in the V/S - FPA window of the FCU.
The HDG V/S TRK FPA pushbutton on the FCU allows the pilot to select either type of reference to be used for guidance and for display on the PFD.

R



NFC5-01-2230-037-A300AB

ENGAGEMENT CONDITIONS

The pilot can engage the mode manually as follows :
- Pull out the V/S FPA selection knob (at least five seconds after lift-off) or push it in for an immediate level-off (V/S = 0).
- Engage the AP and/or FD if AP and FD were not engaged (basic mode of AP/FD engagement).
- Select a different altitude (more than 250 feet from present altitude) when in ALT*.
- Select a higher altitude than present altitude when in DES, OP DES, or EXP DES◁ mode.
- Select a lower altitude than present altitude when in CLB, OP CLB, or EXP CLB◁ modes.

The mode engages automatically :
- five seconds after lift-off, if no other vertical mode is engaged
- upon loss of G/S* or G/S mode
- upon loss of FINAL mode
- upon loss of LOC* or LOC mode
- upon loss of NAV mode when DES mode is engaged
- upon loss of vertical flight path in DES mode

DISENGAGEMENT CONDITIONS

The pilot can disengage the V/S mode manually by :
– pulling or pushing the altitude selector knob
– pushing the EXPED pushbutton ◁ or
– initiating a go-around.
It disengages automatically :
– when the aircraft reaches the FCU altitude or
– upon G/S* engagement.

GUIDANCE

The FMGC pitch mode guides the aircraft to the target V/S or FPA. The corresponding A/THR mode is SPEED or MACH. The FMA displays "V/S (FPA)".
The V/S (FPA) guidance has priority over the speed guidance. If the selected target V/S or FPA is too high (relative to the current thrust condition and speed), the FMGC will steer the aircraft to the target V/S or FPA, but the aircraft will also accelerate or decelerate. When the speed reaches the authorized limit, the V/S or FPA decreases automatically to maintain the minimum (or maximum) speed limit.

Note : If the pilot sets V/S = 0 or pushes the V/S-FPA pushbutton to level off (if the push to level off function is installed), it automatically sets the V/S or FPA target to zero and the aircraft levels off and maintains its altitude.

EXPEDITE

Expedite mode is an OPEN mode, used in climb or descent, to reach the desired altitude with the maximum vertical gradient.

ENGAGEMENT CONDITIONS

The pilot can engage EXPEDITE, if :
- The aircraft has been in flight for more than 5 seconds.
- Managed speed is available.

  The pilot manually engages EXPEDITE by pushing the EXPED pushbutton on the FCU.
  If the FCU-selected altitude is higher than the present altitude, EXP CLB mode engages.
  If the FCU-selected altitude is lower than the present altitude, EXP DES mode engages.

DISENGAGEMENT CONDITIONS

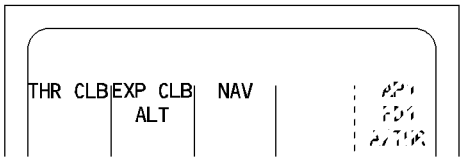
The pilot can manually disengage EXPEDITE by :
- Pulling out the V/S (FPA) selector knob to engage the V/S (FPA) mode.
- Pulling out the altitude selector knob to engage OP CLB or OP DES.
- Pulling out the speed selector knob to activate the selected speed target, and engage OP CLB or OP DES. A white box appears around the longitudinal mode and flashes for 10 seconds. A triple click sounds.
- Pushing in the ALT selector knob to engage the CLB or DES mode, provided that the engagement conditions are met.
- Selecting a higher altitude than the present altitude, when in EXP DES. If this action is not followed by another expected pilot action within 5 seconds, a triple click sounds. A steady white box appears around the longitudinal mode, then flashes for 10 seconds after the triple click.
- Selecting a lower altitude than the present altitude, when in EXP CLB. If this action is not followed by another expected pilot action within 5 seconds, a triple click sounds. A steady white box appears around the longitudinal mode, then flashes for 10 seconds after the triple click.
- Activating a reversion to V/S to protect the aircraft from exceeding VLS or VMAX. A white box appears around the longitudinal mode and flashes for 10 seconds. A triple click sounds.
  * In FD mode only, if the crew does not follow the FD orders, a reversion to V/S occurs when reaching VMAX + 4 in EXP CLB or VLS – 2 in EXP DES (VLS – 17 with speedbrakes). (Refer to 1.22.30 “reversions”).

EXPEDITE automatically disengages with ALT* engagement.

GUIDANCE

R When the aircraft is in EXP CLB, the target speed is Green Dot, which is maintained with
R pitch control. Autothrust if active sets the thrust at CLB THRUST automatically.
R When the aircraft is in EXP DES, the target speed is 340 knots or Mach 0.8 which is
R maintained with pitch control. Autothrust if active sets the thrust at IDLE automatically.
When EXPEDITE is engaged, the system disregards SPD CSTR, ALT CSTR, and SPD LIM.

NFC5-01-2230-040-A100AA



FMA in EXP CLB

MODE REVERSIONS

There are several types of mode reversions. Each one observes a specific logic that can be described as follows :

INTERACTION BETWEEN LATERAL MODES, VERTICAL MODES, AND MANAGED SPEED PROFILE

· **When NAV mode is engaged :**
The FMGS guides the aircraft along the flight plan and considers the constraints attached to the F-PLN waypoints. As a result :
– Managed CLB and DES modes are available.
– The managed speed profile includes :
V2 - SPD CSTR (if applicable) - SPD LIM - ECON CLB SPD/MACH - ECON CRZ MACH - ECON DES (MANAGED SPD) - SPD/MACH - SPD CSTR - SPD LIM - HOLD SPD - VAPP/GS MIN.
It is valid for all vertical modes, except EXPEDITE ◁.

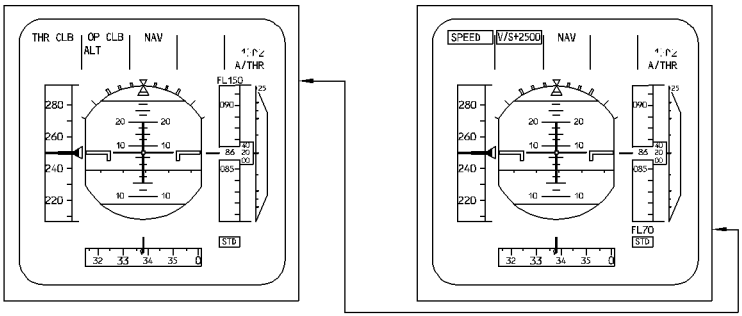
· **When NAV mode is not engaged :**
The FMGS considers that the flight plan is not followed, and ignores all speed and altitude contraints linked to the flight plan waypoints. As a result :
– The managed vertical CLB and DES modes are not available.
– The managed SPD profile disregards the speed constraints and includes :
V2 - SPD LIM - ECON CLB - ECON CRZ - ECON DES (MANAGED SPD) - SPD LIM - VAPP/GS MIN target.

As a consequence : When NAV mode disengages (manual or automatic)
– CLB mode, when engaged, reverts to OPEN CLB. The lateral mode is boxed white for 10 seconds. The vertical mode is boxed white.
If within 5 seconds the disengagement of the NAV mode is not confirmed by one of the following crew actions :
· FCU altitude change
· Level-off
· Selection of the V/S mode, then
A triple click aural warning sounds. In addition, a white box flashes around the vertical mode for 10 additional seconds.
– DES mode, when engaged, reverts to V/S mode on current value.
If within 5 seconds the disengagement of the NAV mode is not confirmed by one of the following crew actions :
· FCU altitude change
· Level-off
· Selection of the V/S mode, then
A triple click aural warning sounds. In addition, a white box flashes around the vertical mode for 10 additional seconds.
– Speed and altitude constraints are disregarded (but speed limit is retained).

MODE REVERSION DUE TO FCU ALTITUDE CHANGE

1. When an OPEN mode is engaged, the aircraft climbs or descends towards the altitude set on the FCU. If the pilot sets the FCU altitude to a target incompatible with the active open mode, a mode reversion occurs and V/S (FPA) engages on the current V/S (FPA). This reversion applies to CLB, OP CLB, DES, OP DES, EXP DES ◁ , EXP CLB ◁.
   e.g. : Reversion from OP CLB to V/S

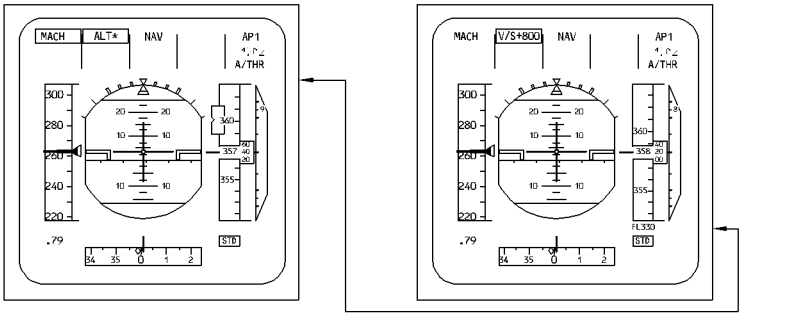
NFCS-01-2230-040BA310AA



FCU ALTITUDE CHANGE FROM FL150 to FL70

2. With ALT* engaged, if the target altitude is changed by <u>any</u> value greater than 250 feet, V/S (FPA) engages on the current V/S. (Also Refer to the mode reversion table).

NFCS-01-2230-040BB310AA



FCU ALTITUDE CHANGE FROM FL360 TO FL330

If within 5 seconds after the reversion to V/S (FPA) the pilot does not confirm the altitude target change by :
- Pulling the ALT knob, or
- Setting a new V/S (or FPA) target, or
- Pushing the V/S (FPA) selector knob on the FCU.

A triple click sounds, and the V/S (FPA) is boxed white for 10 additional seconds.

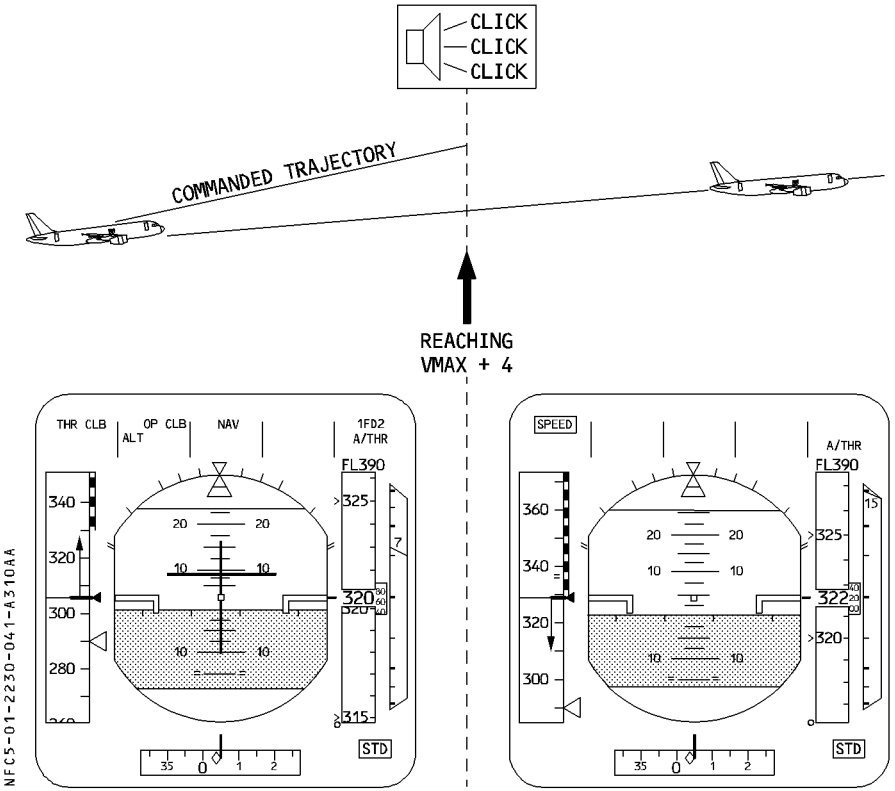
AUTOMATIC SPEED MODE PROTECTION

FDs are engaged in an OPEN mode in climb with AP not engaged

If FDs are engaged in CLIMB, or OPEN CLIMB mode, or EXP CLB (if installed) and the pilot does not follow the FD bars to maintain the commanded climb (pitch too low and autothrust in maximum climb thrust), the aircraft accelerates.

Both FDs disengage when VMAX+4 is reached (VMAX being VMO, VLE or VFE). If the A/THR is active, it reverts to SPEED mode and reduces thrust to recover the speed target.

A triple click aural warning sounds.



AUTOMATIC SPEED MODE PROTECTION

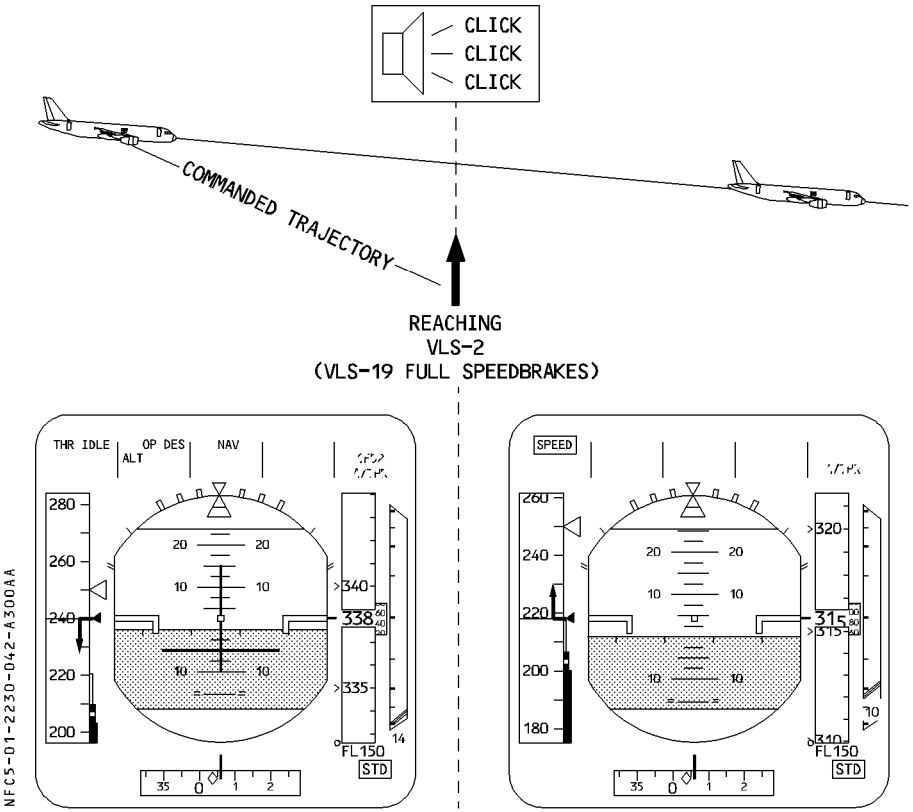
FDs are engaged in an OPEN mode, in descent with the AP not engaged

If the FDs are engaged in DES, or OP DES mode, or EXP DES (if installed) and, if the pilot does not follow the FD bars to maintain the commanded pitch, the aircraft decelerates (insufficient descent rate and idle thrust).

If the airspeed reaches VLS-2, both FDs disengage. (If speedbrakes are extended, the FDs disengage between VLS-2 and VLS-19, depending on the position of the speedbrakes).

The A/THR, if active, reverts to SPEED mode upon FD bars disengagement, and increases thrust to recover the speed target. A triple-click aural warning sounds.

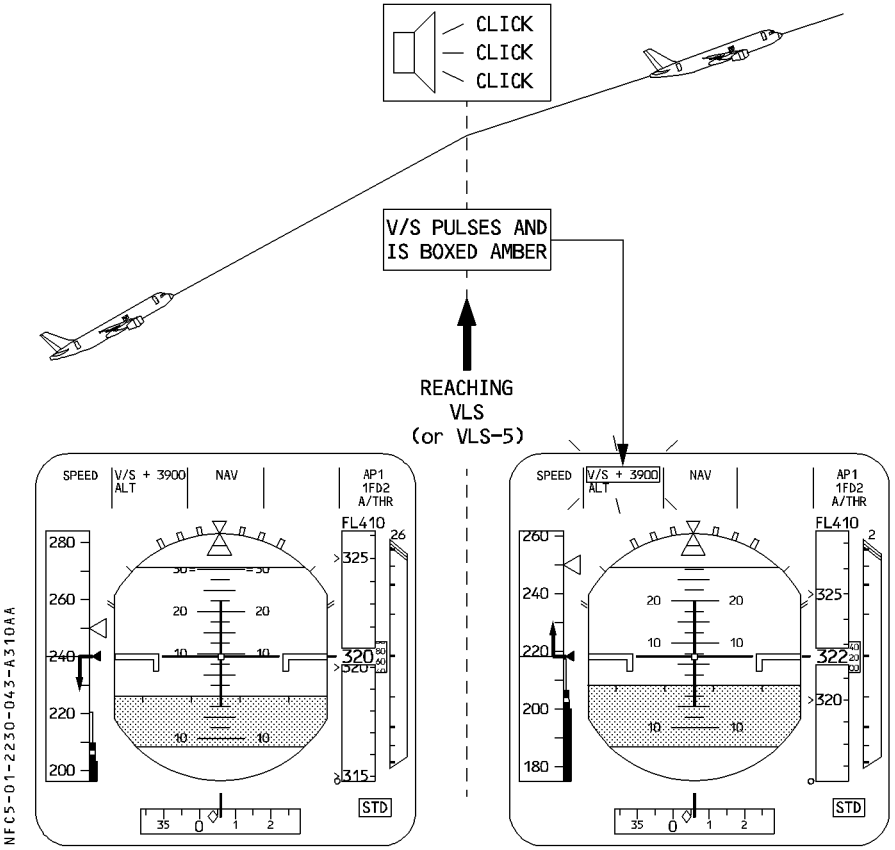
R



AUTOMATIC SPEED PROTECTION IN V/S (or FPA) MODE

R **In climb**

R When climbing with V/S mode engaged : If the selected V/S value is excessive (with
R regards to thrust and speed), the FMGS maintains the V/S target, but the airspeed
R decreases. When reaching VLS (or VLS - 5, if the speed target is VLS), the AP temporarily
R abandons the V/S target, and automatically decreases the vertical speed to maintain VLS.
R The same applies, if FPA mode is used with an excessive FPA target.
R



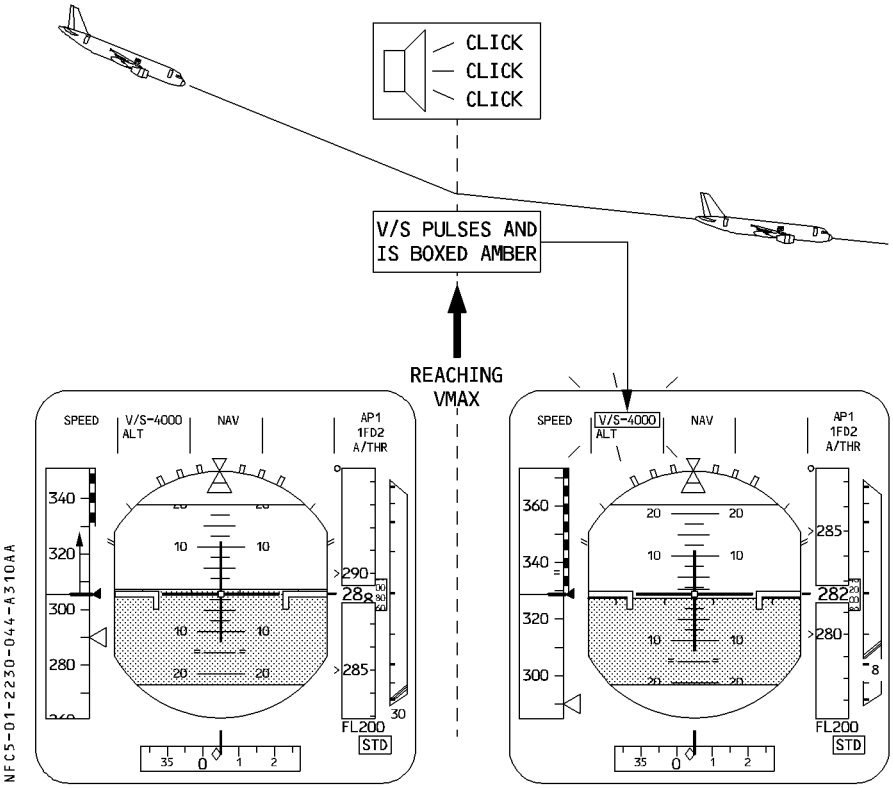
R V/S mode remains engaged.
R On the FMA, the V/S target is boxed with a flashing amber rectangle, and the V/S value
R pulses. Besides, an aural triple click is generated.

R *Note : When flying with FD bars only (AP OFF), the FMGS adjusts the pitch bar so that VLS*
R *is maintained. However, no triple click is generated and the V/S target display on*
R *the FMA remains unchanged.*

AUTOMATIC SPEED PROTECTION IN V/S (or FPA) MODE

R **In descent**

R When descending with V/S mode engaged : If the selected V/S value is excessive (with
R regards to thrust and speed), the FMGS maintains the V/S target, but the airspeed
R increases. When reaching VMAX (VMO or VLE in clean, or VFE + 4 knots), the AP
R temporarily abandons the V/S target, and automatically decreases the vertical speed to
R maintain VMAX.
R The same applies, if FPA mode is used with an excessive FPA target.
R



R V/S mode remains engaged.
R On the FMA, the V/S target is boxed with a flashing amber rectangle, and the V/S values
R pulses. Besides, an aural triple click is generated.

R *Note : When flying with FD bars only (AP OFF), the FMGS adjusts the pitch bar so that*
R *VMAX is maintained. However, no triple click is generated and the V/S target*
R *display on the FMA remains unchanged.*

MODE REVERSIONS (SUMMARY)

There are only 2 types of vertical mode reversions on aircraft equipped with global speed protection.

Reversion due to a change of the FCU selected altitude

Vertical mode engaged	FCU altitude selection change	Vertical mode switches to
CLB - OP CLB EXP CLB ◁	BELOW AIRCRAFT ALTITUDE	V/S on current V/S
DES - OP DES EXP DES ◁	ABOVE AIRCRAFT ALTITUDE	
ALT* ACTIVE	ANY CHANGE	

Reversion due to the loss of NAV mode (manual or automatic)

CONDITIONS	EVENT	CONSEQUENCE
CLB engaged	Loss of NAV mode	OP CLB engages
DES engaged		V/S engages

R **SPEED PROTECTION when FD orders are not followed by the crew (AP NOT engaged)**

R

CONDITIONS	EVENT	CONSEQUENCE
· FD engaged only (no AP) and · OP DES or EXP DES ◁ or DES engaged · A/THR active (IDLE thrust)	IAS = VLS – 2 (if speedbrakes are extended between VLS – 2 and VLS – 19)	FD bars disappear. If A/THR active, automatic engagement of SPEED mode on the A/THR. Thrust increases to recover the speed target.
· FD engaged only (no AP) and · OP CLB or EXP CLB ◁ or CLIMB engaged · A/THR active (CLIMB thrust)	IAS = VMAX + 4 VMAX = VFE or VLE or VMO/MMO	FD bars disappear. If A/THR active, automatic engagement of SPEED mode on the A/THR. Thrust decreases to recover the speed target.

SPEED PROTECTION due to excessive V/S

CONDITIONS	EVENT	CONSEQUENCE
· Excessive V/S or FPA selected in climb	IAS = VLS (or VLS – 5 if target = VLS)	The selected V/S (or FPA) target is temporarily abandoned to maintain VLS in climb or VMAX in descent.
· Excessive V/S or FPA selected in descent, and · Clean configuration	IAS = VMAX	
· Excessive V/S or FPA < 0 selected in descent, and · Configuration other than clean	IAS = VMAX	

Enhanced mode reversion alertness

The following sequences, or mode reversions, are highlighted by a triple click :

- V/S selection in ALT*
- SPD selection in SRS
- CLB (or EXP CLB) to OP CLB, upon lateral crew action while climbing toward a constraint
- ALT* to V/S, upon ALT target change
- FD disengagement in OPEN modes
- Alerting FMA display when V/S-(FPA) target is not held
- CLB to OP CLB reversion, upon profile loss
- Automatic FD re-engagement in basic mode

R
- DES to V/S upon flight plan loss
- FINAL DES to V/S, upon NAV loss
- Reversion to V/S when selected ALT crosses the current altitude
- Automatic FD re-engagement in basic lateral mode
- NAV to HDG, upon NAV loss

AP/FD COMMON MODES

GENERAL

These modes are called "common" because they are related to both the lateral and the vertical axes.
The AP/FD common modes are :
– On takeoff : Runway/Runway track associated to SRS vertical modes.
– In approach : ILS approach (LAND) or non-ILS approach (APP NAV FINAL).
– In go around : Go around track associated to SRS vertical modes.
These modes are engaged simultaneously on both axes.

<table>
<tr><th colspan="2">COMMON MODES</th><th>VERTICAL</th><th>LATERAL</th></tr>
<tr><td colspan="2">TAKEOFF</td><td>SRS</td><td>RWY
RWY TRK</td></tr>
<tr><td rowspan="3">APPROACH MODES</td><td rowspan="2">ILS APPROACH</td><td>G/S*
G/S</td><td>LOC*
LOC</td></tr>
<tr><td colspan="2">LAND, FLARE,
ROLL OUT</td></tr>
<tr><td>NON ILS APPROACH</td><td>FINAL</td><td>APP NAV</td></tr>
<tr><td colspan="2">GO AROUND
(GA)</td><td>SRS</td><td>GA TRK</td></tr>
</table>

TAKEOFF

Takeoff mode combines the SRS (Speed Reference System) vertical mode with the RWY lateral mode.
Both are simultaneously engaged, but may be disengaged separately.
Takeoff mode is available :
– During the takeoff run and initial climb for FD bars guidance.
– Five seconds after lift-off for AP use.

SRS (SPEED REFERENCE SYSTEM)

The SRS mode controls pitch to steer the aircraft along a path in the vertical plane at a speed defined by the SRS guidance law.

– **Engagement conditions**

The SRS mode automatically engages, when the thrust levers are set to the TOGA or FLX/MCT detent, providing :

· V2 has been inserted in the MCDU PERF TO page.
· The slats are extended.
· The aircraft has been on the ground for at least 30 seconds.

– **Disengagement conditions**

The SRS mode disengages :

R · Automatically, at the acceleration altitude (ACC ALT), or if ALT* or ALT CST* mode
R engages (above 400 feet RA).
R · If the crew engages another vertical mode.
R · If the crew selects a speed while in SRS mode : SRS reverts to OP CLB mode, and a
R triple-click aural warning is heard.

R *Note : In Engine Out conditions, the SRS mode does not automatically disengage at EO*
R *ACC ALT. Refer to Engine Out procedures.*

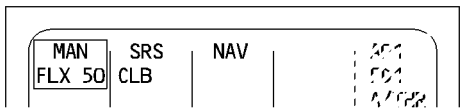
– **Guidance**

In SRS mode, the aircraft maintains a speed target equal to V2 + 10 knots in normal engine configuration. When the FMGS detects an engine failure, the speed target becomes the highest of V2 or current speed, limited by V2 + 15 knots.

The SRS guidance law also includes :

· Attitude protection to reduce aircraft nose-up during takeoff (18° maximum or 22.5° maximum in case of windshear).
· Flight path angle protection that ensures a minimum vertical speed of 120 feet/minute.
· A speed protection limiting the target speed to V2+ 15 knots.

Note : If during takeoff the pilot inadvertently sets an altitude on the FCU below the current altitude, the aircraft will remain in SRS mode until the pilot takes some other action.



Typical FMA at takeoff with a Flex temperature

NFS-01-2250-047-A320A

RUNWAY (RWY)

The RUNWAY mode has two submodes :

· RWY mode, which gives lateral guidance orders during takeoff roll and initial climb out (up to 30 feet RA) if a LOC signal is available

· RWY TRK mode, which gives lateral guidance on the track the aircraft was flying at mode
R engagement (at 30 feet RA)

– **Engagement conditions**

The RWY engagement conditions are :

– The conditions required for SRS mode engagement :
  · V2 is inserted in the MCDU PERF TO page
  · slats are extended.
  · the aircraft has been on ground for at least 30 seconds.
– The aircraft is receiving a LOC signal and LOC deviation is less than 1/2 dot.
– The aircraft heading is within 20° of the ILS related course.
– The ILS course is identical to the runway heading of the origin airport as selected for the active flight plan, if any.

The RWY TRK mode engages automatically at 30 feet (RA) if NAV mode does not engage (NAV not armed prior to takeoff).

– **Disengagement conditions**

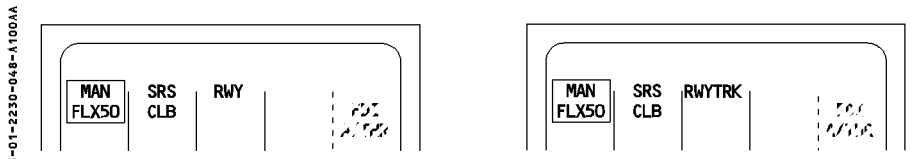
RWY mode disengages if :

– The LOC signal is lost below 30 feet RA or the aircraft heading and the runway heading differ by more than 20°.
– Another lateral mode is engaged.

Note : If the takeoff runway has no ILS, RWY mode is not available and the PFD does not display the yaw bar nor RWY on FMA.

– **Guidance**

– The RWY mode uses the LOC signal to guide the aircraft on the runway centerline while the aircraft is on the ground.
  The PFD displays the FD yaw bar.
  The FMA displays RWY.
– The RWY TRK mode guides the aircraft on the track the aircraft was flying at mode engagement.
  The FD displays the conventional guidance bar.
  The FMA displays "RWY TRK".



Typical FMA with RWY mode engaged.

APPROACH

The aircraft can fly two different types of approaches :
- ILS (or LOC) approaches
- Non-ILS approaches (VOR/DME, VOR, NDB, RNAV)

The pilot uses an ARRIVAL lateral revison to insert these approaches into the flight plan.

R The APPR pushbutton on the FCU is used to arm the guidance modes related to the approach inserted into the flight plan.
- For an ILS approach, the guidance modes are LOC and G/S.
- For a non-ILS approach, the guidance modes are FINAL and APP NAV.

ILS APPROACH

The ILS approach mode includes the following modes :

VERTICAL MODE	LATERAL MODE
G/S* (capture) G/S (track)	LOC* (capture) LOC (track)
COMMON MODES LAND - FLARE - ROLL OUT	

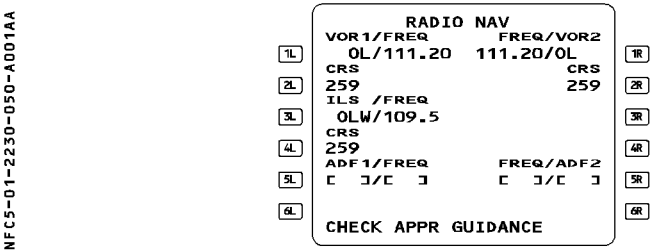
The sequencing of these modes is automatic once the pilot has pushed the APPR pushbutton and the conditions for engagement are met.

Selection

The ILS approach is selected when the approach pushbutton of the FCU is pressed and
- an ILS approach or a runway only or no approach is inserted in the Flight Management flight plan (arrival page), and an ILS frequency is set in on the MCDU, or
- both radio management panels are set to NAV and each has the ILS frequency and course set in.

Check approach guidance message

If the pilot inserts a non-ILS approach into the flight plan, and then uses the RAD NAV page to tune an ILS manually, the MCDU displays "CHECK APPR GUIDANCE". This message is a reminder that the available APPR guidance modes are APP NAV and FINAL.



Example : OLW was manually entered on the RAD NAV page although a VOR approach is selected in the flight path.

R **(ILS) APPR MODE**

Arming conditions

The pilot arms the (ILS) APPR mode (LOC and G/S in blue on the FMA) by pushing the APPR pushbutton on the FCU, provided that :

- An ILS approach is selected,
- The aircraft is above 400 feet RA,
- The ILS and RA are available,
- Go-around or takeoff or final mode is not engaged,
- ILS frequency and course are identically set on both receivers.

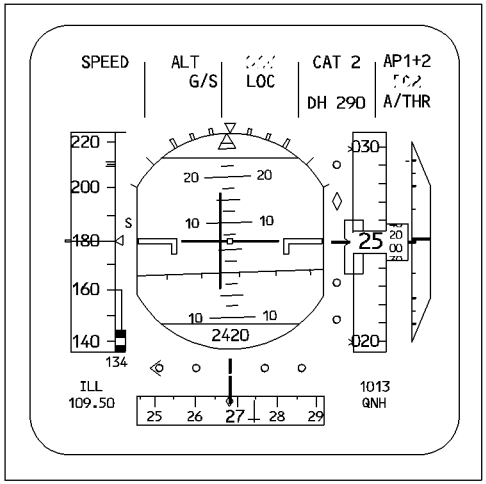
– LOC and G/S blue are displayed on the FMA. Both modes will automatically engage when conditions are met.
– Second autopilot may be engaged.
– Current landing capability is displayed on the FMA.

Disarming conditions

ILS APPR mode is disarmed, if the aircraft is above 400 feet and :

– When the pilot presses the APPR pushbutton, both the LOC and the G/S modes disarm.
  - The HDG/TRK mode engages, if the LOC mode was engaged, and the V/S FPA mode engages if the G/S mode was engaged.
– When the pilot presses the LOC pushbutton, only the G/S mode disarms.
  - The V/S (FPA) mode engages, if the G/S mode was engaged.

R – When the pilot pulls the HDG/TRK selector knob.
R – When the pilot engages the go-around mode.



LOC AND G/S ARMED

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Engagement conditions of LOC and G/S modes

When ILS capture conditions are fulfilled :

– LOC* mode engages, and
– G/S* mode engages. No radio altimeter validity is required with this FMGC standard for G/S engagement. The FMA displays "LOC*", or "G/S*", or both, in green.

Nevertheless, G/S* mode cannot engage if :

– LOC* mode is not engaged, or
– The aircraft is above the glide path and its trajectory does not cross the ILS G/S beam.

Once the aircraft is established on the LOC axis, the LOC mode engages.
When the aircraft is established on the G/S axis, the G/S mode engages.
The FMA displays "LOC" and "G/S" in green. The AP/FD guides the aircraft along the G/S down to 30 feet, and along the LOC during the flare and the roll out.

Disengagement conditions of LOC and G/S modes

If the aircraft is above 400 feet, the (ILS) APPR mode disengages when the pilot :

– Presses the APPR pushbutton, HDG V/S or TRK FPA engages.
– Presses the LOC pushbutton, the LOC mode remains engaged. The system reverts to V/S
R (FPA), if G/S was engaged.
– Pulls out the HDG/TRK selector knob, HDG V/S or TRK FPA engages.
– Engages the go-around mode.
– When the LOC or G/S signal has been lost for 7 seconds or more above 200 feet RA. AP/FDs disengage and FDs reengage in basic modes (HDG V/S or TRK FPA).

R *Note : G/S* or G/S modes may be engaged above the operating range of the radio altimeters (8000 feet for TRT, and 5000 feet for Collins and Honeywell RA). The landing capability displayed on the FMA will reflect the lack of RA validity (CAT 1) until the radio altimeters become active.*
But, if the radio altimeters fail, or if the FMGS receives no radio altimeter data, LOC, G/S, and AP/FDs will disengage and FDs will re-engage on basic modes.

Disengagement conditions of G/S only

- The pilot pulls out the V/S FPA selector knob. LOC mode remains engaged, but G/S mode disengages and V/S or FPA engages.
- When the pilot pushes or pulls the ALT selector knob. LOC mode remains engaged, and the mode selected by the crew engages, as a function of the FCU-selected altitude.

LOC capture assistance function

In NAV mode, and when within 20 NM of the destination runway, the aircraft is guided with a track angle of 20° from the LOC axis. This helps the aircraft intercept and capture the LOC beam. When the ILS frequency or the ILS ident entered on the RAD NAV page differs from the ILS of the destination runway entered in the Flight Plan :

- The aircraft loses the LOC capture assistance function ;
- The "RWY/ILS MISMATCH" message is displayed on the scratchpad ;
- The pilot should select HDG mode to perform the LOC capture.

Note : There is no glideslope capture assistance. The pilot shall ensure that the aircraft flight path intercepts the G/S beam.

LAND MODE

Engagement conditions

LAND mode automatically engages when the LOC and G/S modes are engaged, and the aircraft is below 400 feet RA. The FMA displays "LAND", indicating that LOC and G/S are locked. No action on the FCU will disengage LAND mode. FLARE and ROLL OUT modes will successively engage.

Disengagement conditions

LAND mode disengages :

- Upon engagement of the go-around mode ;
- If the pilot presses the APPR pushbutton, when the aircraft has been on the ground for at least 10 seconds with the autopilot disconnected.
- When both AP/FDs are disengaged.

Note : When LAND is not displayed on the FMA, at/or slightly below 400 feet, the landing capability degrades to CAT1 and the triple click is generated. No autoland is authorized with CAT1 displayed on the FMA.

FLARE MODE

Once the aircraft reaches approximately 40 feet RA (the precise value is a function of V/S):
- The FLARE mode engages.
- The FMA displays "FLARE" in green.

R At 30 feet RA, the AP/FD aligns the yaw axis with the runway centerline and the aircraft
R flares on the pitch axis. If the autothrust is active, thrust is automatically reduced to IDLE
R (refer to A/THR RETARD mode).
R When both AP/FDs are disengaged, FLARE mode disengages.
R After main landing gear touchdown, the autopilot (if engaged) sends a nose down order.

R **Align sub-mode**
R Align is a sub-mode of LAND that lines up the aircraft's axis with the ILS course. It is not
R displayed to the crew.

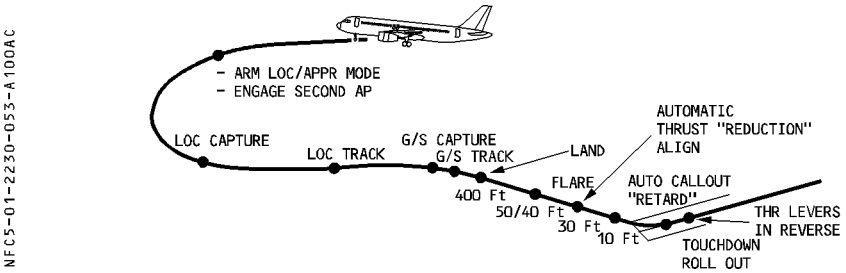
R ROLL OUT MODE

R At touchdown, the ROLL OUT mode engages and guides the aircraft along the runway
R centerline. The FMA displays "ROLL OUT" in green, and the PFD displays the yaw bar and
R no FD bars.

SPEED CONTROL

R The autothrust, when active, controls speed. The approach speed target (VAPP) is either
R managed by the FMGS or selected by the crew :
R · When managed, the speed target is computed by the FMGS and may be modified by the
R crew through the MCDU. At 700 feet RA, the current speed target value is memorized by
R the autothrust, to ensure stabilized speed guidance, even if Flight Management fails.
R Below 700 feet, any new VAPP or WIND entry in the MCDU has no effect on the speed
R target.
R · When selected, the autothrust always targets the speed selected on the FCU.

TYPICAL ILS APPROACH



AUTOLAND WARNING LIGHT

The following situations, when occurring below 200 feet RA, with the aircraft in LAND mode, trigger the flashing AUTOLAND red warning and a triple click aural warning :

- Both APs OFF below 200 feet RA ;
- Excessive deviation in LOC (1/4 dot above 15 feet RA) or GLIDE (1 dot above 100 feet RA) In addition, LOC and GLIDE scales flash on the PFD.
- Loss of LOC signal above 15 feet, or loss of GLIDE signal above 100 feet.
  The FD bars flash on the PFD. The LAND mode remains engaged.
- The difference between both radio altimeter indications is greater than 15 feet.

LANDING CAPABILITIES

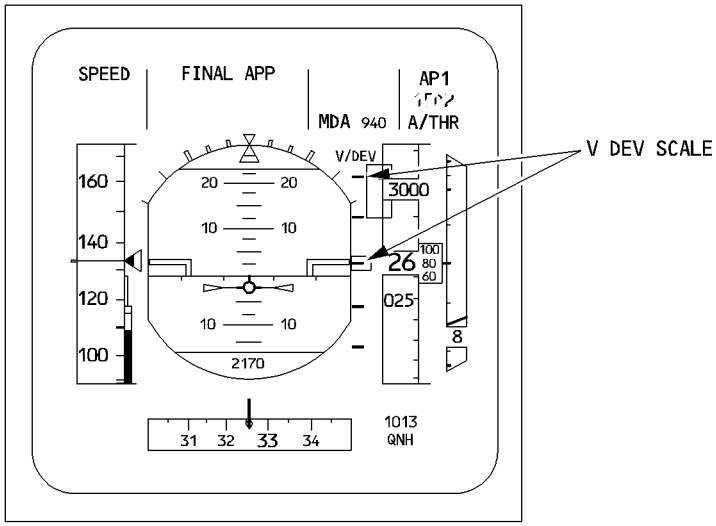
Each FMGC computes its own automatic landing capability.
The FMA displays “CAT1”, “CAT 2”, “CAT 3 SINGLE” or “CAT 3 DUAL” messages as soon as the APPR pushbutton is pushed in to arm ILS approach modes (Refer to 4.05.70).

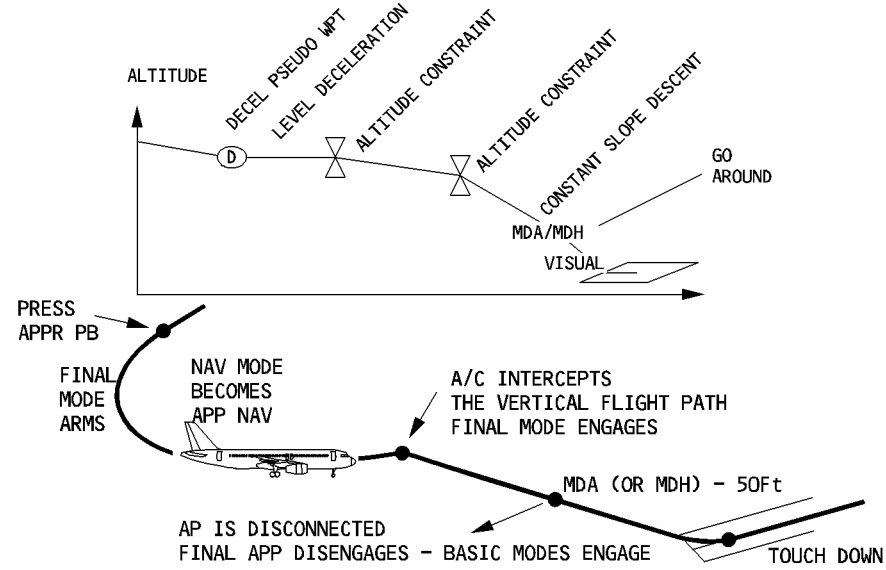
NON PRECISION APPROACH MODE

This mode guides the aircraft laterally and vertically down to the Minimum Descent Altitude (MDA) or Minimum Descent Height (MDH) along the final descent profile computed by the FMGS.

This mode is used to fly a NON ILS approach (VOR, VOR/DME, NDB, RNAV..). as inserted into the flight plan.

R





The NON ILS approach includes the following managed modes :
APP NAV mode for lateral guidance
FINAL mode for vertical guidance

SELECTION

A NON ILS approach (VOR, VOR/DME, NDB, RNAV) is selected, if the active flight plan calls for it (and it has been inserted in that flight plan).

ARMING CONDITIONS

The pilot arms the APP NAV and FINAL modes by pressing the APPR pushbutton on the FCU, if all of the following conditions are met :
– The aircraft is above 400 feet AGL.
– The flight plan is valid (lateral and vertical profile).
– The active flight plan has selected a NON ILS approach.
– GA mode is not engaged.
The FMA displays "FINAL" and "APP NAV" in blue.
If NAV mode was already engaged, APP NAV engages immediately.

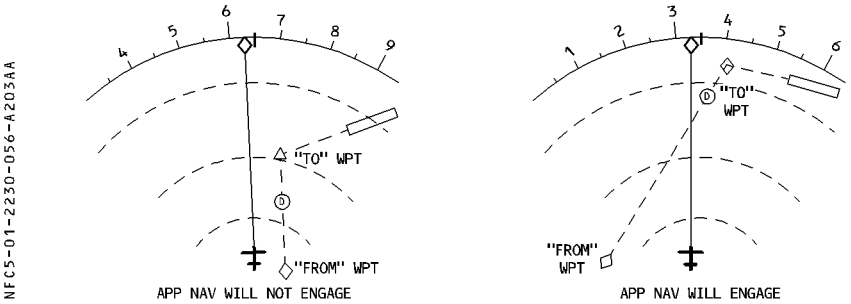
DISARMING CONDITIONS

FINAL and NAV modes are disarmed if the pilot :
– Presses the APPR pushbutton, or
– Presses the LOC pushbutton arming the LOC mode, or
– Engages the GO AROUND mode.

ENGAGEMENT CONDITIONS

APP NAV and NAV modes engage under the same conditions :
If NAV mode was engaged, APP NAV engages immediately. If HDG/TRK is engaged, APP NAV engages when the intercept conditions are met (aircraft track line must intercept the flight plan active leg).
FINAL mode engages, if :
– APPR phase is active, and the deceleration point has sequenced, and
– APP NAV is engaged, and
– Crosstrack error is less than 1.5 NM, and
– FINAL is armed, and
R – The aircraft intercepts a descending leg of the vertical flight path, or
R – In V/S (FPA) or OPEN DES, the aircraft intercepts a level-off segment of the vertical
R flight profile, with an FCU-selected altitude different from this level-off segment.

The "TO" waypoint is displayed in white on the ND and MCDU.



DISENGAGEMENT CONDITIONS

The FINAL and APP NAV modes disengage :
- If the pilot presses the APPR pushbutton (HDG V/S or TRK FPA mode engages)
- If the pilot presses the LOC pushbutton (LOC mode arms, if an ILS is selected and HDG V/S or TRK FPA mode engages).
- If the pilot pulls out the HDG TRK selector knob, the FMGS reverts to basic modes HDG V/S or TRK FPA.
- Automatically, at MDA (or MDH) – 50 feet or 400 feet AGL, if no MDA/MDH entered.
- When the GO AROUND mode engages.

Note : If the pilot engages V/S or FPA mode, only FINAL mode disengages. NAV mode remains engaged.

GUIDANCE

The FINAL mode guides the aircraft on the vertical profile down to the Minimum Descent Altitude (or the Minimum Descent Height, if the aircraft has the QFE pin program installed).
The FINAL mode :
- Displays a vertical deviation scale (± 200 feet) on the Primary Flight Display and a VDEV symbol showing deviation from descent path.
- Anticipates leaving the altitude selected by the Flight Control Unit, when the aircraft reaches the Continue Descent symbol (arrow blue on the navigation display)
- Gives precise vertical guidance on the descent and final path, with an internal vertical speed limitation to avoid excessive V/S.

If the autopilot is engaged while you are using the APP NAV/FINAL modes, it automatically disengages at MDA (or MDH) – 50 feet.
FD modes revert to basic HDG-V/S or TRK-FPA.

WARNING

If, during a non ILS approach, the GPS PRIMARY function is lost, a triple click aural warning is triggered.

GO AROUND (GA)

Go-around mode combines the speed reference system (SRS) vertical mode with the GA TRK lateral mode.

ENGAGEMENT CONDITIONS

Setting at least one thrust lever to the TOGA detent engages both SRS/GA TRK modes, if :

- The flaps lever is at least in position 1, and
- The aircraft is in flight, or
- The aircraft has been on the ground for less than 30 seconds (AP disengages and can be re-engaged five seconds after lift-off).
- FD bars are automatically restored in SRS/GA TRK modes.
  If FPV/FPD was previously selected, it reverts to FD bars.
  The FMA displays “SRS” and “GA TRK” in green.

DISENGAGEMENT CONDITIONS

- The SRS mode disengages :
  - Automatically, at the Go-around acceleration altitude (GA ACC ALT), or if ALT* mode engages (above 400 feet RA).
  - If the crew engages another vertical mode.
  - If the crew selects a speed while in SRS mode : SRS reverts to OP CLB mode and a triple-click aural warning is heard.

  Note : In Engine Out conditions, the SRS mode does not automatically disengage at EO ACC ALT. Refer to Engine Out procedures.

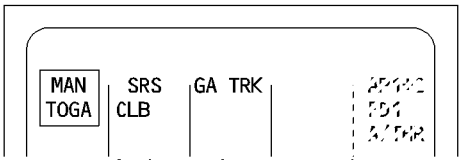
- GA TRK disengages, when the pilot engages another lateral mode above 100 feet RA.

Note : In dual AP configuration, disengagement of the Go-around mode on either axis causes AP2 to disconnect.

GUIDANCE

- The SRS law maintains the current speed at Go-around engagement or VAPP, whichever is higher. Nevertheless, the SRS speed target is limited to VLS + 25 knots in both engine configurations, and VLS + 15 knots in engine-out. When SRS mode disengages, the target speed becomes Green Dot speed.
- GA TRK mode guides the aircraft along the current track at Go-around initiation.

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Typical FMA in Go Around

AUTOTHRUST

GENERAL

The autothrust (A/THR) is a function of the FMGS, it includes 2 independent A/THR commands, one per FMGC. Each one is able to control the thrust of both engines simultaneously through 2 engine interface units and 2 electronic engine controls (IAE engines) or 2 engine control units (CFM engines). Only one FMGC controls the active A/THR, it is called the master FMGC.

Thrust is controlled :

- automatically when the A/THR is active
- manually by the pilot.

The autothrust is active when the A/THR pushbutton of the FCU is lighted green and A/THR is displayed white in the FMA 5th column.

The position of the thrust levers determines whether A/THR is armed, active, or disconnected.

The autothrust system, when active :

- maintains a specific thrust in THRUST mode
- controls the aircraft speed or MACH in SPEED/MACH mode
- uses ALPHA FLOOR mode to set maximum thrust when the aircraft angle of attack exceeds a specific threshold.

The autothrust system can operate independently or with the AP/FD.

- When performing alone, A/THR always controls the speed.
- If the autothrust system is working with the AP/FD, the A/THR mode and AP/FD pitch modes are linked together. (Refer to 1.22.30 Interaction between AP/FD and A/THR modes).

R When autothrust is active, the FMGS commands the thrust according to the vertical
R mode logic, but uses a thrust not greater than the thrust commanded by the position of the thrust lever. For example, when the thrust levers are set at the CL (climb) detent, FG can command thrust between idle and max climb.

The autothrust system, when armed, automatically activates if the thrust levers are moved into the active range sector. Outside of this range, thrust levers control thrust directly.

DISENGAGEMENT CONDITIONS

– The SRS mode disengages :

R – Automatically, if ALT* mode engages (above 400 feet RA).
– If the crew engages another vertical mode.
– If the crew selects a speed while in SRS mode : SRS reverts to OP CLB mode and a triple-click aural warning is heard.

Note : The SRS mode does not automatically disengage when climbing through the GA ACC ALT. The pilot has to manually engage OP CLB mode to increase the speed target to Green Dot speed.

Note : In Engine Out conditions, the SRS mode does not automatically disengage at EO ACC ALT. Refer to Engine Out procedures.

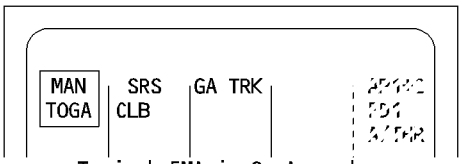
– GA TRK disengages, when the pilot engages another lateral mode above 100 feet RA.

Note : In dual AP configuration, disengagement of the Go-around mode, on either axis, causes AP2 to disconnect.

GUIDANCE

– The SRS law maintains the current speed at Go-around engagement, or VAPP, whichever is higher. Nevertheless, the SRS speed target is limited to VLS + 25 knots, in a two-engine configuration, and VLS + 15 knots, in an engine-out configuration. When the SRS mode disengages, the target speed becomes Green Dot speed.
– GA TRK mode guides the aircraft along the current track at Go-around initiation.

NFC5-01-2230-057-A350AA



Typical FMA in Go Around

AUTOTHRUST

GENERAL

The autothrust (A/THR) is a function of the FMGS, it includes 2 independent A/THR commands, one per FMGC. Each one is able to control the thrust of both engines simultaneously through 2 engine interface units and 2 electronic engine controls (IAE engines) or 2 engine control units (CFM engines). Only one FMGC controls the active A/THR, it is called the master FMGC.

Thrust is controlled :

- automatically when the A/THR is active
- manually by the pilot.

The autothrust is active when the A/THR pushbutton of the FCU is lighted green and A/THR is displayed white in the FMA 5th column.

The position of the thrust levers determines whether A/THR is armed, active, or disconnected.

The autothrust system, when active :

- maintains a specific thrust in THRUST mode
- controls the aircraft speed or MACH in SPEED/MACH mode
- uses ALPHA FLOOR mode to set maximum thrust when the aircraft angle of attack exceeds a specific threshold.

The autothrust system can operate independently or with the AP/FD.

- When performing alone, A/THR always controls the speed.
- If the autothrust system is working with the AP/FD, the A/THR mode and AP/FD pitch modes are linked together. (Refer to 1.22.30 Interaction between AP/FD and A/THR modes).

R When autothrust is active, the FMGS commands the thrust according to the vertical
R mode logic, but uses a thrust not greater than the thrust commanded by the position of the thrust lever. For example, when the thrust levers are set at the CL (climb) detent, FG can command thrust between idle and max climb.

The autothrust system, when armed, automatically activates if the thrust levers are moved into the active range sector. Outside of this range, thrust levers control thrust directly.

THRUST LEVERS

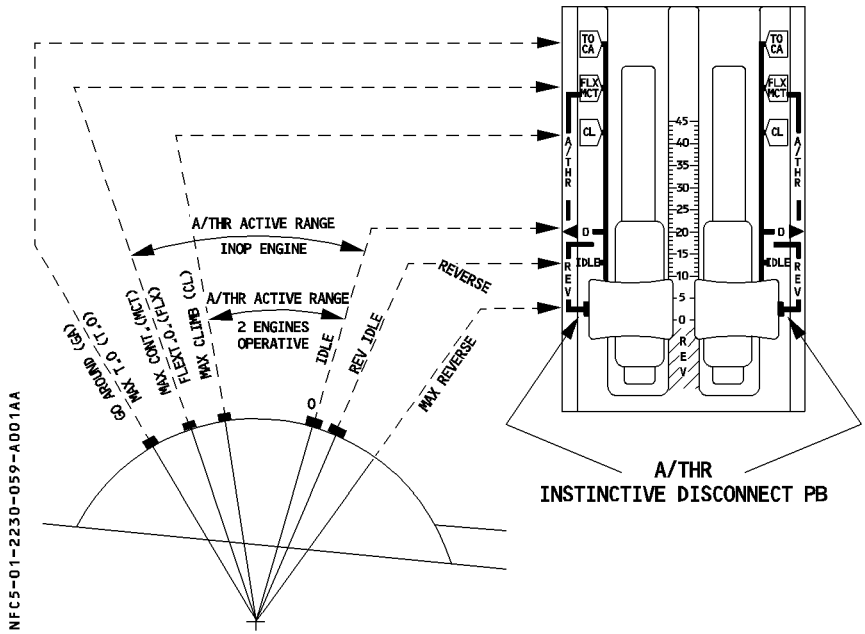
The pilot uses the thrust levers to do the following :
– Manually select engine thrust.
– Arm and activate autothrust (A/THR).
– Engage reverse thrust.
– Engage the takeoff and go around modes.

When autothrust is disconnected, the thrust levers control thrust directly : each lever position corresponds to a given thrust.

Five detents divide each of the thrust lever sectors into four segments. The detents are :

TO GA : Max takeoff thrust
FLX MCT : Max continuous thrust (or FLX at takeoff)
CL : Maximum climb thrust
IDLE : Idle thrust for both forward and reverse thrust
MAX REV : Maximum reverse thrust

When the thrust levers are at the IDLE position, the pilot can pull them up to clear the IDLE stop and select reverse thrust. (There is no reverse detent as such).



A/THR ARMING CONDITIONS

Arming conditions of the A/THR are numerous. The following is a list of the most important ones :

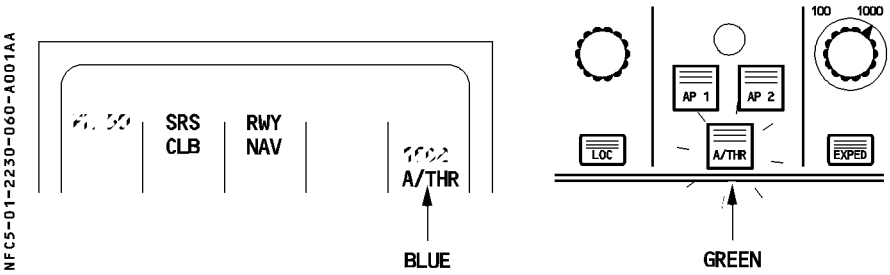
- One FMGC operative
- One FAC operative
- 2 ADIRS operative
- 2 FADECs operative
- One channel of the FCU operative
- One LGCIU operative
- A/THR is not manually disabled (instinctive disconnect pushbutton has not been pressed for more than 15 seconds).

The flight crew arms A/THR :

- On the ground
  - By pushing the A/THR pushbutton on the FCU when the engines are not running, or
  - By setting the thrust levers at the FLX or TOGA detent when the engines are running.
- In flight
  - By pushing the A/THR pushbutton on the FCU while the thrust levers are out of the active range, or
  - While A/THR is active ("A/THR" white on the FMA), by setting all thrust levers beyond the CL detent or at least one lever above the MCT detent, or
  - By engaging the go around mode.

When the A/THR is armed :

- The FCU's A/THR pushbutton light comes on
- "A/THR" is displayed in blue on the FMA.



R *Note : At takeoff, if the thrust levers are set back to idle, the A/THR disengages and cannot*
R *be rearmed until the aircraft becomes airborne.*

A/THR ACTIVATION

The A/THR is active when it controls thrust or speed. The position of the thrust lever determines the maximum thrust that the A/THR system can command (except in α-floor condition).

R The A/THR being armed, is activated :

- when the pilot sets both thrust levers between the CL and IDLE detents (two engines operative)

R - when the pilot sets one thrust lever between the MCT and IDLE detents (one engine
R inoperative).

R The A/THR being disconnected, is activated when the pilot pushes the FCU pushbutton
R while the thrust levers are within the active range, including IDLE position.
R
R *Note : When the pilot sets both thrust levers to IDLE position, the A/THR disconnects but,*
R *if the pilot pushes the A/THR pushbutton of the FCU, he will simultaneously arm and*
R *activate the autothrust. Due to the thrust levers position, IDLE thrust will be*
R *maintained.*

- when ALPHA FLOOR is activated, regardless of the initial status of A/THR and the position of the thrust levers.

When A/THR is active :

- The A/THR pushbutton on the FCU lights up.

R - The FMA displays A/THR mode in green in the first column and A/THR in white in the
R fifth column.

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EFFECTS OF THRUST LEVER MOVEMENT WHILE A/THR IS ACTIVE

- When both thrust levers are set above the CL detent (both engines operative) or one thrust lever is set above MCT (one engine operative) the A/THR reverts from active to armed. "A/THR" turns to blue on the FMA and the thrust levers control the thrust directly. The FMA displays "MAN THR" white in its first column.
  The thrust levers provide the crew with an immediate increase of thrust when both thrust levers are pushed above the CL detent (2 engines) or the active thrust lever above the MCT detent (one engine operative).
- When both thrust levers are set below the CL detent (both engines operative) or one thrust lever is set below MCT (one engine operative), a repeating warning (amber caution, single chime, ECAM message "A/THR LIMITED") is activated every 5 seconds until the pilot moves the lever back into the detent. "THR LVR" green is displayed on the FMA
  "LVR CLB" (both engines operative) or "LVR MCT" (one engine operative) flashes white in the first column of the FMA.
  This device reminds the crew that the normal operating position of the thrust levers, when A/THR is active, is the CL detent (2 engines) or the MCT detent (one engine operative).
- When one thrust lever is in the CL detent and the other one out of the detent, the "LVR ASYM" amber message comes up until both levers are set in the CL detent (only with both engines operative).

A/THR DISCONNECT

When the A/THR is disconnected, it is neither armed nor active.
The A/THR can be disconnected in two ways :

* Standard disconnection
  - The pilot pushes the instinctive disconnect pushbutton on the thrust levers (which immediately sets the thrust corresponding to the lever positions) or
  - The pilot sets both thrust levers to IDLE detent.
* Non-standard disconnection
  - The pilot pushes the A/THR pushbutton on the FCU while A/THR is armed/active, or
  - The system loses one of the arming conditions.

R **Below 100 feet radio altitude**

R When the radio altitude is below 100 feet and the pilot sets both thrust levers above the R CL detent or one above the MCT detent, the autothrust will disconnect. It will rearm R automatically when at least one of the thrust levers is set to TOGA.
R If the PF sets the thrust levers slightly above CL detent but below TOGA and come back R to CL detent, the A/THR will disconnect and remain disconnected. As a result, the thrust R will increase up to CLIMB thrust. The crew has to manually set the appropriate thrust for R landing (or go around).

A/THR ACTIVATION

The A/THR is active when it controls thrust or speed. The position of the thrust lever determines the maximum thrust that the A/THR system can command (except in α-floor condition).

R The A/THR being armed, is activated :

- when the pilot sets both thrust levers between the CL and IDLE detents (two engines operative)

R - when the pilot sets one thrust lever between the MCT and IDLE detents (one engine
R inoperative).

R The A/THR being disconnected, is activated when the pilot pushes the FCU pushbutton
R while the thrust levers are within the active range, including IDLE position.

R

R *Note : When the pilot sets both thrust levers to IDLE position, the A/THR disconnects but,*
R *if the pilot pushes the A/THR pushbutton of the FCU, he will simultaneously arm and*
R *activate the autothrust. Due to the thrust levers position, IDLE thrust will be*
R *maintained.*

- when ALPHA FLOOR is activated, regardless of the initial status of A/THR and the position of the thrust levers.

When A/THR is active :

- The A/THR pushbutton on the FCU lights up.

R - The FMA displays A/THR mode in green in the first column and A/THR in white in the
R fifth column.

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EFFECTS OF THRUST LEVER MOVEMENT WHILE A/THR IS ACTIVE

– When both thrust levers are set above the CL detent (both engines operative), or one thrust lever is set above MCT (one engine operative), the A/THR reverts from active to armed. "A/THR" turns to blue on the FMA and the thrust levers control the thrust directly. The FMA displays "MAN THR" in white in its first column.
The thrust levers provide the crew with an immediate increase of thrust when both thrust levers are pushed above the CL detent (2 engines), or the active thrust lever above the MCT detent (one engine operative).
– When both thrust levers are set below the CL detent (both engines operative), or one thrust lever is set below MCT (one engine operative), a repeating warning (amber caution, single chime, ECAM message "A/THR LIMITED") is activated every 5 seconds until the pilot moves the lever back into the detent. "THR LVR" green is displayed on the FMA.
"LVR CLB" (both engines operative), or "LVR MCT" (one engine operative), flashes white in the first column of the FMA.
This device reminds the crew that the normal operating position of the thrust levers, when A/THR is active, is either the CL detent (2 engines) or the MCT detent (one engine operative).
– When one thrust lever is in the CL detent and the other one out of the detent, the "LVR ASYM" amber message comes up until both levers are set in the CL detent (only with both engines operative).

A/THR DISCONNECT

When the A/THR is disconnected, it is neither armed nor active.
The A/THR can be disconnected in two ways :
– Standard disconnection :
  · The pilot pushes the instinctive disconnect pushbutton on the thrust levers (which immediately sets the thrust corresponding to the lever positions), or
  · The pilot sets both thrust levers to IDLE detent.
– Non-standard disconnection :
  · The pilot pushes the A/THR pushbutton on the FCU, while A/THR is armed/active, or
  · The system loses one of the arming conditions.

CAUTION

If the pilot pushes and holds one instinctive disconnect pushbutton for more than 15 seconds, the A/THR system is disconnected for the remainder of the flight. All A/THR functions including ALPHA FLOOR are lost, and they can be recovered only at the next FMGC power-up (on ground).

THRUST LOCK FUNCTION

The THRUST LOCK function is activated when the thrust levers are in the CL detent (or the MCT detent with one engine out) and the pilot pushes the A/THR pushbutton on the FCU or the A/THR disconnects due to a failure.

– "THR LK" flashes amber on the FMA.
– ECAM "ENG THRUST LOCKED" flashes every five seconds.
– ECAM displays "THR LEVERS..... MOVE"
– A single chime sounds and the Master Caution Light flashes every five seconds.

The thrust is locked at its level prior to disconnection. Moving the thrust levers out of CL or MCT suppresses the thrust lock and gives the pilot manual control with the thrust levers. All warnings cease when the pilot moves the thrust levers out of the detent.

A/THR DISCONNECT CAUTION

		A/THR DISCONNECTION	
		BY INSTINCTIVE DISCONNECT OR SETTING TWO LEVERS TO IDLE (if above 50 ft RA)	**BY OTHER MEANS**
CONSEQUENCE	MASTER CAUTION	illuminated-3 sec max	illuminated
	ECAM MESSAGE	amber A/THR OFF message 9 sec maximum	Flashing "ENG THRUST LOCKED" (amber AUTO FLT A/THR OFF THR LEVERS..... MOVE (blue)
	AUDIO	single chime	single chime
	CLR pushbutton on ECAM CONTROL PANEL	extinguished	illuminated
ACTION	MASTER CAUTION pushbutton	extinguishes MASTER CAUTION light erases ECAM message	extinguishes MASTER CAUTION light
	CLR puhbutton on ECAM CONTROL PANEL	No effect	extinguishes MC light and CLR pushbutton, erases ECAM message calls status
	INSTINCTIVE DISCONNECT pushbutton	extinguishes MASTER CAUTION light erases ECAM message	extinguishes MASTER CAUTION light
ECAM STATUS MESSAGE		NO	YES

R – Standard disconnection triggers temporary ECAM message and caution light. Single
R chime sounds.
R – Non standard disconnection triggers caution light and ECAM message removed only by
R a pilot action. Single chime sounds.

A/THR MODES

Except in takeoff and go around situations, normal operation of the A/THR system requires the thrust levers to be :

– In the CL detent for the two-engine configuration. If they are not set in the CL detent, "LVR CLB" flashes white on the FMA.

– In MCT detent when in the one-engine-out configuration. If the appropriate lever is not set in the MCT detent, "LVR MCT" flashes white on the FMA.

The A/THR modes are selected automatically in conjunction with the AP/FD modes (except for ALPHA FLOOR).

A/THR in THRUST mode	AP/FD pitch mode maintains the speed : OP CLB - OP DES - CLB - EXP CLB◁ - EXP DES◁ - SRS - FLARE and DES (IDLE path)
A/THR in SPEED/MACH mode	If neither AP nor FD is engaged
	If AP/FD controls a vertical path V/S-FPA-ALT*- ALT CST*-ALT-ALT CRZ-G/S* -G/S-FINAL and DES (geometric path)
A/THR in RETARD mode	Automatic landing (AP engaged in LAND mode).

THRUST mode

– In THRUST mode, autothrust commands a specific thrust level in conjunction with the AP/FD pitch mode. This thrust level is limited by thrust lever position.

FMA display	Meaning
THR MCT	Single engine thrust in climb. The live engine is at maximum continuous thrust (thrust lever in MCT detent)
THR CLB	Climb thrust two engine configuration (at least one thrust lever in the CL detent, the other one below CL)
THR LVR	Undetermined thrust (neither CLB or MCT thrust)
THR IDLE	Minimum thrust (both engines at IDLE thrust)

Note : When the A/THR is armed for takeoff or go around, the FMA displays "MAN TOGA" (or "MAN FLX") in white to remind the crew that the thrust levers have been positioned properly.

RETARD MODE

The RETARD mode is only available during automatic landing (AP engaged in LAND mode). At approximately 40 feet RA, the RETARD mode engages and remains engaged after touchdown. The A/THR commands IDLE thrust during the flare, and the FMA and engine warning display "IDLE". If the autopilot is disengaged during the flare before touchdown, the SPEED mode replaces the RETARD mode, and the pilot has to manually reduce thrust.

Note : In an automatic landing, the system generates a "RETARD" callout at 10 feet radioaltitude (RA), which prompts the pilot to move the thrust levers to IDLE in order to confirm thrust reduction. In manual landing conditions, the system generates this callout at 20 feet RA, as a reminder.

ALPHA FLOOR

ALPHA FLOOR is a protection that commands TOGA thrust, regardless of the thrust levers' positions. This protection is available from lift-off to 100 feet RA on approach.
ALPHA FLOOR calls up the following indications :
- "A FLOOR" in green, surrounded by a flashing amber box on the FMA, and in amber on the engine warning display, (as long as α-floor conditions are met).
- "TOGA LK" in green, surrounded by a flashing amber box on the FMA, when the aircraft leaves the α-floor conditions. TOGA thrust is frozen.

To cancel ALPHA FLOOR or TOGA LK thrust, the pilot must disconnect the autothrust.

SPEED/MACH mode

In SPEED/MACH mode, the A/THR adjusts the thrust in order to acquire and hold a speed or Mach target.
The speed or Mach target may be :
- Selected on the FCU by the pilot.
- Managed by the FMGC.

When in SPD/MACH mode, the A/THR does not allow speed excursions beyond the following limits, regardless of the target speed or Mach number :
- For a selected speed target, the limits are VLS and VMAX (VMO-MMO, VFE-VLE, whichever applies).
- For a managed speed target, the limits are maneuvering speed (Green Dot, S, F, whichever applies) and maximum speed (340/.80-VFE-VLE, whichever applies).

The changeover from SPEED to MACH mode is either automatic, performed by the FMGC, or manual, with the pilot pushing the SPD/MACH changeover pushbutton.
The FMA displays "SPEED" or "MACH".

Approach autothrust :

R Below 3200 feet radioaltitude, with at least CONF 1, the A/THR logic is modified to be more responsive to speed variation. This is referred to as approach autothrust.

SPEED MODE IN APPROACH PHASE

When the aircraft flies an approach in managed speed, the speed target displayed on the PFD in magenta, is variable during the approach.
This managed speed target is computed in the FMGS, using the "ground speed mini function".

GROUND SPEED MINI FUNCTION PRINCIPLE

The purpose of the ground speed mini function is to take advantage of the aircraft inertia, when the wind conditions vary during the approach. It does so by providing the crew with an adequate indicated speed target. When the aircraft flies this indicated speed target, the energy of the aircraft is maintained above a minimum level ensuring standard aerodynamic margins versus stall.
If the A/THR is active in SPEED mode, it will automatically follow the IAS target, ensuring an efficient thrust management during the approach.
The minimum energy level is the energy level the aircraft will have at touchdown, if it lands at VAPP speed with the tower reported wind as inserted in the PERF APPR page.
The minimum energy level is represented by the Ground Speed the aircraft will have at touchdown. This Ground Speed is called "GROUND SPD MINI".
During the approach, the FMGS continuously computes the speed target, using the wind experienced by the aircraft, in order to keep the ground speed at or above the "Ground Speed Mini".
The lowest speed target is limited to VAPP and its upper limit is VFE of next configuration in CONF 1, 2, 3 and VFE - 5 in CONF FULL.
The speed target is displayed on the PFD speed scale in magenta, when approach phase and managed speed are active. It is independent of the AP/FD and/or ATHR engagements.
Wind is a key factor in the ground speed mini function.

TWR WIND

It is the MAG WIND entered in the PERF approach page. It is the average wind, as provided by the ATIS or the tower. Gusts must not be inserted, they are included in the ground speed mini computation.

TWR HEADWIND COMPONENT

The TWR HEADWIND COMPONENT is the component of the MAG WIND projected on the runway axis (landing runway entered in the flight plan). It is used to compute VAPP and GS mini.

CURRENT HEADWIND COMPONENT

The actual wind measured by ADIRS is projected on the aircraft axis to define the CURRENT HEADWIND COMPONENT (instantaneous headwind). The CURRENT HEADWIND COMPONENT is used to compute the variable speed target during final (IAS target).

VAPP COMPUTATION

VAPP, automatically displayed on the MCDU PERF APPR page, is computed as follows :
VAPP = VLS + 1/3 of the TWR HEADWIND COMPONENT or
VAPP = VLS + 5 knots, which ever is highest.
"1/3 of the TWR HEADWIND COMPONENT" has 2 limits :
– 0 knots as the minimum value (no wind, or tailwind)
– + 15 knots as the maximum value.
The crew can manually modify the VAPP and TWR wind values on the PERF APPR page.

SPEED TARGET COMPUTATION

The FMGS continuously computes a speed target (IAS target), that is the MCDU VAPP value plus an additional variable gust.



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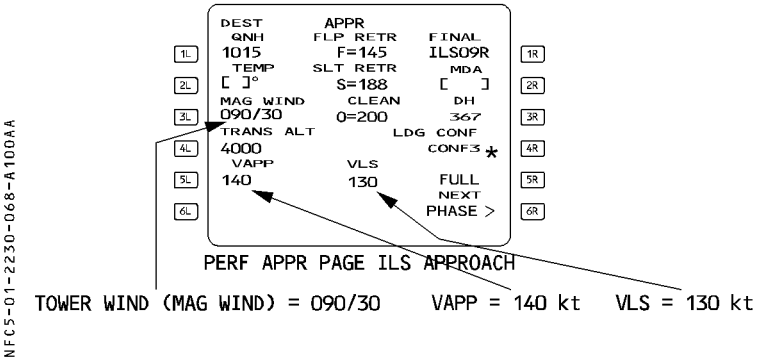
The gust is the instantaneous difference between the CURRENT HEADWIND COMPONENT and the TWR HEADWIND COMPONENT. It is always positive (or equal to zero for no wind or tailwind). The IAS target is displayed on the PFD as a magenta triangle moving with the gust variation. The IAS targets have 2 limits :
– VAPP as the minimum value
R – VFE – 5 kts in CONF FULL, or VFE of the next configuration in CONF 1, 2 or 3 as the maximum value.

GROUND SPEED MINI (GS mini) COMPUTATION

Ground speed mini concept has been defined to prevent the aircraft energy from dropping below a minimum level during final approach. The GS mini value is not displayed to the crew.

EXAMPLE

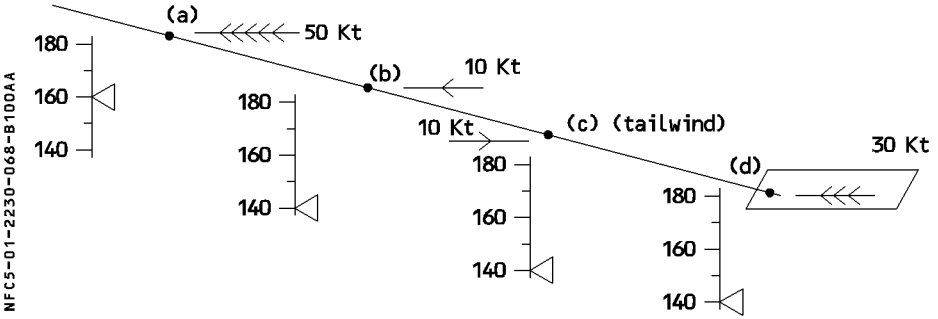
R Approach on runway 09
R The tower wind direction is on the runway axis.
R



R **IAS TARGET VALUES**

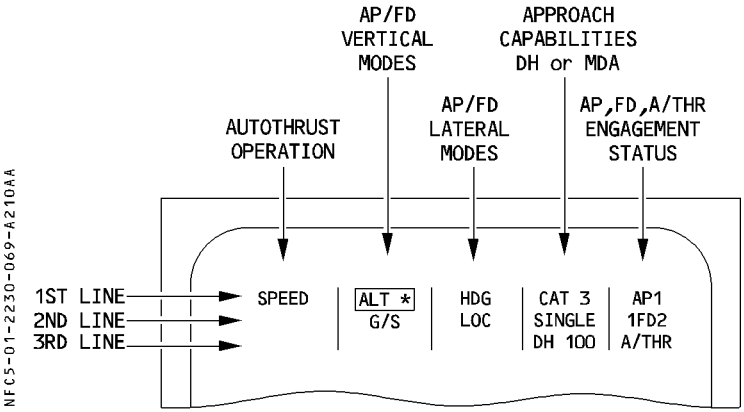
R If we turn the previously explained speed target definition into formulae, we obtain the
R following result :
IAS TARGET = Max [VAPP, (VAPP + CURRENT HEADWIND - TWR HEADWIND)]

Current wind in approach	IAS target
(a) 090/50	Max [VAPP, (140 + 50 - 30) = 160 kt
(b) 090/10	Max [VAPP, (140 + 10 - 30) = 140 kt
(c) 270/10	Max [VAPP, (140 + 0 - 30) = 140 kt
(d) 090/30	Max [VAPP, (140 + 30 - 30) = 140 kt



FLIGHT MODE ANNUNCIATOR (FMA)

The Flight Mode Annunciator (FMA), located on the top of the PFDs, reflects the status of the A/THR, the AP/FD vertical and lateral modes, the approach capabilities, and the AP/FD-A/THR engagement status.
A white box is displayed for 10 seconds around each new annunciation. The white box display time may be increased to 15 seconds in some mode reversion cases associated with an aural triple click.



In the three left columns :
The engaged modes are displayed in green on the first line.
The armed modes are displayed in blue, or in magenta, on the second line.
Modes, armed due to a constraint, are displayed in magenta.
Special messages, are displayed on the third line :
– First priority is given to messages related to flight controls :
  · MAN PITCH TRIM ONLY flashes red for 9 seconds, then remains steady.
  · USE MAN PITCH TRIM pulses amber for 9 seconds, then remains steady.
– Lower priority messages related to FMGS.

In the fourth column, approach capabilities are displayed in white.
DH or MDA/MDH is displayed in blue.

Note : The DH or MDA/MDH is rounded off to the nearest 10 feet.

In the right column, AP, FD, A/THR engagement status are displayed in white.
FD is boxed for 10 seconds, in case of automatic FMGC switching.
When armed, A/THR is displayed blue.

Note : The FMGS synchronizes A/THR mode, AP/FD modes, and landing capability to provide identical information on both PFDs.

AUTO THRUST ANNUNCIATIONS (FMA COLUMN 1)

First line

R

DISPLAY	COLOR	MEANING
MAN TOGA	White White box	A/THR is armed, at least one thrust lever is in TOGA detent.
MAN FLX XX	White White box blue numbers	A/THR is armed, at least one thrust lever is in MCT/FLX detent, with FLX TO temp set at XX°. The other thrust lever is at, or below, the MCT/FLX detent.
MAN MCT	White White box	A/THR is armed, at least one thrust lever is in the MCT/FLX detent, the other is at, or below, this detent.
MAN THR	White Amber box	A/THR is armed, and the most advanced thrust lever is above CL detent (2 engines operative, or one above MCT/FLX (engine-out) and not in a detent.
THR MCT	Green	A/THR is active in thrust mode and the most advanced thrust lever is in the MCT/FLX detent (engine-out).
THR CLB	Green	A/THR is active in thrust mode, and the most advanced thrust lever is in the CL detent.
THR IDLE	Green	A/THR is active in thrust mode and commands idle thrust.
THR LVR	Green	A/THR is active in thrust mode with both thrust levers below CL detent, or the live thrust lever (1 engine) below MCT.
SPEED or MACH	Green	A/THR is active in SPEED or MACH mode.
A. FLOOR	Green Amber box	A/THR is active and commands TOGA thrust, while α FLOOR conditions are met.
TOGA LK	Green Amber box	A/THR is active and TOGA thrust is locked (α FLOOR conditions are no longer met).

Third line

DISPLAY	COLOR	MEANING
LVR CLB (flashing)	White	Request to set the thrust levers in CL detent.
LVR MCT (flashing)	White	Request to set the live thrust lever in MCT/FLX detent.
LVR ASYM	Amber	(2 engines only). One thrust lever is in CL or MCT/FLX detent, and the other one is not in this detent.
THR LK (flashing)	Amber	After A/THR disconnection (pilot's action on FCU or failure) resulting in thrust being frozen. Both thrust levers being in CL detent, or one in MCT/FLX (engine-out) detent.

Note : The amber caution light flashes and a single chime sounds every five seconds, as long as the pilot takes no appropriate action in the following cases :

- *THR LK*
- *LVR CLB (if the thrust levers are below the CLB detent).*
- *LVR MCT (if the thrust levers are below the FLX/MCT detent).*

AP/FD VERTICAL MODES (FMA COLUMN 2)

First line

DISPLAY	COLOR	MEANING
SRS	Green	Takeoff or go-around mode is engaged.
CLB	Green	Climb mode is engaged. The FMGS target altitude is higher than the actual altitude. ALT CSTR are taken into account.
OP CLB	Green	Open Climb mode is engaged. The FCU-selected altitude is higher than the actual altitude. ALT CSTR are disregarded.
EXP CLB	Green	Expedite Climb is engaged. The selected altitude is higher than the actual altitude. Green dot is maintained, ALT CSTR are disregarded.
ALT* or ALT CST*	Green	ALT CAPTURE is engaged. – ALT* green, in case of FCU-selected altitude capture. – ALT CST* green, in case of ALT CSTR capture (vertical profile)
ALT or ALT CST	Green	ALTITUDE HOLD mode is engaged. – ALT is green, when the FCU-selected altitude is held. – ALT CST is green, when an ALT CSTR is held (vertical profile)
ALT CRZ	Green	ALT mode is engaged and CRZ FL is held.
DES	Green	Descent mode is engaged. The FMGS target altitude is lower than the actual altitude. ALT CSTR are taken into account.
OP DES	Green	Open Descent mode is engaged. The FCU-selected altitude is lower than the actual altitude. ALT CSTR are disregarded.
EXP DES	Green	Expedite descent is engaged, the selected altitude is lower than the actual altitude. Mach. 0.80 or 340 knots is maintained ALT CSTR are disregarded.
G/S*	Green	Glide Slope capture mode is engaged.
G/S	Green	Glide Slope mode is engaged.
V/S ± XXXX	Green + blue numbers	Vertical speed mode is engaged to acquire and hold the V/S selected on the FCU. ALT CSTR are disregarded. If the aircraft reaches VLS or VMAX and cannot maintain the target, the indication is boxed amber and flashes, and the target pulses.
FPA ± XX	Green + blue numbers	Flight Path Angle mode is engaged to acquire and hold the FPA selected on the FCU. ALT CSTR are disregarded. If the aircraft reaches VLS or VMAX and cannot maintain the target, the indication is boxed amber and flashes, and the target pulses.

AP/FD VERTICAL MODE (FMA COLUMN 2)

Second line

DISPLAY	COLOR	MEANING
CLB	Blue	Climb mode is armed.
ALT	Blue or Magenta	Altitude mode is armed. – blue when the target altitude is the FCU selected altitude – magenta when the target altitude is an ALT CSTR.
DES	Blue	Descent mode is armed before the descent phase.
G/S	Blue	Glide Slope mode is armed.
FINAL	Blue	Final descent mode is armed.
ALT G/S	Blue/Blue	ALT and G/S modes are armed.
ALT G/S	Magenta/ Blue	ALT CSTR and G/S modes are armed.
ALT FINAL	Blue/Blue	ALT and FINAL modes are armed.
ALT FINAL	Magenta/ Blue	ALT CSTR and FINAL modes are armed.
DES G/S	Blue/Blue	DES and G/S modes are armed.
DES FINAL	Blue/Blue	DES and FINAL modes are armed.

Third line

DISPLAY	COLOR	MEANING
SPEED SEL : XXX	Blue	Indicates a preset speed associated with the cruise or climb phase
MACH SEL : .XX	Blue	Indicates a preset Mach associated with the cruise or climb phase

Note : These two messages use both the first and second columns (third line).

AP/FD LATERAL MODES (FMA COLUMN 3)

First line

DISPLAY	COLOR	MEANING
RWY	Green	RWY mode is engaged.
RWY TRK	Green	RWY mode is engaged once airborne at or above 30 feet RA.
HDG	Green	HEADING mode is engaged.
TRACK	Green	TRACK mode is engaged.
NAV	Green	NAV mode is engaged to guide the aircraft along the FM lateral F-PLN.
LOC*	Green	LOC capture mode is engaged.
LOC	Green	LOC track mode is engaged.
APP NAV	Green	NAV mode is engaged during a NON ILS approach.
GA TRK	Green	GO AROUND track mode is engaged.

Second line

DISPLAY	COLOR	MEANING
NAV	Blue	NAV mode is armed.
LOC	Blue	LOC mode is armed.
APP NAV	Blue	NAV mode is armed for a NON ILS approach.

AP/FD COMMON MODES (FMA COLUMN 2 AND 3)

DISPLAY	COLOR	MEANING
LAND	Green	Land mode is engaged below 400 feet RA.
FLARE	Green	Flare mode is engaged.
ROLL OUT	Green	Roll out mode is engaged.
FINAL APP	Green	APP NAV and Final modes are engaged during a NON ILS approach.

APPROACH CAPABILITIES (FMA COLUMN 4)

First line

DISPLAY	COLOR	MEANING
CAT 1	White	CAT 1 capability available
CAT 2	White	CAT 2 capability available
CAT 3	White	CAT 3 capability available

Second line

DISPLAY	COLOR	MEANING
SINGLE	White	CAT 3 capability available, with FAIL PASSIVE condition.
DUAL	White	CAT 3 capability available, with FAIL OPERATIONAL condition.

Third line

DISPLAY	COLOR	MEANING
MDA/MDH XXXX	White Blue	Minimum descent altitude or minimum descent height as inserted by the pilot on PERF APPR page.
DH XXX NO DH	White/Blue White	Decision height as inserted by the pilot on PERF APPR page. NO DH : when NO inserted on PERF APPR page.

AP/FD - A/THR ENGAGEMENT STATUS (FMA COLUMN 5)

First line

DISPLAY	COLOR	MEANING
AP 1 + 2	White	Autopilot 1 and 2 are engaged.
AP 1	White	Autopilot 1 is engaged.
AP 2	White	Autopilot 2 is engaged.

Second line

DISPLAY	COLOR	MEANING
X FD Y	White	X and Y give the FD engagement status on PFD1 and PFD2. X and Y can be 1, 2, –. – : no FD is engaged on the corresponding PFD 1 : FD1 is engaged on the corresponding PFD 2 : FD2 is engaged on the corresponding PFD e.g. : the normal status (FD 1 and 2 engaged) is 1FD2.

Third line

DISPLAY	COLOR	MEANING
A/THR	White	A/THR is active.
A/THR	Blue	A/THR is armed.

SPECIAL MESSAGES (FMA COLUMNS 2 AND 3)

The third line displays three types of messages :
- It gives first priority to flight control messages ;
- It gives second priority to vertical Flight Management messages ;
- It gives last priority to EFIS reconfiguration messages.

DISPLAY	COLOR	MEANING
MAN PITCH TRIM ONLY	Red	Displayed in case of L + R elevator loss.
USE MAN PITCH TRIM	Amber	F/CTL are in direct law.
CHECK APP SEL	White	The aircraft is in cruise at less than 100 NM from the Top of Descent, or in descent, or in approach and : – A non ILS approach has been selected. – An ILS frequency is tuned on the RAD NAV page.
SET MANAGED SPD	White	The SPEED target is selected, but a preselected SPEED does not exist for the next flight phase.
SET GREEN DOT SPD	White	The aircraft is in Engine-Out mode, and the SPEED target is selected. This message is displayed, if the FCU-selected speed is : ≤ Green Dot –10 knots, or ≥ Green Dot + 10 knots except in ALT*, ALT mode
SET HOLD SPD	White	The aircraft is in selected SPEED control, a Holding pattern is inserted in the F-PLN, and the aircraft is 30 seconds before the deceleration point to the precomputed HOLD SPEED.
DECELERATE	White	This message is displayed, if the thrust is not reduced when passing the top of descent, and the aircraft is above the descent profile.
MORE DRAG	White	DES mode is engaged, idle is selected, and : – Either the aircraft is above the vertical profile and the predicted intercept point of the theoretical profile is at less than 2 NM from the next ALT CSTR, or – In auto speed control and the aircraft enters a speedbrake decelerating segment.

GENERAL

The aircraft has two flight augmentation computers (FACs) that perform four main functions:

- Yaw function
  - Yaw damping and turn coordination
  - Rudder trim
  - Rudder travel limitation
- Flight envelope function
  - PFD speed scale management
    - Minimum/maximum speed computation
    - Maneuvering speed computation
  - Alpha-floor protection
- Low-Energy Warning function ◁
- Windshear detection function ◁

In performing these functions the FAC uses independent channels :

Yaw damper
Rudder trim
Rudder travel limit
Flight envelope

Each FAC interfaces with the elevator aileron computers (ELACs) when the APs are disengaged, or with the FMGS when at least one AP is engaged.

Both FACs engage automatically at power-up.

The pilot can disengage or reset each FAC (in case of failure) by means of a pushbutton on the flight control overhead panel.

When a FAC is disengaged (FAC pushbutton set off) but still valid, the flight envelope function of the FAC remains active.

R If both FACs are valid, FAC1 controls the yaw damper, turn coordination, rudder trim, and rudder travel limit, and FAC2 is in standby.

FAC1 keeps the aircraft within the flight envelope through FD1 ; FAC2 performs this function through FD2.

If a failure is detected on any channel of FAC1, FAC2 takes over the corresponding channel.

YAW FUNCTIONS

YAW DAMPING

Yaw damping stabilizes the aircraft in yaw and coordinates its turns.

R In automatic flight (AP engaged) during takeoff and go around, it assists rudder application after an engine failure (short-term yaw compensation).

Note : When the AP is engaged, the FMGS sends orders to the FAC to give :
- *yaw damping during approach*
- *yaw control for runway alignment in ROLL OUT mode*

RUDDER TRIM

The rudder trim function :

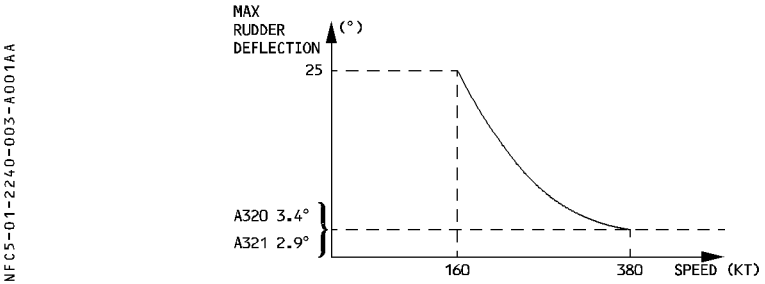
- Executes trim orders the pilot enters with the manual trim knob
- When AP is engaged
  - executes trim orders from the FMGS.
  - Assists the system in recovering from engine failure (long-term yaw compensation) in all flight guidance modes.
  - If the pilot pushes the rudder more than 10° out of trim, it disengages the AP.

Note : When the AP is engaged, the rudder trim knob is inoperative : the master FMGC sends rudder trim orders to the FAC.

RUDDER TRAVEL LIMITATION

This function limits rudder deflection as a function of speed in order to avoid high structural loads. It is governed by the following law :

R



If both FACs lose the rudder travel limitation function, the value of the rudder deflection limit is locked at the time of the second failure.
When the slats are extended, the FACs automatically set the rudder deflection limit at the low-speed setting (maximum authorized deflection).

FLIGHT ENVELOPE FUNCTION

As long as one Flight Augmentation Computer (FAC) is valid, it governs the flight envelope function, the rudder position display, and the rudder trim indication regardless of what the flight crew does with the FAC pushbutton.

PFD SPEED SCALE MANAGEMENT

The FAC controls the speed scale on the PFD (Refer to 1.31).
When both FACs are operative, FAC1 supplies data to PFD1 and FAC2 supplies it to PFD2.
The FAC computes :

- The minimum and maximum speeds :
  - VSW (stall warning)
  - VLS
  - VFE and VFE for the next configuration
  - VLE
  - VMO/MMO
- The maneuvering speeds :
  - Green Dot Speed
  - S speed
  - F speed

  (Refer to 3.04.10 for speed definition).

The FAC also computes the speed trend and displays it as an arrow on the PFD speed scale.
The PFD displays these various speeds as appropriate, and they also go to the FMGEC to be used as limits for various guidance modes.

Note : The principle of the speed computation is as follows :

- *First, the FAC computes VS1G (stall speed). From VS1G it computes the Gross Weight (GW) which is also sent to the Elevator Aileron computers :*
  - *When the aircraft is below 14 500 feet and 250 knots, it computes this from current angle of attack, speed/Mach, altitude, thrust, and CG.*
  - *When the aircraft is above 14 500 feet or 250 knots, it computes this out of the GW, which it has memorized and updated with a fuel consumption model set in the FAC.*
- *Finally the FAC computes the various minimum and maneuvering speeds, Vα prot and Vsw.* R
- *The accuracies of the various minimum and maximum speeds are functions of the accuracy with which the FAC computes aircraft gross weight. Normal accuracy for VLS in CONFIG FULL is about ± 3 kt.*

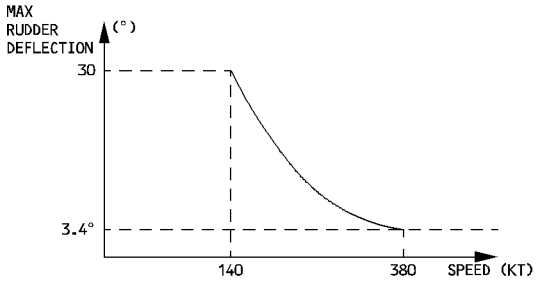
RUDDER TRIM

The rudder trim function :
- Executes trim orders the pilot enters with the manual trim knob
- When AP is engaged
  - executes trim orders from the FMGS.
  - Assists the system in recovering from engine failure (long-term yaw compensation) in all flight guidance modes.
  - If the pilot pushes the rudder more than 10° out of trim, it disengages the AP.

Note : When the AP is engaged, the rudder trim knob is inoperative : the master FMGC sends rudder trim orders to the FAC.

RUDDER TRAVEL LIMITATION

This function limits rudder deflection as a function of speed in order to avoid high structural loads. It is governed by the following law :



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If both FACs lose the rudder travel limitation function, the value of the rudder deflection limit is locked at the time of the second failure.
When the slats are extended, the FACs automatically set the rudder deflection limit at the low-speed setting (maximum authorized deflection).

FLIGHT ENVELOPE FUNCTION

As long as one Flight Augmentation Computer (FAC) is valid, it governs the flight envelope function, the rudder position display, and the rudder trim indication regardless of what the flight crew does with the FAC pushbutton.

PFD SPEED SCALE MANAGEMENT

The FAC controls the speed scale on the PFD (Refer to 1.31).
When both FACs are operative, FAC1 supplies data to PFD1 and FAC2 supplies it to PFD2.
The FAC computes :

- The minimum and maximum speeds :
  - VSW (stall warning)
  - VLS
  - VFE and VFE for the next configuration
  - VLE
  - VMO/MMO
- The maneuvering speeds :
  - Green Dot Speed
  - S speed
  - F speed

  (Refer to 3.04.10 for speed definition).

The FAC also computes the speed trend and displays it as an arrow on the PFD speed scale.
The PFD displays these various speeds as appropriate, and they also go to the FMGEC to be used as limits for various guidance modes.

Note : The principle of the speed computation is as follows :

- *First, the FAC computes VS1G (stall speed). From VS1G it computes the Gross Weight (GW) which is also sent to the Elevator Aileron computers :*
  - *When the aircraft is below 14 500 feet and 250 knots, it computes this from current angle of attack, speed/Mach, altitude, thrust, and CG.*
  - *When the aircraft is above 14 500 feet or 250 knots, it computes this out of the GW, which it has memorized and updated with a fuel consumption model set in the FAC.*
- *Finally the FAC computes the various minimum and maneuvering speeds, Vαprot and Vsw.*
- *The accuracies of the various minimum and maximum speeds are functions of the accuracy with which the FAC computes aircraft gross weight. Normal accuracy for VLS in CONFIG FULL is about ± 3 kt.*

ALPHA-FLOOR PROTECTION

Alpha-floor protection automatically sets the thrust at TOGA thrust, when the aircraft reaches a very high angle of attack.
The Flight Augmentation Computer (FAC) generates the signal that triggers the alpha-floor mode. This, in turn, sets TOGA thrust on the engines, regardless of the thrust lever positions (Refer to 1.22.30 A/THR modes).
The FAC sends this signal when the angle of attack is above a predetermined threshold, that is a function of the configuration.
In CONF3 and CONF FULL, this threshold decreases as a function of the aircraft deceleration rate (down to – 3°).
Alpha-floor is available from lift-off until the aircraft reaches 100 feet RA in approach.

Note : – *Alpha-floor is lost, when one of the following combinations of failures occurs :*
SFCC1 and FAC2, or
SFCC2 and FAC1, or
Both FCU channels, or
1 EIU, or
Both FMGCs.
– *Alpha-floor is lost under alternate or direct flight control law.*
R – *Alpha-floor is lost in engine-out, when slats/flaps are extended.*

LOW-ENERGY WARNING

An aural low-energy "SPEED SPEED SPEED" warning, repeated every five seconds, warns the pilot that the aircraft's energy level is going below a threshold under which he will have to increase thrust, in order to regain a positive flight path angle through pitch control.
It is available in Configuration 2, 3, and FULL. The FAC computes the energy level with the following inputs :
– Aircraft configuration
– Horizontal deceleration rate
– Flight path angle
The warning is inhibited when :
– TOGA is selected, or
– Below 100 feet RA, or
– Above 2000 feet RA, or
– Alpha floor, or the ground proximity warning system alert is triggered, or
– In alternate or direct law, or
– If both radio altimeters fail.
During deceleration, the low-energy warning is triggered before alpha floor (unless alpha floor is triggered by stick deflection). The amount of time between the two warnings depends on the deceleration rate.

WINDSHEAR DETECTION FUNCTION

R The windshear detection function is provided by the Flight Augmentation Computer (FAC)
R in takeoff and approach phase in the following conditions :
R – At takeoff, 3 seconds after liftoff, up to 1300 feet RA
R – At landing, from 1300 feet RA to 50 feet RA
R – With at least CONF 1 selected.
R The warning consists of :
R – A visual "WINDSHEAR" red message displayed on both PFDs for a minimum of 15
R seconds.
R – An aural synthetic voice announcing "WINDSHEAR" three times.

WINDSHEAR DETECTION PRINCIPLES

The FACs generate the windshear warning whenever the predicted energy level for the aircraft falls below a predetermined threshold.
In computing this energy level prediction, the FACs use data from different sources. From ADIRS comes data such as vertical speed, air and ground speeds and slope ; from other sources come such derived parameters as total slope, longitudinal wind gradient, and vertical wind.
The FACs express this energy level as an angle of attack and compare it with an angle-of-attack threshold above which windshear conditions are most likely and pilot action is required.

GUIDANCE

In windshear conditions, flight guidance acts on specially adapted FD pitch orders received from the speed reference system (SRS). The pilot must set go around thrust immediately (which also triggers the FD SRS mode), and follow the pitch order to execute the optimum escape maneuver.

CONTROLS AND INDICATORS

FAC ENGAGEMENT

Refer to 1.27 FLIGHT CONTROL CHAPTER

RUDDER TRIM OPERATION

Refer to 1.27 FLIGHT CONTROL CHAPTER

GENERAL

R The FMS AOC function gives an interface between a ground station and one onboard FMGC, allowing data transmission between these two computers via the ACARS
R Management Unit or the ATSU.
Two different sets of message can be exchanged :
UPLINK messages from the ground station. They consist in reception of data requested or directly sent to the crew.
DOWNLINK messages from the FMGC (master). They consist in reports or requests sent to the ground station.
R The FMGS/ACARS or FMGS/ATSU interface enables the following AOC capabilities.
- F-PLN initialization (flight plan and performance data)
- Takeoff data
- Wind data
- Flight reports
- Broadcast data

Crews can send message using ACARS FUNCTION pages or relevant MCDU pages.
Only one FMGC talks to the ground station. This FMGC is called FMGC "master".

GENERAL SCRATCHPAD MESSAGES

NOT XMITTED TO ACARS	: A crew request or report was sent to the ground but the communication was not established or not acknowledged.
NO ANSWER TO REQUEST	: A crew request was previously sent to the ground and no answer (uplink message) was received within 4 minutes.

FLIGHT PLAN INITIALIZATION FUNCTION

This function enables lateral and vertical flight plan data as well as performance data to be exchanged between the aircraft and a ground station. The aircraft may send flight plan requests for active and secondary flight plan. (downlink messages). The ground station may send flight plan and performance data (uplink messages) either under aircraft request or automatically without any request.

Each uplink message concerns either the active or secondary flight plan but never both flight plans at the same time. The data sent to the aircraft are checked for flight plan consistency.

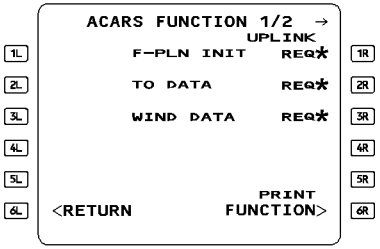
A MCDU message comes up when an uplink message is received. "ACT (or SEC) RTE UPLINK".

If an error prevents the decodind process of the message, "INVALID RTE UPLINK" is displayed on MCDUs.

Au uplink message can be routed to the active flight plan if no engine is started and no active flight plan exists. Otherwise, it is routed to the secondary. The crew will insert it into the secondary flight plan or will reject it using the CLR key.

Note : The flight plan may also be initialized using the ACARS FUNCTION page selected from DATA INDEX page.

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ACARS FUNCTION PAGE 1
(FROM DATA INDEX)

PERFORMANCE DATA

On ground and before engine start, the ground station may also send performance data to the aircraft.
Performance data are always associated with the uplink flight plan. It is either automatically inserted with the active flight plan data, or stored in the secondary with the corresponding flight plan.
This message contains part or all of the following data :
ZFW, ZFWCG, taxi fuel, block fuel, cruise flight level, tropopause altitude, cruise temperature, transition altitude, cost index, performance factor.

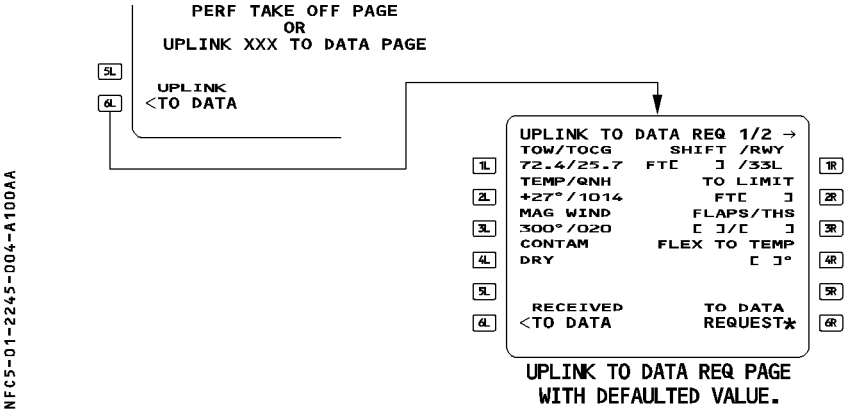
Note : After engine start an uplink performance data message is rejected automatically without any scratchpad message.

SCRATCHPAD MESSAGES RELATED TO FLIGHT PLAN AND PERFORMANCE

INVALID RTE UPLINK	An error is detected, the uplink message is rejected.
ACT or SEC RTE UPLINK	A F-PLN is stored in the active or secondary flight plan.
FLT NUMBER UPLINK	FLT NBR has been initialized within a F-PLN message without previous request.
CHECK FLT NUMBER	The uplinked FLT NBR differs from the one specified in the request.
CHECK CO RTE	The uplinked CO RTE ident differs from the one specified in the request.
INVALID FLT NBR UPLINK	The uplink contains a valid F-PLN but the FLT NBR is invalid.
PERF DATA UPLINK	Performance data is received
INVALID PERF UPLINK	Performance uplink message has been rejected
RTE DATALINK IN PROG	A flight plan modification is performed after a F-PLN INIT request has been sent ; this message is displayed until the uplink is received.
UPLINK INSERT IN PROG	This message is displayed during insertion of a Flight Plan.

TAKEOFF DATA FUNCTION

The takeoff data function is available for the active flight plan only. It is used to request to the ground station, information data for up to 2 runways and to receive this data for up to 4 runways.
The crew sends a request indicating the departure airport, runway idents, CG, GW and weather conditions (such as baro setting wind, temperature...). In response he receives the takeoff speeds for up to 4 runways but only one set of data may be inserted in the active flight plan for the selected active runway.
Takeoff speeds are computed for max and flex takeoff.
The takeoff data function has required the modification of the standard PERF TAKEOFF page and the addition of 2 news pages :
· UPLINK TO DAT REQ page that enables the crew to specify a request to the ground.
· UPLINK XXX TO DATA page (XXX for MAX or FLEX)
These 2 pages are accessed from the PERF TAKEOFF page in PREFLIGHT and DONE phase only.



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UPLINK TO DATA REQ PAGE
WITH DEFAULTED VALUE.

SCRATCHPAD MESSAGES RELATED TO TAKEOFF DATA

TAKEOFF DATA UPLINK : Takeoff data uplink message is received
INVALID TAKEOFF UPLINK : The UPLINK message is rejected

WIND DATA FUNCTION

This function enables the crew to request and to receive forecasted winds associated to the active or secondary flight plan.
The uplink message (ground station to aircraft) may be received upon crew request or automatically without crew request.
The request is initiated from WIND pages or from ACARS FUNCTION page (Refer to 4.03).
The uplink wind data when received are directly displayed on the wind pages but not inserted in the flight plan, one set for each flight phase : CLIMB, CRUISE, DESCENT. The alternate wind at alternate cruise flight level is displayed on DESCENT page.

* Winds are associated to altitude for climb an descent phases
* Winds are associated to waypoint for cruise phase and step level. One wind per waypoint.
  - On ground and without entered winds, an uplink message is directly inserted in the flight plan.
  - In flight, winds are temporary stored until the crew inserts it phase per phase. Phase of flight is indicated in the WIND title page.
  - Clearing the INSERT UPLINK* prompt using the CLR key deletes the uplink wind data for the selected phase.

When uplink winds are deleted, the wind page reverts to the previous status.
The flight plan B page is modified of the uplink wind only after it is inserted by the crew.
R AOC uplink winds are then considered as crew manual entries (large font).

SCRATCHPAD MESSAGES RELATED TO WIND DATA

INVALID WIND UPLINK	An error is detected, the uplink is rejected.
WIND DATA UPLINK	Uplinked winds are received.
WIND UPLINK PENDING	A temporary flight plan exists or a DIR TO page is displayed when a wind uplink is received. The message is stored.
WIND UPLINK EXISTS	A F-PLN modification (active or secondary) is attempted when uplink winds are not inserted. This message disappears automatically when the wind uplink is inserted or deleted.
CHECK DEST DATA	The aircraft is at 180 NM from destination, and the destination QNH, TEMP or WIND displayed on the PERF
R	APPR page was received by AOC uplink or, if following insertion of a descent wind uplink, a conflict concerning the above parameters exists.
CHECK ALTN WIND	The uplinked alternate cruise flight level differs from the default alternate cruise flight level.

FLIGHT REPORTS

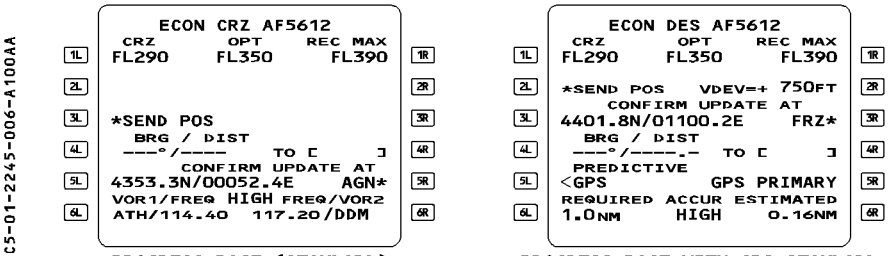
Flight reports provide real time information to the ground concerning the aircraft current situation and position.
Several types of flight reports are available :
- The Position report : provides current aircraft position
- the Progress report : provides data relative to the destination
- The Flight-Plan report : provides the active route
- the Performance Data report : provides performance data currently used by FMS.

These reports may be manually initiated via a dedicated prompt or automatically sent in response to a ground request or upon specific conditions.

POSITION REPORT

This report is sent :
- manually via a MCDU prompt or
- following a ground request or
- automatically upon sequencing a designated reporting fix (designated by the ground in a uplink message).

The manual POSITION REPORT downlink prompt is displayed on the PROG page. (SEND POS prompt).



PROGRESS PAGE (STANDARD)

PROGRESS PAGE WITH GPS STANDARD

Note : Position report are initiated from active flight plan only.

POSITION report content

- Aircraft position
- Overfly reporting waypoint
- Time of report (UTC)
- Aircraft altitude
- Next reporting waypoint
- ETA at next reporting waypoint
- Reporting waypoint following next report
- SAT
- Current wind
- Remaining fuel

PROGRESS REPORT

A progress report contains data relative to the aircraft arrival time and EFOB at destination for the active F-PLN.
This downlink message is automatically sent following :

— a ground request or
— a change of destination or
— a change of runway or
— a specific event. The possible events that can be selected in the navigation database policy file are :
  - X minutes to Top of Descent
  - Z minutes to Destination
  - ETA changes more than W minutes from the previous report.

  X, Z and W are minutes of time set in the navigation database policy file.

The progress report cannot be manually sent by the crew via a dedicated MCDU prompt.

PROGRESS report content

- Flight Number
- Arrival Airport Ident
- Destination Runway Ident
- Predicted remaining fuel
- ETA at destination
- Reason for report (specific event, ground request...).

FLIGHT PLAN REPORT

The F-PLN report broadcasts flight plan data to the ground. Only data from the active flight plan can be sent.
This downlink message is sent to the ground :
- automatically following a ground request
- manually by the crew using a prompt displayed on the ACARS FUNCTION page. (Refer to ACARS page description). This prompt may be invalidated through the navigation database policy file.

The Flight Plan report can be downlinked either while on ground or in flight during any flight phase.

FLIGHT PLAN report content

The report contains the active and alternate flight plan.

PERFORMANCE DATA REPORT

The Performance Data report is a downlink message that allows the transmission of performance data (CG, FUEL, CG...) relative to the active F-PLN.
This message is automatically sent following a ground request. Manual sending is not possible.

PERFORMANCE DATA report content

Sends to the ground :
- Current GW
- Cruise Altitude
- Current CG
- Fuel on Board
- Block Fuel
- Reserve Fuel
- Cost Index
- Top of Climb Temperature
- Climb Transition Altitude
- Tropopause Altitude
- Taxi Fuel
- ZFW
- ZFWCG

PRINT FUNCTION

The print function enables several types of data and report to be printed :

* Flight plan initialization data
* Takeoff data
* Wind data
* Preflight report
* In flight report
* Post flight report

The 3 first reports may differ when automatically or manually printed for the following reason :

The automatic process prints the uplink message although the manuall process prints the current active data as displayed on the relevant MCDU pages.

The last 3 reports being processed from the same sources are identical in automatic or manual printing.

R *Note : AOC is not necessary linked to printing process. The printing function may be*
R *activated within the FMGS and selected independently from the AOC.*

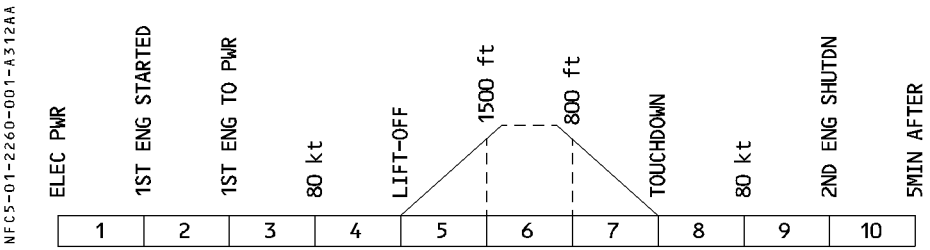
— One or several print functions may be deactivated (refer to PRINT FUNCTION PAGE).
R — If an AOC function is not active, (not selected in the nav database policy file) the printing
R process is invalidated for this specific AOC function.

R **AOC/PRINTER PROGRAMMING OPTIONS** ◁

R Option programming for the AOC/PRINTER functions is obtained through the Navigation
R Data Base policy file or the Airline Modifiable Information (AMI) file.
The list summarizes the possible options :

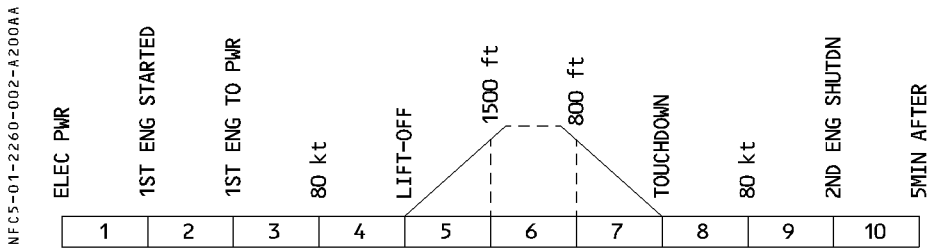
R	Data Link (ACARS or AOC) Inhibit	Disables AOC function
	F-PLN Data Request Inhibit	Disables uplink and downlink requests of F-PLN initialization data
	Performance Data Request Inhibit	Disables uplink and downlink requests of Performance Initialization data
	Takeoff Data Request Inhibit	Disables uplink and downlink request of Takeoff Initialization data
	Wind Data Request Inhibit	Disables uplink and downlink request of predicted wind data
	Flight Number Enable	Flight Number is included within the F-PLN Request or Progress Report downlinks
	Position Report Inhibit	Disables a manual Position Report downlink
	Progress Report Triggers	Defines the triggers for the automatic downlink of the Progress Report
	F-PLN Report Inhibit	Disables the manual downlink of the F-PLN Report
R	Auto Print of ACARS or AOC uplinks	Selects/Deselects the automatic printing of the F-PLN, INIT, TO and wind data uplinks. If Autoprint is selected, the crew can deselect it manually. If auto printing is deselected, the crew cannot manually reselect it.
	Auto Print of Flight Reports	Selects/Deselects the automatic printing of the Preflight, Inflight, Postflight reports. If selected, the crew can deselect it manually. If autoprint is deselected, the crew cannot manually preselected it.

WARNINGS AND CAUTIONS



E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
FAC 1 (2) FAULT	SINGLE CHIME	MASTER CAUT	NIL	FAC FAULT lt	3, 4, 5 7,8
YAW DAMPER 1 (2)	NIL	NIL	NIL	NIL	3, 4, 5 7, 8, 10
RUDDER TRIM 1 (2) FAULT RUD TRV LIM 1 (2) FCU 1 (2) FAULT	NIL	NIL	NIL	NIL	3, 4, 5 7, 8
FAC 1 + 2 FAULT	SINGLE CHIME	MASTER CAUT	NIL	FAC FAULT lts	4, 5, 7, 8
YAW DAMPER SYS	SINGLE CHIME	MASTER CAUT	NIL	NIL	4, 5, 7, 8, 10
RUD TRIM SYS	SINGLE CHIME	MASTER CAUT	F/CTL	NIL	4, 5, 7, 8
RUD TRV LIM SYS	SINGLE CHIME	MASTER CAUT	NIL	NIL	4, 5
A/THR OFF A/THR disconnection (Refer to 1.22.30).	SINGLE CHIME	MASTER CAUT	NIL	NIL	4, 8, 10
A/THR LIMITED A/THR is active but thrust levers are set below CL detent (2 engines), or MCT detent (1 engine).	SINGLE CHIME every 5 seconds	MASTER CAUT every 5 seconds	NIL	NIL	1, 2, 3, 4 8, 9, 10
FCU 1 + 2 FAULT	SINGLE CHIME	MASTER CAUT	NIL	NIL	3, 4, 5, 7, 8
AP OFF AP disengagement (Refer to 1.22.30).	CAVALRY CHARGE	MASTER WARN	NIL	NIL	-
– (ILS) CAPABILITY DOWNGRADE. Condition(s) required for CAT3/CAT2 are no longer fulfilled. (Refer to 4.05.70). – Mode reversions (Refer to 1.22.30).	TRIPLE CLICK	NIL	NIL	NIL	2, 3, 4, 5, 8, 9, 10
WINDSHEAR No ECAM message.	SYNTHETIC VOICE "WINDSHEAR" repeated 3 times	NIL	NIL	"WINDSHEAR" on PFDs	2, 3, 4 8, 9
WINDSHEAR DET FAULT or REAC W/S DET FAULT ◁	SINGLE CHIME	MASTER CAUT	NIL	NIL	3, 4, 5 8
LOW ENERGY WARNING Available between 100 and 2000 feet in CONF ≥ 2. No ECAM message.	SYNTHETIC VOICE "SPEED" 3 times every 5 seconds	NIL	NIL	NIL	1, 2, 3, 4 8, 9, 10

WARNINGS AND CAUTIONS



R

E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
AUTOLAND (No ECAM message) Only available below 200 feet.	NIL	AUTO LAND (red) on glareshield	NIL	NIL	2, 3, 4, 5, 8, 9 10
When GPS primary is lost, The "GPS PRIMARY LOST" message is displayed on the ND and PFD.	TRIPLE* CLICK	NIL		ND/MCDU message	
"NAV FMS/GPS POS DISAGREE is triggered, when FMS 1 or 2 position differs from GPS 1 or 2 position by more than : – A longitude threshold that depends on the latitude : · 0.5 minutes for latitudes below 55°, · 0.9 minutes for latitudes at or above 55°, and below 70°, – A latitude threshold of 0.5 minutes, regardless of the latitude. Above 70° of latitude, a longitude difference does not trigger the alarm.	SINGLE CHIME	MASTER CAUT		NIL	1, 3, 4, 10

* Only during a non precision approach.

BUS EQUIPMENT LIST

		NORM		EMER ELEC		
		AC	DC	AC ESS	DC ESS	HOT
FMGC	1				SHED	
	2		DC2			
MCDU	1			SHED		
	2	AC2				
	3 ◁	AC1				
FCU	1				X	
	2		DC2			

23.00 CONTENTS

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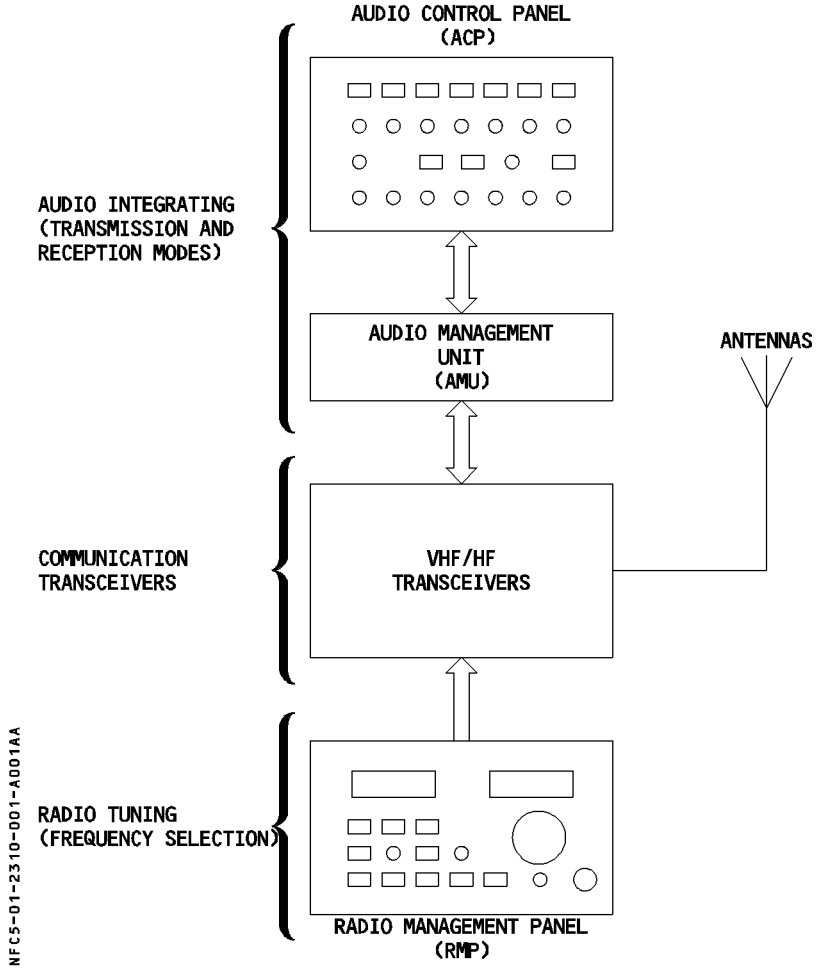
23.50 WARNINGS AND CAUTIONS

– WARNINGS AND CAUTIONS 1
– MEMO DISPLAY 1

23.60 ELECTRICAL SUPPLY

GENERAL

The communications system comprises the following subsystems :
- VHF/HF tranceivers
- Radio tuning systems (Radio Management Panels).
- Audio integrating system (Audio Management Unit, Audio Control Panels).



VHF/HF/SELCAL

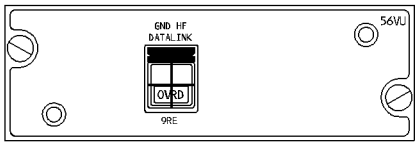
The flight crew can use either of the two Radio Management Panels (RMPs) (third RMP ◁) to tune each transceiver. The flight crew uses the Audio Control Panel (ACP) to select a VHF or HF system for transmitting. The ACP works through the Audio Management Unit (AMU). Each system is connected to the RMPs for frequency selection and to the AMU for connection to the audio integrating and SELCAL (Selective Calling) systems.

– **VHF**

The aircraft has two identical VHF communication systems (third VHF system ◁). Each system has a transceiver in the avionics compartment, and an antenna on the fuselage. (Only VHF1 operates in EMER ELEC CONFIG). Its range is from 118.0 to 136.975 MHZ. The VHF has an alarm to indicate that the microphone is stuck (◁). If a microphone is in the emission position for more than 30 seconds, an interrupted tone sounds for 5 seconds, and the emission is turned off. To reactivate the emission, the crew releases the push-to-talk button and presses it again.

– **HF**

Two identical HF communication systems are options. Each has a transceiver in the avionics compartment, and a common tuner and common antenna in the vertical stabilizer. Its range is from 2.0 to 30 MHZ. When in data mode, digital information is transmitted between HF1 and ATSU. HF transmission is inhibited on ground. A GND HF DATALINK pushbutton, located on the overhead panel, may override the inhibition. HF must not be used during refueling.



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– **SELCAL (Selective Calling)**

Upon receiving a call code corresponding to that of the aircraft, the SELCAL system advises the flight crew, both aurally and visually, that a ground station is calling the aircraft.

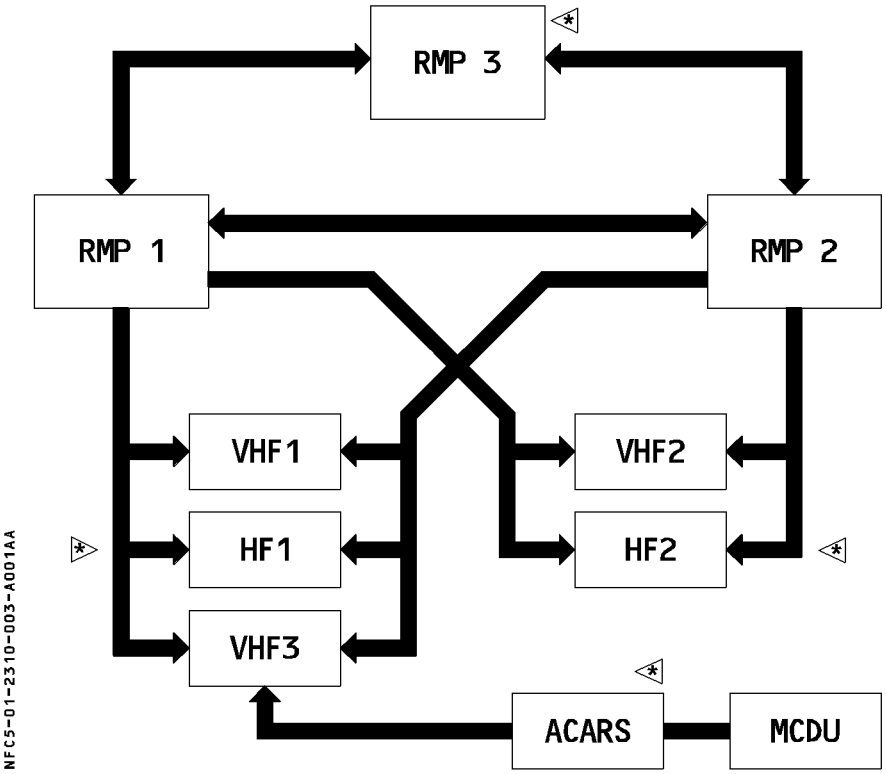
– **VHF emergency radio**

One VHF emergency radio (P855A1 Russian type design) is installed in the right-hand rear lateral console with description/instructions for use attached to it. This emergency radio is required for use only outside the aircraft after emergency landing/ditching.

RADIO TUNING

DESCRIPTION

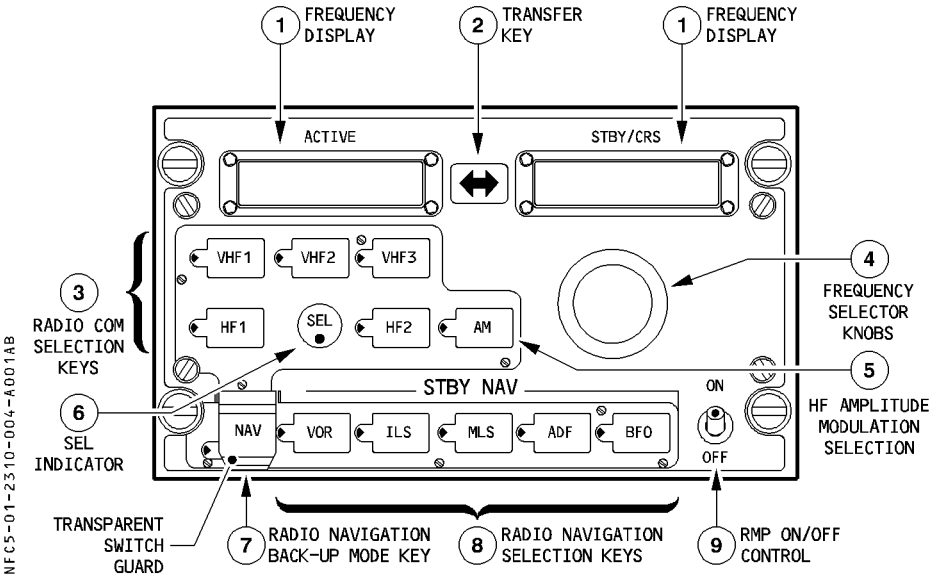
Identical RMPs (Radio Management Panels) :
· Give the flight crew control of all VHF radio communication systems (HF systems ◁).
· Back up to FMGCs for controlling radio navigation systems (Refer to 1.34).
Two RMPs are on the center pedestal (and the third is on the overhead panel ◁).
Each RMP can control any VHF (HF ◁) transceiver. RMP1 and RMP2 are connected directly to all VHF (HF ◁) transceivers, (whereas RMP3 is connected to them via RMP1 and RMP2 ◁). RMPs are connected together so that each RMP is updated to the selections made on other RMPs.
Only RMP1 functions in EMER ELEC CONFIG.



R If one RMP fails, the remaining one controls all the VHF (HF ◁) tranceivers.

R

RADIO MANAGEMENT PANEL



(1) Frequency displays

The ACTIVE display window shows the active frequency of the selected radio, which is identified by a green light on the selection key.
The STBY/CRS (standby/course) display window shows a standby frequency that the pilot can activate by pressing the transfer key or change by rotating the tuning knobs. (For a description of the CRS function (see 1.34)).

(2) Transfer key

Pressing this key moves the active frequency to the standby window and the standby frequency to the active window.
This tunes the selected receiver to the new active frequency.

(3) Radio com selection keys

When the pilot presses one of these keys :
· The ACTIVE window displays the frequency set on that radio.
· The STBY/CRS window displays the selected standby frequency or course.
· The selected key displays a green monitor light.

(4) Frequency selector knobs

The pilot uses these concentric knobs to select the STBY frequency or CRS.
The outer knob controls whole numbers ; the inner knob controls decimal fractions.

(5) AM pb sw

If the aircraft has HF radios and the flight crew has selected an HF tranceiver, this switch selects the AM mode. (The default mode is the SSB, or single side-band, mode).
This key displays a green monitor light when the AM mode is active.

(6) SEL indicator

The SEL indicator glows white on both RMPs when a transceiver normally associated with one RMP is tuned by another :
· VHF1 tuned by RMP2 or RMP3,
· VHF2 tuned by RMP1 or RMP3.
· VHF3, HF1, HF2 (◁) tuned by RMP1 or RMP2.

(7) NAV pb sw (with transparent switchguard)

The pilot presses this key to be able to select navigation receivers and courses through the RMP. It does not affect the selection of communication radios and their frequencies. (Refer to 1.34 for additional information).

(8) Radio navigation selection keys

The pilot presses one of these keys to select a navigation radio to control through this RMP. This turns on the green monitor light in the key.
(Refer to 1.34 for addition information).

(9) ON/OFF sw

This switch controls the power supply to the RMP.

Note : RMP3 is able to control VHF and HF transceivers through RMP1 and RMP2 even when they are OFF.

GENERAL

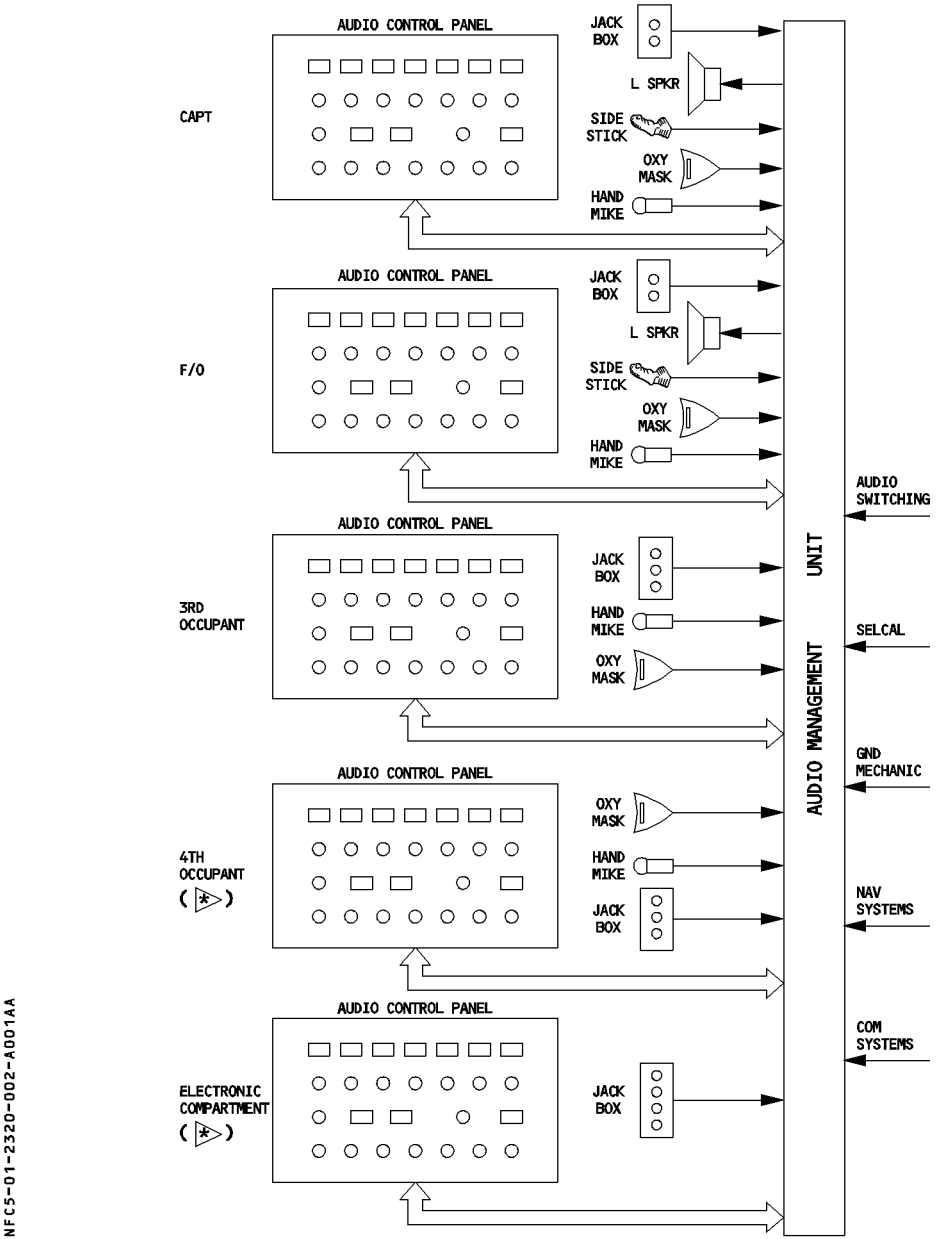
Intercommunications is divided into two main systems:
- the audio management system.
- the cabin intercommunication data system.

AUDIO MANAGEMENT SYSTEM

The audio management system allows the flight crew to use :
- all the radio communication and radio navigation facilities installed on the aircraft in transmission and reception mode.
- the interphone systems
- the call systems
- the passenger address system

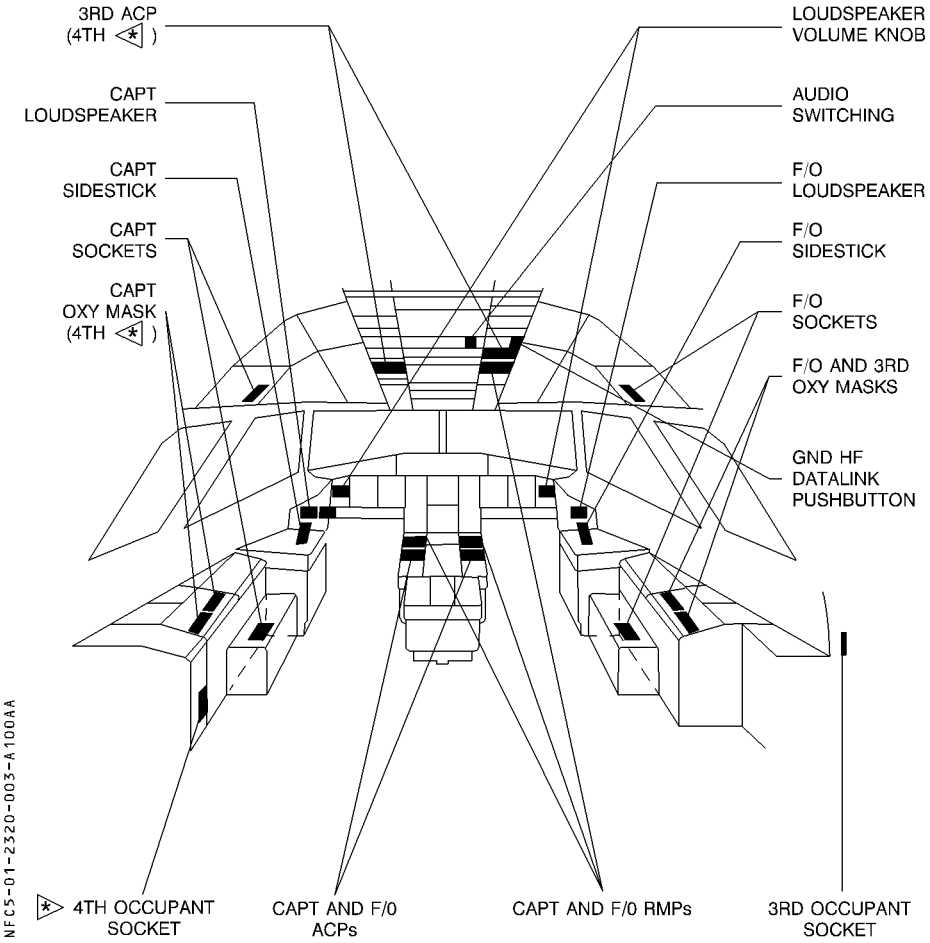
The audio management system includes :
- an audio management unit (AMU)
- three audio control panels (ACPs) (fourth and fifth optional)
- sockets at each station
  - headset jack and boomset connector (hand microphone connector (◁) for pilot, copilot, and third occupant
  - headset jack for fourth occupant
- one interphone jack at the ground power receptacle
- boomsets for the pilot, copilot, and third occupant, and three hand microphones (fourth (◁))
- three cockpit oxygen mask microphones
- one radio press-to-talk switch on each sidestick
- one SELCAL code selection panel (avionics compartment)
- two cockpit loudspeakers with separate volume controls
- if installed, a jack panel in the electronic compartment that groups the headset jack, service interphone jack, hand mike connector, and boomset
- an audio switching facility

If audio channel 1 or 2 fails due to a failure either in an ACP or the corresponding AMU, the crew can use the AUDIO SWITCHING selector to select the third audio channel.



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COMPONENTS' LOCATION (PILOTS' STATION)



CABIN INTERCOMMUNICATION DATA SYSTEM

The Cabin Intercommunication Data System (CIDS) transmits, controls, and processes signals for the following cabin systems :

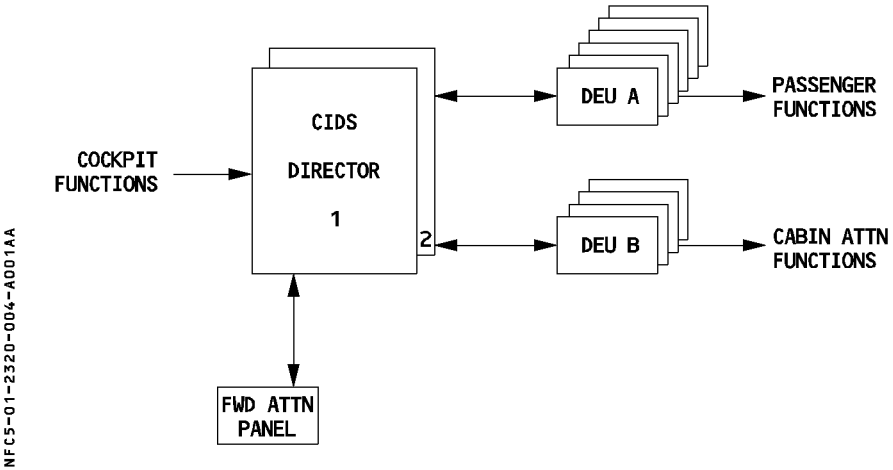
- cabin and service interphone
- passenger address
- passenger lighted sign
- reading light
- general cabin illumination
- emergency evacuation signalling
- lavatory smoke indication
- passenger entertainment music and video ◁

R - escape slide bottle pressure monitoring ◁

The CIDS has the following main components :

- two CIDS directors connected in parallel, one active and the other in standby.
- forward attendant panel for control of the cabin systems.
- programming and test module that allows the system to be reprogrammed after changes are made in the cabin configuration.

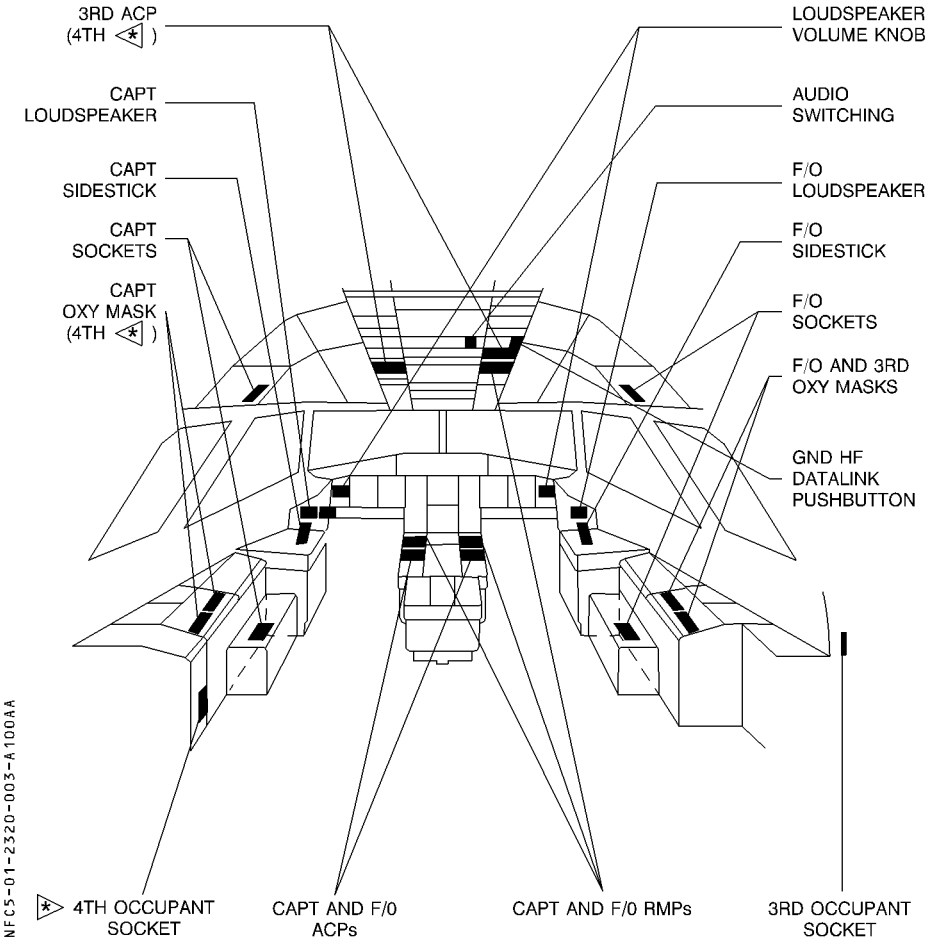
FOR INFO



Decoder/Encoder Units (DEUs) are linked to the two directors.

- *Type A units (for passengers) are along each side of the passenger cabin. The loudspeakers, lighted signs, call buttons, call lights and general illumination ballast units are divided into small groups each connected to a type A DEU.*
- *Type B units (for attendants) are near the exit doors. The area call panels, attendant handsets, slide and door pressure sensors, and attendant indicator panels are connected to type B DEUs.*

COMPONENTS' LOCATION (PILOTS' STATION)



CABIN INTERCOMMUNICATION DATA SYSTEM

The Cabin Intercommunication Data System (CIDS) transmits, controls, and processes signals for the following cabin systems :

- Cabin and service interphone
- Passenger address
- Passenger lighted signs
- Reading lights (LED technology)
- General cabin illumination
- Emergency evacuation signalling
- Lavatory smoke detectors and indicators
- Passenger entertainment music and video
- Escape slide bottle pressure monitoring

R
- Vacuum system control function

R
- Cargo and lavatory smoke detection function

The CIDS has the following main components :

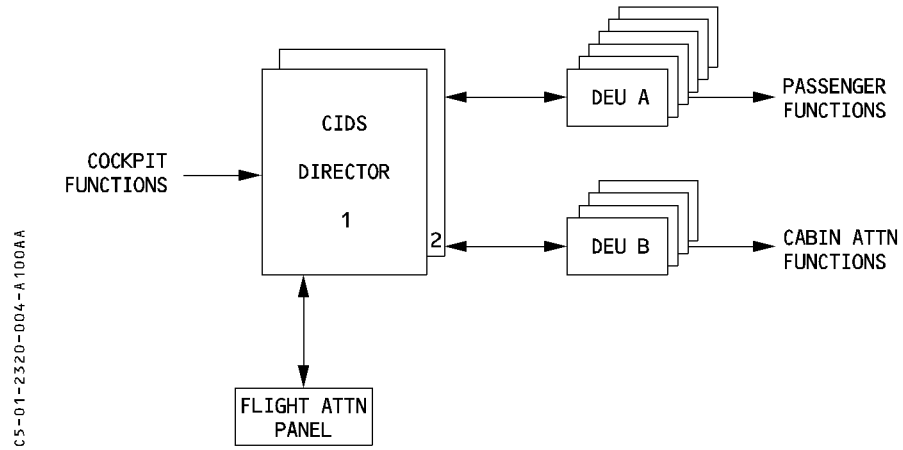
- Two CIDS directors connected in parallel ; one active, and the other on standby.

R
- Flight Attendant Panel (FAP) to monitor and control the cabin systems.
- Attendant Indication Panels (AIP), After Attendant Panels (AAP) and Area Call Panels (ACP)
- Decoder/Encoder Units (DEUs) linked to the two directors.
  - Type A units (for passengers) installed along the cabin.
    The loudspeakers, lighted signs, call buttons, call lights and general illumination ballast units are divided into small groups, each connected to a type A DEU.

R
  - Type B units (for attendants) installed near the exit doors. The Area Call panels, smoke detectors, attendant handsets, slide and door pressure sensors, and attendant indicator panels, are connected to type B DEUs.

FOR INFO

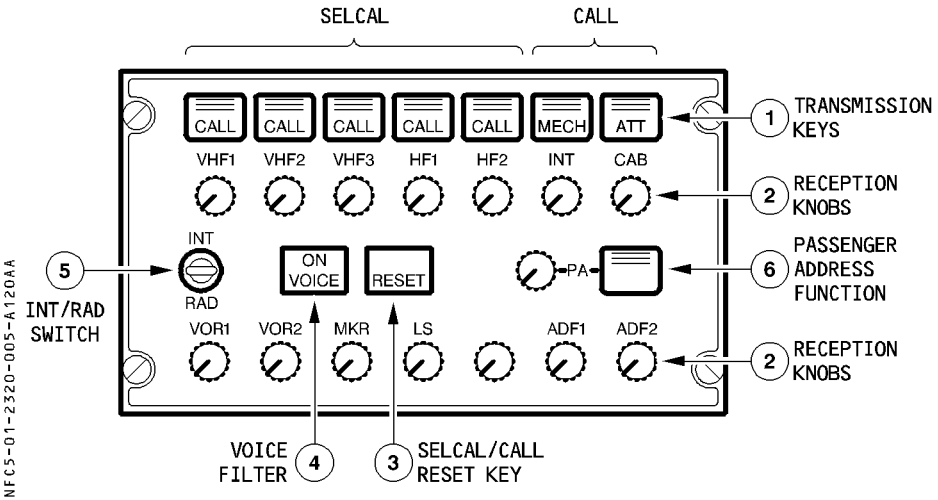
R



CONTROLS

AUDIO CONTROL PANEL

R



(1) Transmission keys

Pressed : The associated channel is selected for transmission.
The three green lines come on.
The pilot deselects the channel by pressing the pushbutton again, or selecting another channel.

CALL : The legend flashes in amber (and the buzzer sounds), when the SELCAL system detects a call.

MECH : The legend flashes in amber (and the buzzer sounds), for a call from the nose gear bay. The MECH light goes off after 60 seconds, if it is not reset.

ATT : The legend flashes in amber (and the buzzer sounds), for a call from a cabin crewmember. The ATT light goes off after 60 seconds, if it is not reset.

(2) Reception knobs

- Pressing and releasing the knob (knob out) selects the associated audio reception channel and the integral white light comes on.
- Rotating the knob adjusts the volume.
- The INTEG LT knob controls the brightness.
- Pressing the knob (knob stays in) disconnects the associated audio reception channel.

Note : For reception of DME audio navigation signals associated to an ILS or MLS station, the ILS (or LS) pushbutton on the FCU must also be selected.

(3) SELCAL/CALL RESET key

Pressing this key extinguishes CALL, MECH, and ATT lights.

(4) ON VOICE key

This key allows the flight crew to inhibit the audio navigation signals (VOR, ADF)
Pressing this key filters out ident signals and turns on the green ON light.

(5) INT/RAD sw

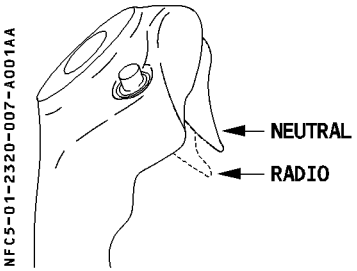
This switch operates as a press-to-talk switch for boom mike or oxygen mask mike.

INT	: Boom and mask mikes transmit on interphone regardless of which transmission key is selected. For reception on interphone, the crew member must have INT selected (INT reception knob out).
Neutral	: Reception is normal. Boom and mask mikes do not transmit.
RAD (press and hold)	: Boom and mask mikes transmit on the radio selected on the audio control panel.

(6) Passenger address (PA) function

(Refer to PASSENGER ADDRESS 1.23.20, below).

SIDE STICK RADIO SELECTOR



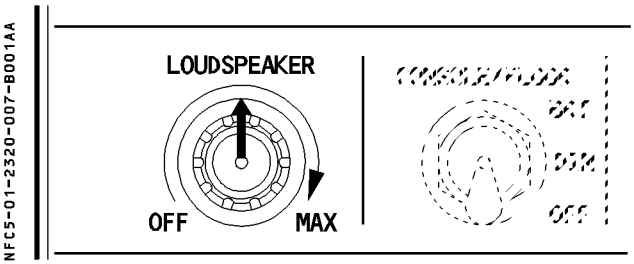
This selector has the same function as the INT/RAD switch on the ACP.

NEUTRAL (spring-loaded) : Boom and mask mikes are dead.
Reception is normal.

RADIO (squeezed) : Boom and mask mikes transmit through the equipment selected by the transmission key on the ACP.

Note : If RADIO is selected on the side stick when the INT/RAD switch is on INT, the radio function has priority over the interphone function.

LOUDSPEAKER VOLUME KNOB



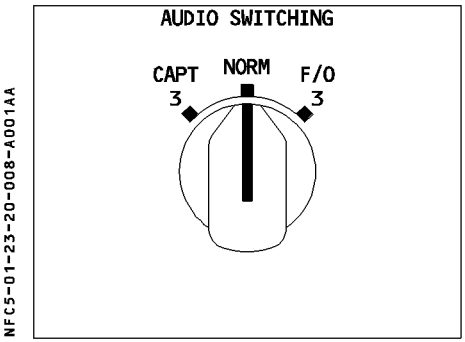
This knob adjusts the volume of the loudspeaker for radio communication.

OFF : Loudspeaker does not respond to signals from the aircraft's radio equipment.

Clockwise rotation : Loudspeaker broadcasts signals from the aircraft's radio equipment at increasing volume.

Note : This knob does not control the loudness of aural alert and voice messages.

AUDIO SWITCHING



The crew can switch to the third ACP if ACP1 or ACP2 fails.
When the crew does this, it takes away the third occupant's access to the acoustic equipment. AUDIO 3 XFRD appears in green on the ECAM MEMO display.

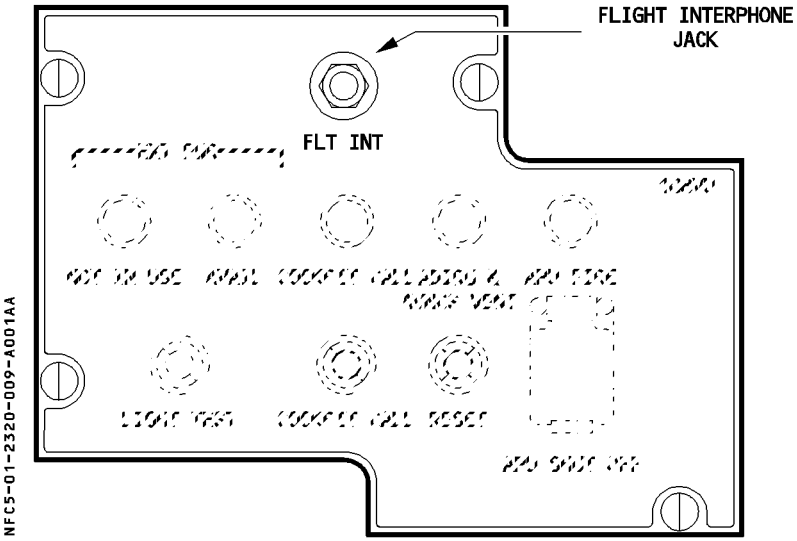
NORM : Each crew member uses his dedicated communication equipment.
CAPT 3 : The pilot uses his acoustic equipment and the third occupant's ACP.
F/O 3 : The copilot uses his acoustic equipment and the third occupant's ACP.

INTERPHONE SYSTEMS

FLIGHT INTERPHONE SYSTEM

This system allows the flight crew members to communicate among themselves and, through a jack on the external power panel, with the ground mechanic.

EXTERNAL POWER PANEL (FORWARD OF THE NOSE L/G BAY)



COCKPIT OPERATION FOR GROUND MECHANIC COMMUNICATION

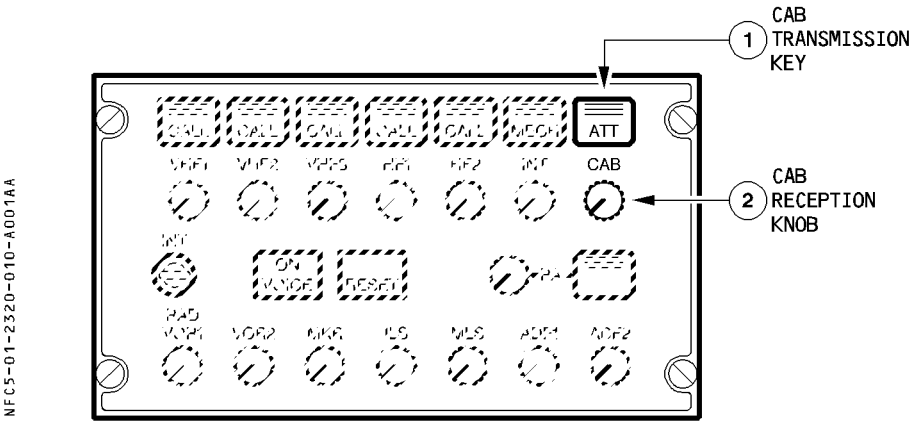
R

	MECH TRANSMISSION KEY ON ACP	INT RECEPTION KNOB ON ACP	INT/RAD SW ON ACP	PUSH TO TALK ON HANDMIKE
BOOMSET OR OXYGEN MASK	PRESSED	OUT	INT OR RAD	–
HANDMIKE	PRESSED	OUT	–	PRESSED

CABIN INTERPHONE SYSTEM

The system allows the flight crew to communicate with the flight attendants, and the flight attendants to communicate among themselves.

R



(1) CAB transmission key

Pressed : Three green lines come on.
Boom, mask, and hand mikes may be used for cabin interphone.

(2) CAB reception knob

Pressed and released (knob out) : The integral white light comes on.
The station receives audio signals from the cabin.
Rotating the knob adjusts the volume.

Pressed (knob in) : The white light goes out.
The cabin interphone is disconnected.

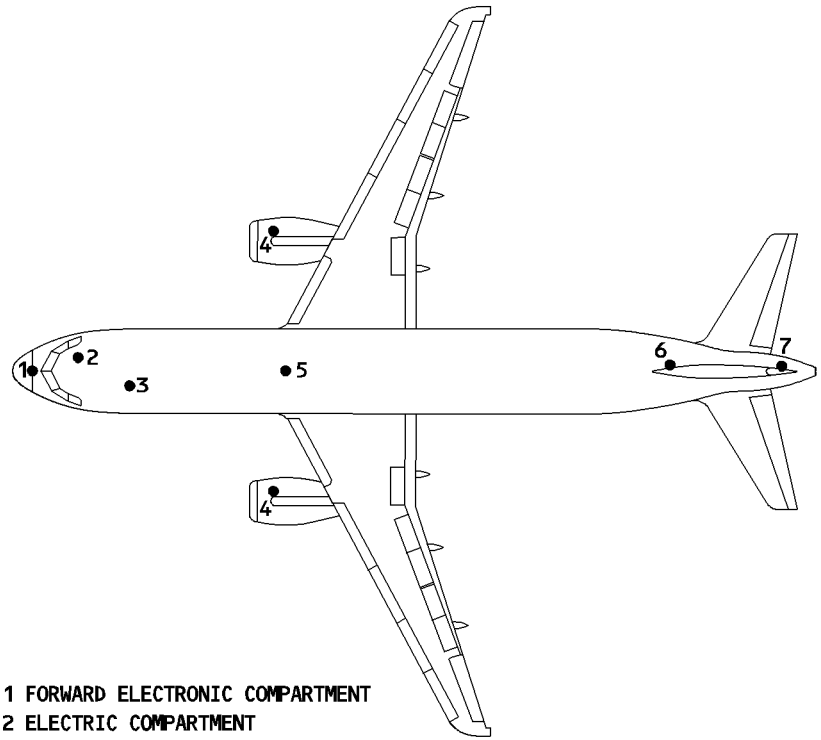
COCKPIT OPERATION FOR CABIN COMMUNICATION

	CAB TRANSMISSION KEY ON ACP	CAB RECEPTION KNOB ON ACP	INT/RAD SW ON ACP	PUSH TO TALK ON HANDMIKE
BOOMSET OR OXYGEN MASK	PRESSED	OUT	RAD	–
HANDMIKE	PRESSED	OUT	–	PRESSED

SERVICE INTERPHONE SYSTEM

The system allows for communication between :
– the flight crew and the service interphone jacks
– the flight attendant stations and the service interphone jacks
– the different service interphone jacks.
The Service Interphone system has :
– seven interphone jacks
– an OVRD switch located on the overhead panel.
The audio lines from the interphone jacks are connected to both CIDS directors.

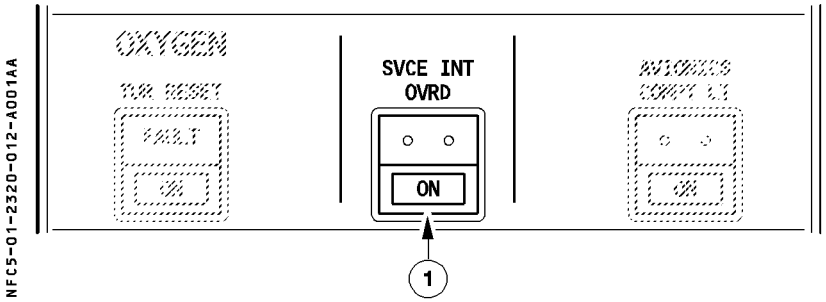
LOCATION OF INTERPHONE JACKS



NFC5-01-2320-011-A001AA

1 FORWARD ELECTRONIC COMPARTMENT
2 ELECTRIC COMPARTMENT
3 AVIONICS COMPARTMENT
4 ENGINE (L & R)
5 BELLY FAIRING PANEL
6 AFT FUSELAGE
7 NEAR APU BAY

CONTROLS AND INDICATORS AT OVERHEAD PANEL



(1) SVCE INT OVRD pb sw

Auto : Ground personnel can communicate with the flight crew by means of the service interphone jacks 10 seconds after the aircraft has landed. The landing gear must be compressed.
ON : Communication is possible when the landing gear is not compressed. The ON light is white.

COCKPIT OPERATION

R

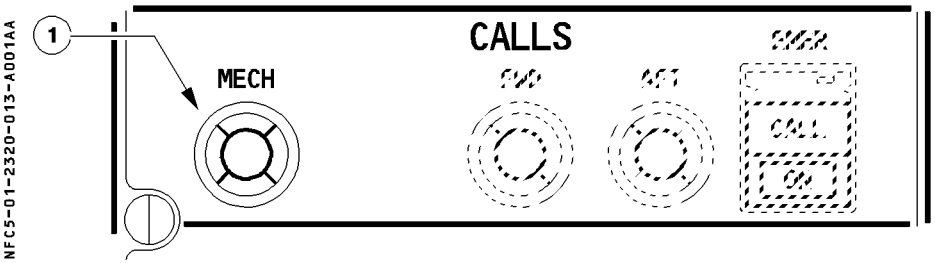
	CAB TRANSMISSION KEY ON ACP	CAB RECEPTION KNOB ON ACP	INT/RAD SW ON ACP	PUSH TO TALK ON HANDMIKE	SVCE INT OVRD PB SW
BOOMSET	PRESSED	OUT	RAD	–	SEE ABOVE CONDITIONS.
HANDMIKE	PRESSED	OUT	–	PRESSED	

CALL SYSTEMS

GROUND MECHANIC CALL

The system allows the flight crew and ground mechanics to communicate with each other.

CONTROLS AND INDICATORS ON OVERHEAD PANEL

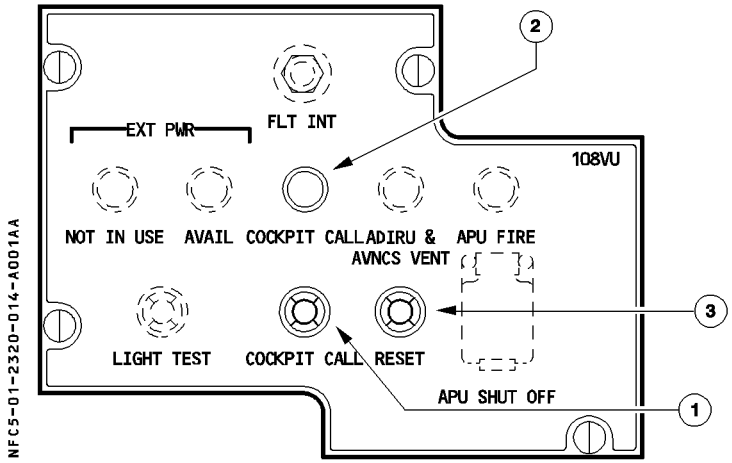


(1) MECH pb

Pressed (and held) : COCKPIT CALL lights up blue on the external power panel in the nose L/G bay.
An external horn sounds.

Released : COCKPIT CALL remains lighted.
The ground mechanic can extinguish it by pressing the RESET button on the external power panel. The external horn stops sounding.

R CONTROLS AND INDICATORS ON THE EXTERNAL POWER PANEL



(1) COCKPIT CALL pb

Pressed : This calls the cockpit.
The MECH lights flash amber on the ACPs and a buzzer sounds.
Released : The MECH lights go out after 60 seconds if they are not reset on the ACPs.
The buzzer stops.

(2) COCKPIT CALL lt

The blue light appears when cockpit calls the ground mechanic. An external horn also sounds.

(3) RESET pb

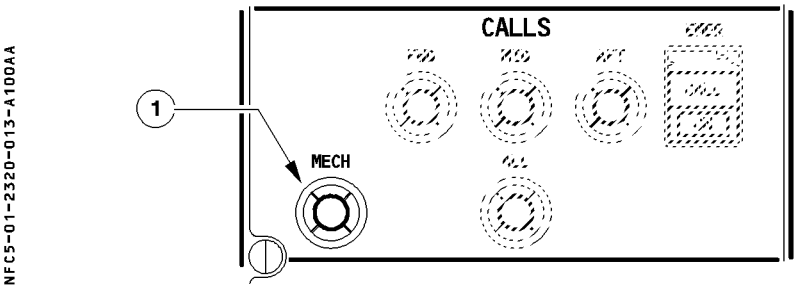
R Pressed : The COCKPIT CALL light goes out.

CALL SYSTEMS

GROUND MECHANIC CALL

The system allows the flight crew and ground mechanics to communicate with each other.

CONTROLS AND INDICATORS ON OVERHEAD PANEL

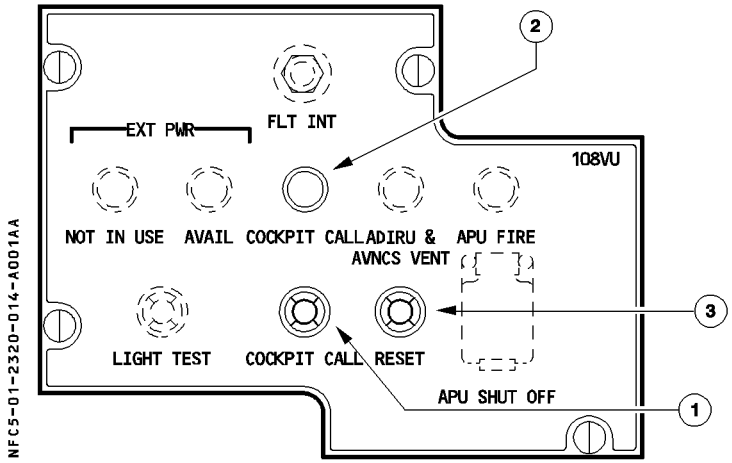


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R **CONTROLS AND INDICATORS ON THE EXTERNAL POWER PANEL**



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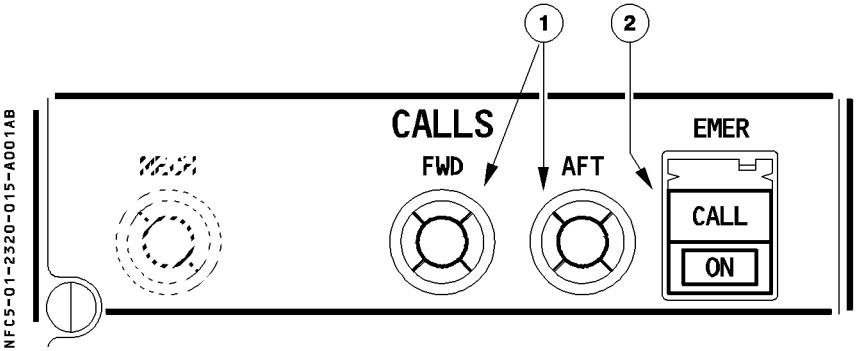
(3) RESET pb

R Pressed : The COCKPIT CALL light goes out.

CABIN CALL SYSTEM

The cabin call system is for communication between the cockpit and the cabin.

CALLS FROM THE COCKPIT



(1) FWD/AFT pushbutton

When pressed, the following aural and visual alerts will trigger in the cabin :

R
- Two lights come on in pink on the FWD or AFT area call panel, as applicable.
- On the Attendant Indication Panel (AIP), the "CAPTAIN CALL" message appears and a light comes on in green.
- A high-low chime sounds in the FWD or AFT section of the cabin, as applicable.

(2) EMER pushbutton-switch (guarded)

When pressed, the following aural and visual alerts will trigger in the cabin :
- Two pink lights flash on all area call panels.
- The "EMERGENCY CALL" message appears on all AIPs.
- A high-low chime sounds three times, on all of the loudspeakers.

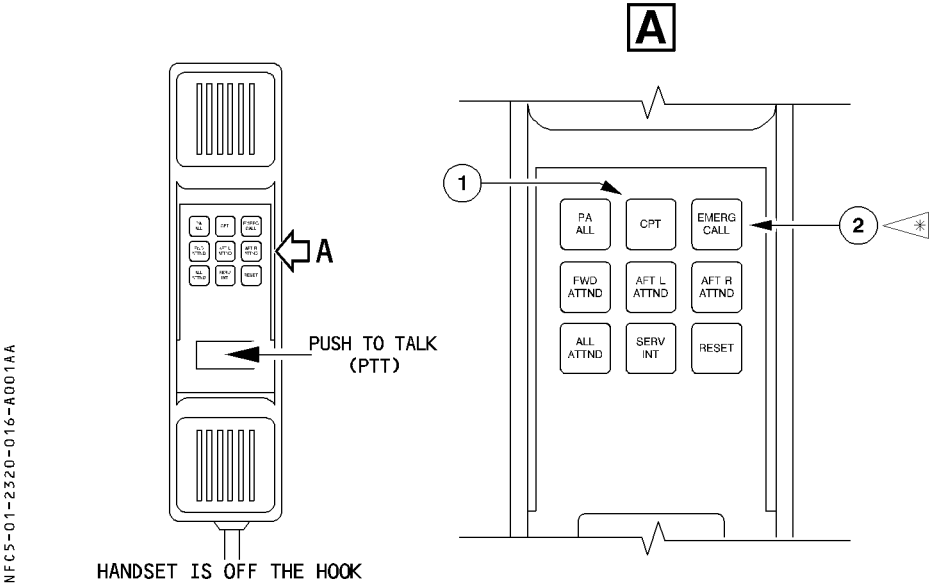
Also, on the cockpit CALLS panel, the ON light flashes in white and the CALL light flashes in amber.

R
R If the cabin handset has an EMER CALL key, the following aural and visual alerts will trigger in the cockpit, when an emergency call is made from the cabin to the cockpit :
- On the EMER pb-sw : The ON light flashes in white, and the CALL light flashes in amber.
- The ATT lights will flash on all Audio Control Panels (ACPs).
- Three buzzers will sound consecutively (for approx. three seconds each).

The cabin call system will reset, when the cabin crewmember hangs up the handset.

CALLS FROM THE CABIN

R



(1) CPT key

When pressed, the following aural and visual alerts will trigger in the cockpit :
- The ATT lights will flash on all Audio Control Panels (ACPs).
- A buzzer (inhibited during takeoff and landing) will sound.

In the cabin, the "CAPTAIN" message will appear on the Attendant Indication Panel (AIP) for which the CPT key was pressed.

R (2) EMER CALL key ◁

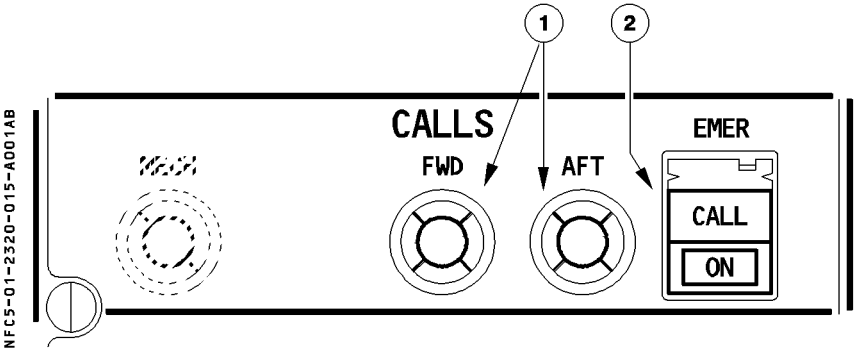
When pressed, the following aural and visual alerts will trigger in the cockpit :
- On the EMER pb-sw : The ON light flashes in white, and the CALL light flashes in amber.
- The ATT lights will flash on all ACPs
R - Three buzzers (inhibited during takeoff and landing) will sound consecutively.

In the cabin, the "EMERGENCY CALL" message will appear on all AIPs.

CABIN CALL SYSTEM

The cabin call system is for communication between the cockpit and the cabin.

CALLS FROM THE COCKPIT



(1) FWD/AFT pushbutton

When pressed, the following aural and visual alerts will trigger in the cabin :

R
- Two lights come on in pink on the FWD or AFT area call panel, as applicable.
- On the Attendant Indication Panel (AIP), the "CAPTAIN CALL" message appears and a light comes on in green.
- A high-low chime sounds in the FWD or AFT section of the cabin, as applicable.

(2) EMER pushbutton-switch (guarded)

When pressed, the following aural and visual alerts will trigger in the cabin :
- Two pink lights flash on all area call panels.
- The "EMERGENCY CALL" message appears on all AIPs.
- A high-low chime sounds three times, on all of the loudspeakers.

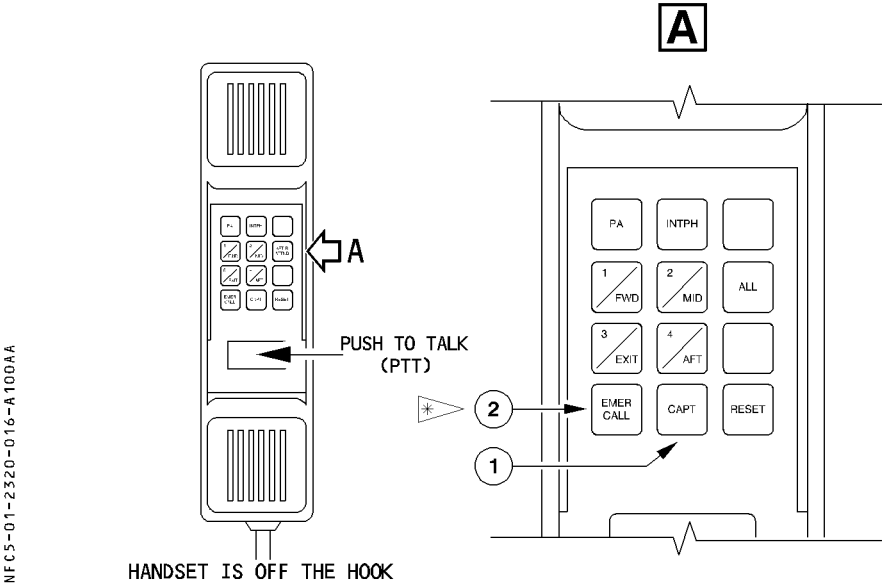
Also, on the cockpit CALLS panel, the ON light flashes in white and the CALL light flashes in amber.

R
R If the cabin handset has an EMER CALL key, the following aural and visual alerts will trigger in the cockpit, when an emergency call is made from the cabin to the cockpit :
- On the EMER pb-sw : The ON light flashes in white, and the CALL light flashes in amber.
- The ATT lights will flash on all Audio Control Panels (ACPs).
- Three buzzers will sound consecutively (for approx. three seconds each).

The cabin call system will reset, when the cabin crewmember hangs up the handset.

CALLS FROM THE CABIN

R



① CAPT key

When pressed, the following aural and visual alerts will trigger in the cockpit :
- The ATT lights will flash on all Audio Control Panels (ACPs).
- A buzzer (inhibited during takeoff and landing) will sound.

In the cabin, the "CAPTAIN" message will appear on the Attendant Indication Panel (AIP) for which the CAPT key was pressed.

R ② EMER CALL key ◁

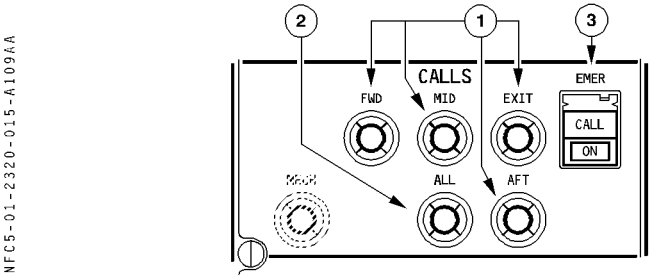
When pressed, the following aural and visual alerts will trigger in the cockpit :
- On the EMER pb-sw : The ON light flashes in white, and the CALL light flashes in amber.
- The ATT lights will flash on all ACPs
R - Three buzzers (inhibited during takeoff and landing) will sound consecutively.

In the cabin, the "EMERGENCY CALL" message will appear on all AIPs.

CABIN CALL SYSTEM

The cabin call system is for communication between the cockpit and the cabin.

CALLS FROM THE COCKPIT



(1) FWD/MID/EXIT/AFT pushbuttons

When pressed, the following aural and visual alerts will trigger in the cabin :

R
- Two lights come on in pink on the FWD/MID/EXIT/AFT area call panel, as applicable.
- On the Attendant Indication Panel (AIP), the "CAPTAIN CALL" message appears and a light comes on in green.
- A high-low chime sounds in the FWD/MID/EXIT/AFT section of the cabin, as applicable.

(2) ALL pushbutton

When pressed, all the stations simultaneously respond, as indicated above.

(3) EMER pushbutton-switch (guarded)

When pressed, the following aural and visual alerts will trigger in the cabin :
- Two pink lights flash on all area call panels.
- The "EMERGENCY CALL" message appears on all AIPs.
- A high-low chime sounds three times, on all of the loudspeakers.

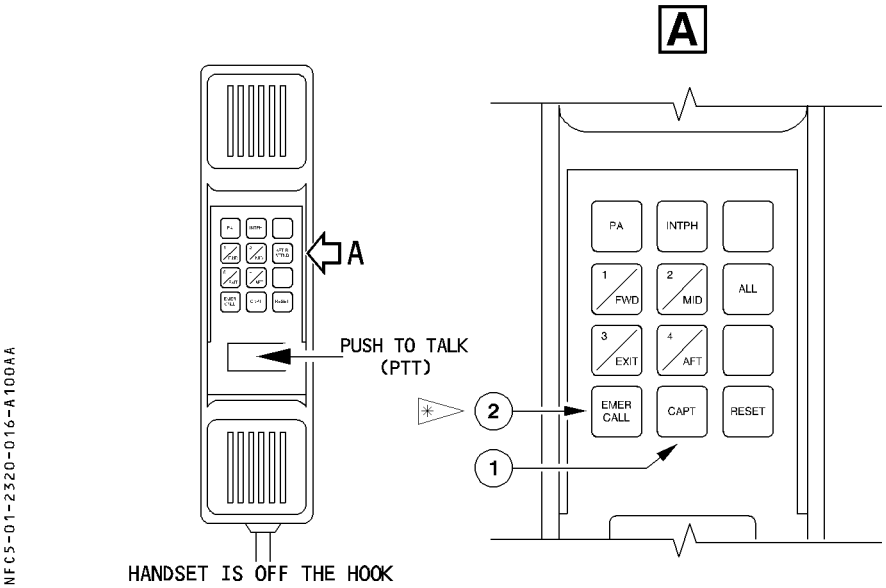
Also, on the cockpit CALLS panel, the ON light flashes in white and the CALL light flashes in amber.

R
R
If the cabin handset has an EMER CALL key, the following aural and visual alerts will trigger in the cockpit, when an emergency call is made from the cabin to the cockpit :
- On the EMER pb-sw : The ON light flashes in white, and the CALL light flashes in amber.
- The ATT lights will flash on all Audio Control Panels (ACPs).
- Three buzzers will sound consecutively (for approx. three seconds each).

The cabin call system will reset, when the cabin crewmember hangs up the handset.

CALLS FROM THE CABIN

R



(1) CAPT key

When pressed, the following aural and visual alerts will trigger in the cockpit :
- The ATT lights will flash on all Audio Control Panels (ACPs).
- A buzzer (inhibited during takeoff and landing) will sound.

In the cabin, the "CAPTAIN" message will appear on the Attendant Indication Panel (AIP) for which the CAPT key was pressed.

R (2) EMER CALL key ◁

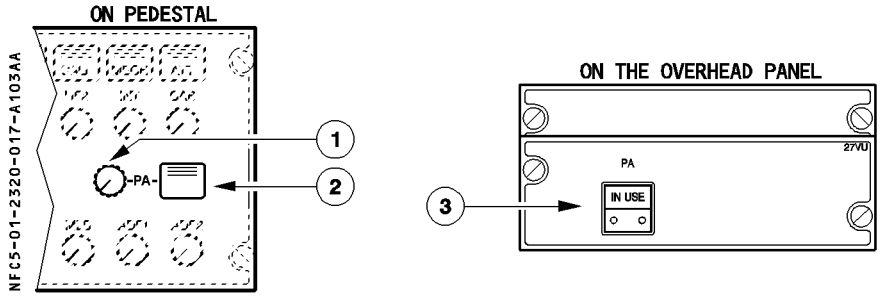
When pressed, the following aural and visual alerts will trigger in the cockpit :
- On the EMER pb-sw : The ON light flashes in white, and the CALL light flashes in amber.
- The ATT lights will flash on all ACPs
R - Three buzzers (inhibited during takeoff and landing) will sound consecutively.

In the cabin, the "EMERGENCY CALL" message will appear on all AIPs.

PASSENGER ADDRESS

The passenger address allows flight personnel to make announcements to passengers in the cabin through loudspeakers. It can be operated from the cockpit (with ACP or handset) or from the cabin (attendant stations).

CONTROLS and INDICATORS



(1) PA transmission key

Pressed and held : The flight crew may use a boom, mask, or hand mike to make an announcement.
Three green lines come on.

Note : The flight crew may use a cockpit handset to make PA announcements without action on the ACPs.

(2) PA reception knob

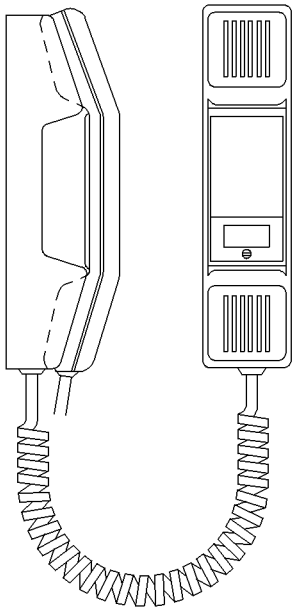
Pressed and released (knob out) : The message goes to the loudspeakers and the integral white light comes on.
R The flight crew can rotate the knob to adjust the volume.
Pressed (knob in) : The PA system is disconnected.
The white light goes out.

(3) PA IN USE lt

Comes on white when the PA is activated from the cockpit or from the cabin (cabin attendant or prerecorded announcement).

Cockpit handset

The cockpit handset at the bottom of the pedestal is for PA announcements.



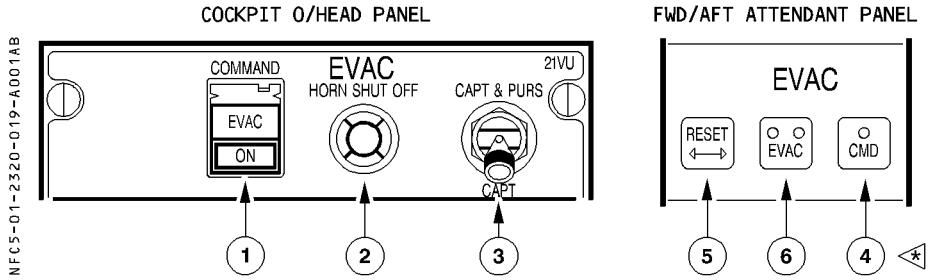
NFCS-01-2320-018-A001AA

PA from cockpit

R

	PA TRANSMISSION KEY ON ACP	PA RECEPTION KNOB ON ACP	PUSH TO TALK ON HANDMIKE	PUSH TO TALK ON HANDSET
BOOMSET OR OXYGEN MASK	PRESSED	OUT		
HANDMIKE	PRESSED	OUT	PRESSED	
HANDSET				PRESSED

EMER EVAC



(1) COMMAND pb

ON : In the cockpit : – EVAC light flashes red.
– Horn sounds.
In the cabin : – EVAC lights flash at FWD and AFT attendant panels.
– Evacuation tone sounds.
Off : The alert is stopped.
The EVAC light flashes red when the alert is activated.

(2) HORN SHUT OFF pb

Pressing this button silences the cockpit horn.

(3) CAPT and PURS/CAPT sw

CAPT and PURS : The alert may either be activated from the cockpit or the cabin.
CAPT : The alert may only be activated from the cockpit.
R If one of the cabin CMD pushbuttons is pressed, only the cockpit
R horn sounds for 3 seconds.

(4) CMD pb

Pressing this button activates the alert, if the cockpit switch is at the CAPT & PURS position.
Pressing it again stops the alert.

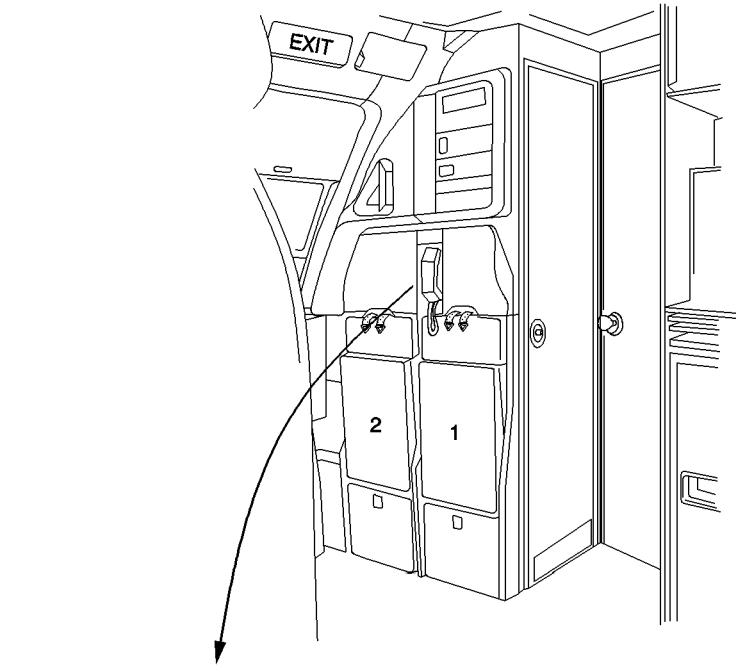
(5) RESET pb

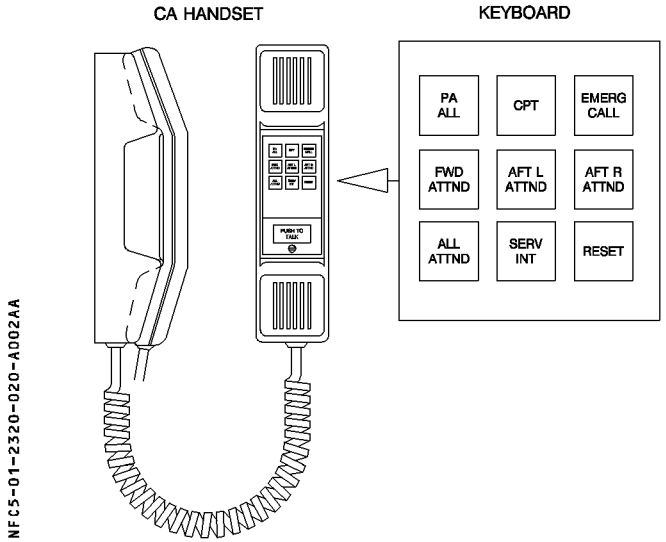
Pressing this button silences the EVAC tone.

(6) EVAC lt

This light flashes when the alert is activated.

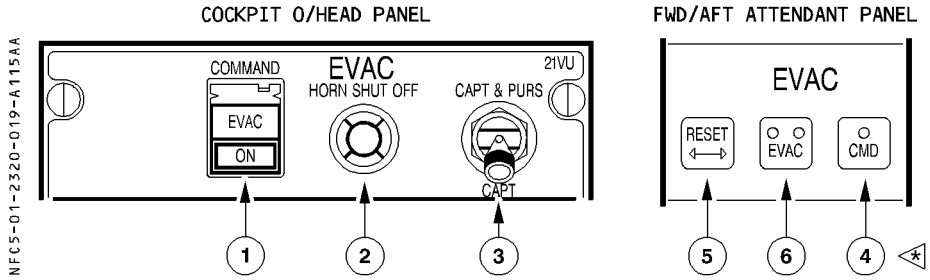
PURSER STATION





NFC5-01-2320-020-A002AA

EMER EVAC



(1) COMMAND pushbutton

ON : In the cockpit : – EVAC light flashes red.
In the cabin : – EVAC lights flash at FWD and AFT attendant panels.
– Evacuation tone sounds.
Off : The alert is stopped.
The EVAC light flashes red when the alert is activated.

(2) HORN SHUT OFF pushbutton

Pressing this button silences the cockpit horn.

(3) CAPT and PURS/CAPT switches

CAPT and PURS : The alert may either be activated from the cockpit or the cabin.
CAPT : The alert may only be activated from the cockpit.
If one of the cabin CMD pushbuttons is pressed, only the cockpit horn sounds for 3 seconds.

(4) CMD pushbutton

Pressing this button activates the alert, if the cockpit switch is at the CAPT & PURS position.
Pressing it again stops the alert.

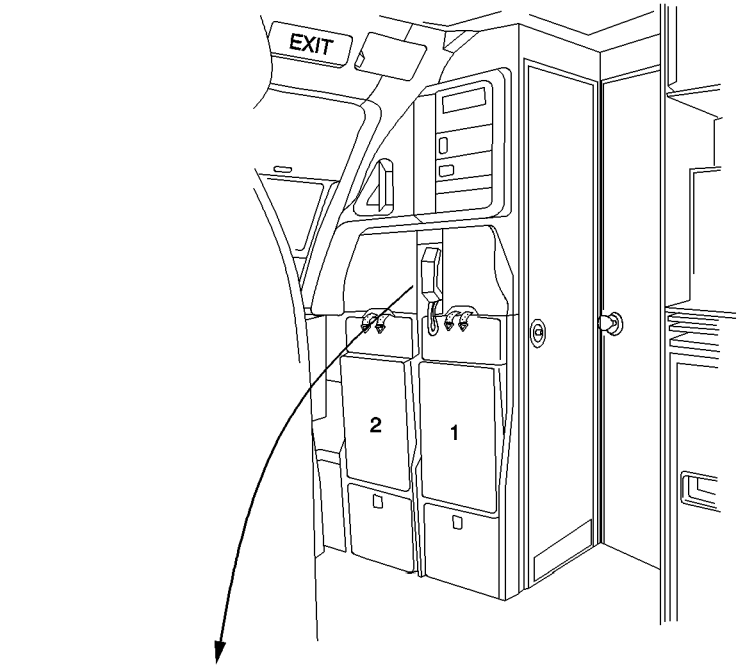
(5) RESET pushbutton

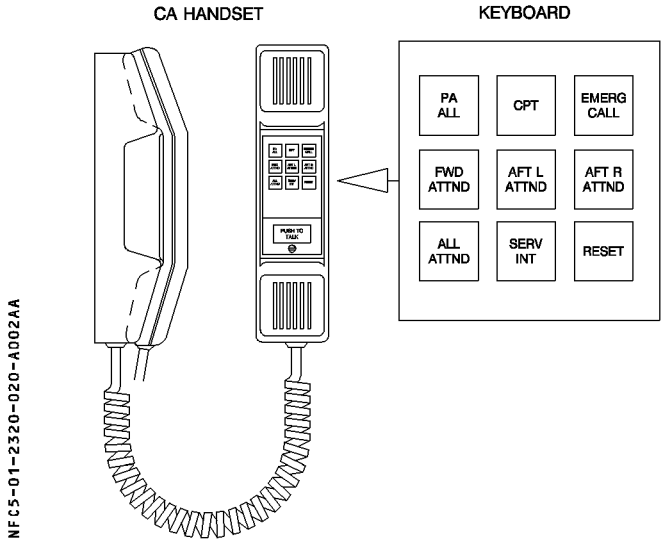
Pressing this button silences the EVAC tone.

(6) EVAC lt

This light flashes when the alert is activated.

PURSER STATION





NFC5-01-2320-020-A002AA

DESCRIPTION

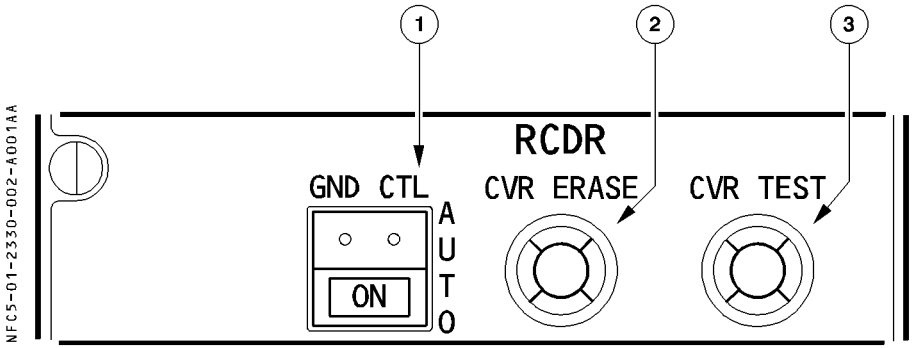
The cockpit voice recorder (CVR) records :
- direct conversations between crew members in the cockpit
- all aural warnings sounded in the cockpit
- communications received and transmitted by radio
- intercommunication conversations between crew members
- announcements transmitted over the passenger address system, if PA reception is selected on the third audio control panel.

Only the last 2 hours of recording are retained.
The CVR system consists of :
- a remote microphone behind the overhead panel.
- a "hot mike" function, which records the crew members voice directly from their microphone, even if the push to talk switch is not activated.
- a crashproof four-track recorder, equipped with an underwater locating beacon, in the aft section of the aircraft
- a control panel on the overhead panel.

It is energized automatically :
- on the ground during the first 5 minutes after the aircraft electrical network is energized
- on the ground with one engine running
- in flight

On the ground, it is stopped automatically 5 minutes after the last engine shutdown.
On the ground, the crew can energize the CVR manually by pressing the GND CTL pushbutton.

CONTROLS AND INDICATORS ON OVERHEAD PANEL



(1) GND CTL switch (spring-loaded)

ON : The CVR, DFDR, and QAR ◁ are on.
The ON light comes on blue.

AUTO : The CVR, DFDR, and QAR ◁ are on, according to the logic. (See page 1).

(2) CVR ERASE pushbutton

Pressed for 2 seconds : This completely erases the tape, if :
— The aircraft is on the ground, and
— The parking brake is on.

(3) CVR TEST pushbutton

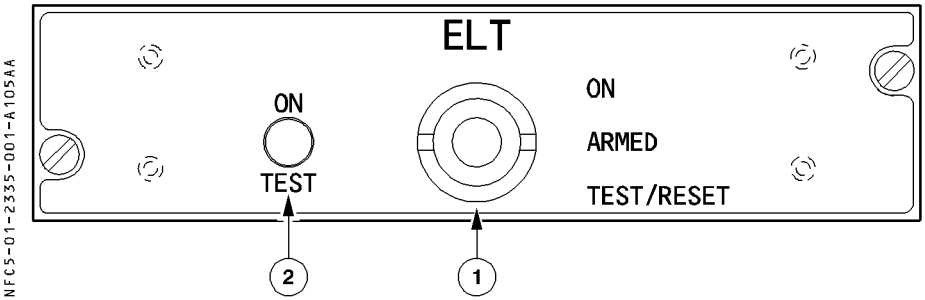
Pressed and held : This activates the test, if the CVR is on (the GND CTL pushbutton pressed, or during the first 5 minutes after energization of the aircraft electrical network), and the parking brake is on.

R Refer to the FCOM 3.03.06, p. 2 for additional
R information.

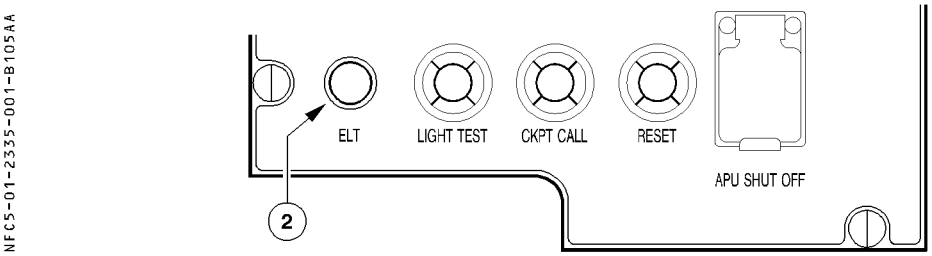
CONTROLS AND INDICATORS

OVERHEAD PANEL

R



EXTERNAL POWER PANEL



(1) ELT sw

R

ON : The Emergency Locator Transmitter (ELT) transmits an emergency signal.

ARMED : In case of impact, the ELT transmits an emergency signal (on 121.5, 243 and 406.025 MHZ).

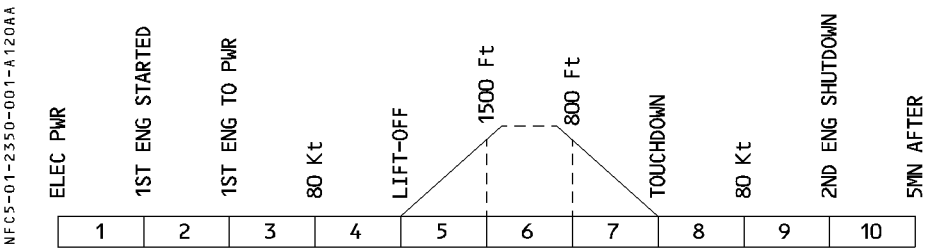
TEST/RESET : Starts the ELT autotest.

Note : If the ELT is triggered by an impact in ARMED mode, selecting TEST/RESET resets the ELT and stops the signal transmission.

(2) ON TEST and ELT lights

These lights come on amber, either when the emergency signal is transmitted or during the ELT autotest.

WARNINGS AND CAUTIONS



E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
CIDS 1 + 2 FAULT	SINGLE CHIME	MASTER CAUTION	NIL	NIL	3,4,5 7,8
VHF 1(2) (3) EMITTING HF 1 (2) EMITTING Transmitter emitting more than 60 seconds.					
SATCOM FAULT (◁)	NIL	NIL			
ACARS FAULT (◁)					
HF 1(2) DATA FAULT (◁)					
VHF 3 DATA FAULT (◁)					
SATCOM DATA FAULT (◁)					

MEMO DISPLAY

This display shows "AUDIO 3 XFRD" in green, if the AUDIO SWITCHING selector is not on NORM.

If ACARS is installed, the display shows :

- "ACARS CALL" pulsing in green, if ACARS has received a message from the ground requesting a voice communication.
- "VHF 3 : VOICE" in green, if VHF3 is operating in voice mode and ACARS communication is interrupted.
- "ACARS MSG" pulsing in green, if ACARS has received a message from the ground.
- "ACARS STBY" in green, if ACARS communications between the aircraft and the ground are lost.

If the SATCOM is installed, the display shows "SATCOM ALERT" in green, when a message with a priority level below 4 is received from the ground.

If HF and ATSU are installed, the display shows "HF VOICE", pulsing in green for 10 seconds and then steady, when all the HF radios are in voice mode.

BUS EQUIPMENT LIST

		NORM		EMER ELEC		
		AC	DC	AC ESS	DC ESS	HOT
RADIO COMMUNICATIONS	VHF1				X	
	VHF2		DC2			
	VHF3 ◁		DC1			
	HF1 ◁			SHED		
	HF2 ◁	AC2				
	RMP1				X	
	RMP2		DC2			
	RMP3 ◁		DC1			
	CAPT ACP				X	
	F/O ACP				X	
	THIRD ACP		DC1			
	FOURTH ACP ◁		DC1			
	SELCAL		DC1			
	FLT INTERPHONE				X	
	CAPT LOUDSPEAKER				X	
	F/O LOUDSPEAKER		DC2			
	EXT HORN					HOT 2
CABIN INTERCOMM DATA SYS	CIDS1		GND/FLT		X	
	CIDS2		GND/FLT		X	
	DEU (A/B)		GND/FLT		X	
COCKPIT VOICE RECORDER	CVR CTL				SHED	
	CVR			SHED		
ACARS ◁		AC1				

24.00 CONTENTS

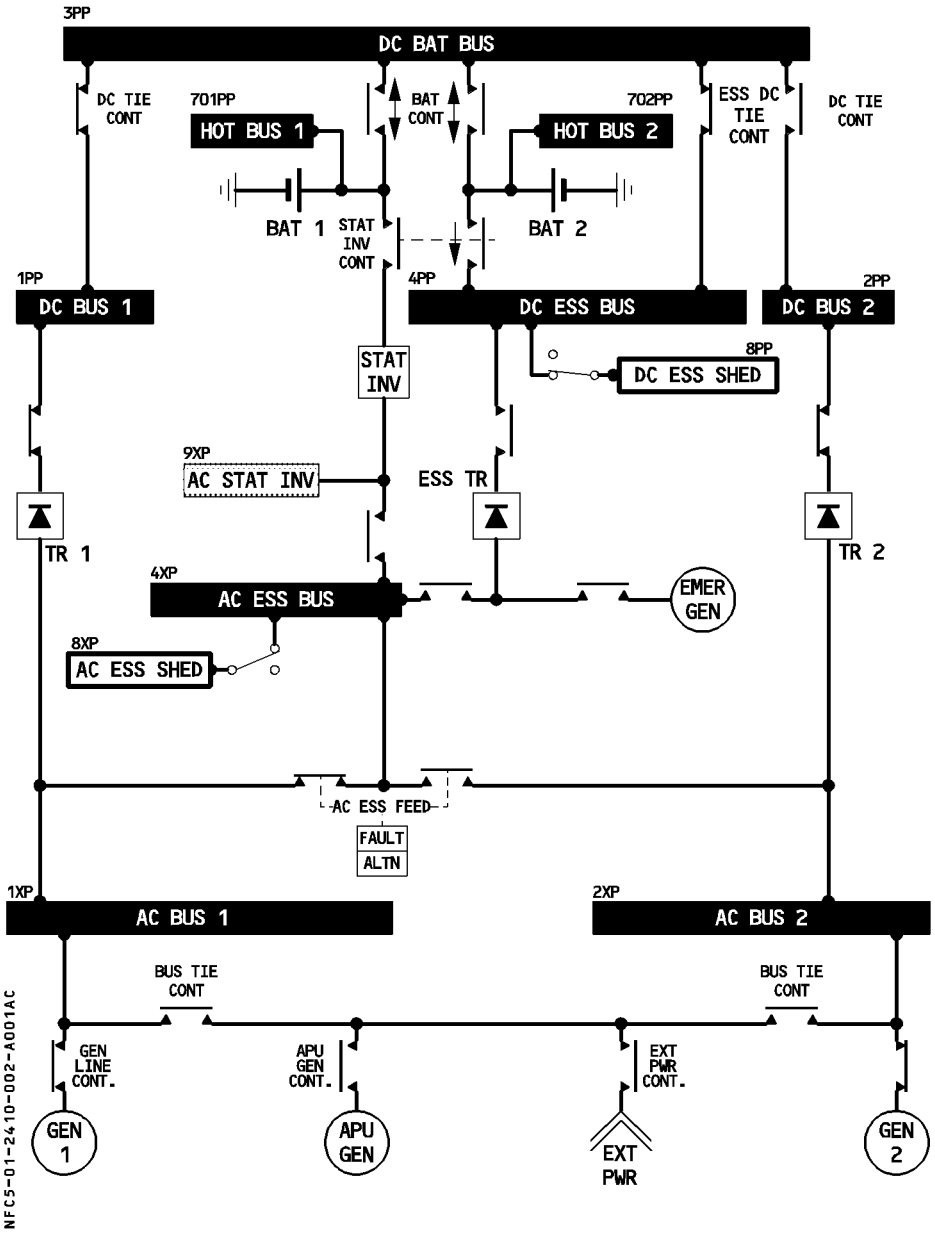
24.10 DESCRIPTION
– GENERAL 1
– GENERATION OF ELECTRICAL POWER 3
– OPERATIONS 5

24.20 CONTROLS AND INDICATORS
– OVERHEAD PANEL 1
– EXTERNAL POWER PANEL 7
– FORWARD CABIN 8
– ECAM ELECTRIC PAGE 9
– WARNINGS AND CAUTIONS 17
– MEMO DISPLAY 18

GENERAL

The electrical power system consists of a three-phase 115/200-volt 400-hertz constant-frequency AC system and a 28-volt DC system.
Electrical transients are acceptable for equipment.
Commercial supply has secondary priority.
Normally, the system produces alternating current, some of which it then transforms into direct current for certain applications.
Each of the aircraft's three generators can supply the whole network.
If all normal AC generation is lost, an emergency generator can supply AC power.
If all AC generation is lost, the system can transform DC power from the batteries into AC power.

FOR INFO


3PP
DC BAT BUS
DC TIE CONT
701PP
HOT BUS 1
BAT CONT
702PP
HOT BUS 2
ESS DC TIE CONT
DC TIE CONT
BAT 1
STAT INV CONT
BAT 2
1PP
DC BUS 1
4PP
DC ESS BUS
2PP
DC BUS 2
STAT INV
8PP
DC ESS SHED
9XP
AC STAT INV
ESS TR
TR 1
TR 2
4XP
AC ESS BUS
EMER GEN
8XP
AC ESS SHED
AC ESS FEED
FAULT
ALTN
1XP
AC BUS 1
2XP
AC BUS 2
BUS TIE CONT
BUS TIE CONT
GEN LINE CONT.
APU GEN CONT.
EXT PWR CONT.
GEN 1
APU GEN
EXT PWR
GEN 2
NFC5-01-2410-002-A001AC

GENERATION OF ELECTRICAL POWER

AC GENERATORS

ENGINE – DRIVEN GENERATORS

Two three-phase AC generators (GEN1, GEN2), driven by the engine through an integrated drive, supply aircraft electrical power. Each generator can supply up to 90 KVA of three phase 115/200-volt 400 hertz power.
Two Generators Control Units (GCU) control the output of their respective generator. The main functions of each GCU are :
– Control the frequency and voltage of the generator output.
– Protect the network by controlling the associated generator line contactor (GLC).

APU GENERATOR AND EXTERNAL POWER

A third generator (APU GEN), driven directly by the APU and producing the same output as each main engine generator, can replace either or both main engine generators at any time.
A ground power connector near the nosewheel allows ground power to be supplied to all busbars.
A Ground and Auxiliary Power Unit (GAPCU) :
– Controls the frequency and voltage of the APU generator and external power output.
– Protects the network by controlling the external power contactor and the APU Generator Line Contactor.

EMERGENCY GENERATOR

The blue hydraulic circuit drives an emergency generator that automatically supplies emergency AC power to the aircraft electrical system, if all main generators fail. This generator supplies 5 KVA of three-phase 115/200-volts 400-hertz power.
A generator control unit (GCU) :
– Keeps the emergency generator at a constant speed,
– Controls the generator's output voltage,
– Protects the network by the controlling the emergency generator line contactor, and
– Controls the emergency generator start-up.

STATIC INVERTER

A static inverter transforms DC power from Battery 1 into one KVA of single-phase 115-volt 400-hertz AC power, which is then supplied to part of the AC essential bus. When the aircraft speed is above 50 knots, the inverter is automatically activated, if nothing but the batteries are supplying electrical power to the aircraft, regardless of the BAT 1 and BAT 2 pushbutton positions.
When the aircraft speed is below 50 knots, the inverter is activated, if nothing but the batteries are supplying electrical power to the aircraft, and the BAT 1 and BAT 2 pushbuttons are both on at auto.

DC GENERATION

TRANSFORMER RECTIFIERS (TRs)

Two main transformer rectifiers, TR 1 and TR 2, supply the aircraft's electrical system, with up to 200 amperes of DC current.
A third (identical) transformer rectifier, the ESS TR, can power the essential DC circuit from the emergency generator, if the engine and APU generators all fail, or if TR 1 or TR 2 fails.
Each TR controls its contactor by internal logic.

BATTERIES

Two main batteries, each with a normal capacity of 23 ampere-hours, are permanently connected to the two hot buses.
Each battery has an associated Battery Charge Limiter (BCL).
The BCL monitors battery charging and controls its battery contactor.

CIRCUIT BREAKERS (C/Bs)

The aircraft has two types of C/Bs :

- Monitored (green) : When out for more than one minute, the C/B TRIPPED warning is triggered on the ECAM.
- Non-monitored (black).

The Wing Tip Brakes (WTB) C/Bs have red caps on them to prevent them from being reset.
The C/B TRIPPED warning on the ECAM indicates the location of the affected C/B. The following panels are monitored : OVHD PNL, L(R) ELEC BAY, REAR PNL J-M or N-R or S-V or W-Z.

Note : The flight crew can clear the ECAM C/B TRIPPED caution by pressing :

- *The EMER CANCEL pushbutton : When pressed, this pushbutton clears and inhibits the ECAM C/B TRIPPED caution for the remainder of the flight, or*
- *The CLR pushbutton : When pressed, this pushbutton only clears the ECAM C/B TRIPPED caution. If the C/B remains pulled, any additional tripped circuit breakers on the same panel will not be detected, and the ECAM will not trigger the caution. However, if the C/B is pushed, any additional tripped circuit breakers will be detected, and the ECAM will trigger the caution again.*

OPERATIONS

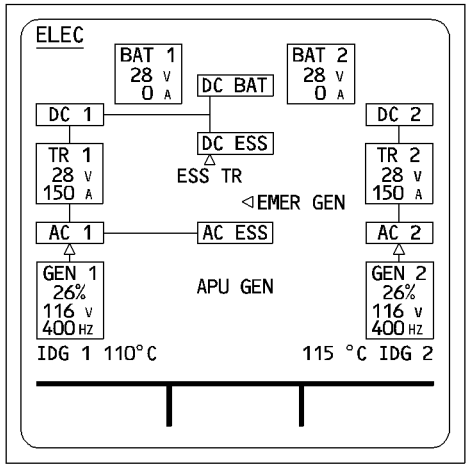
GENERAL

GEN 1 and 2 when operating have priority over the APU generator and over external power.
External power has priority over the APU generator when the EXT PWR pushbutton switch is ON.
The APU generator or external power can supply the entire network.
One engine generator can supply the entire network.
The generators cannot be connected in parallel.

NORMAL CONFIGURATION

IN FLIGHT

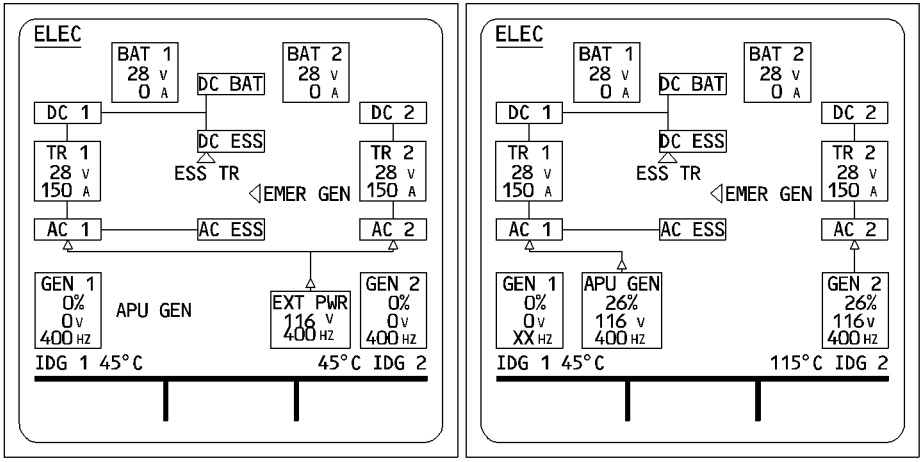
Each engine-driven generator supplies its associated AC BUS (1 and 2) via its generator line contactor (GLC 1 and GLC 2).
AC BUS 1 normally supplies the AC ESS BUS via a contactor.
TR 1 normally supplies DC BUS 1, DC BAT BUS, and DC ESS BUS.
TR 2 normally supplies DC BUS 2.
The two batteries are connected to the DC BAT BUS, if they need charging. When they are fully charged, the battery charge limiter disconnects them.



NFC5-01-2410-006-A100AA

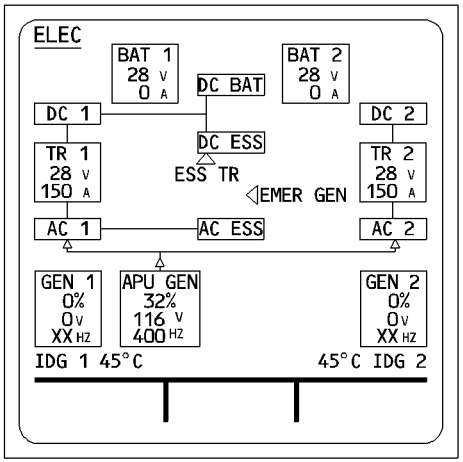
ON GROUND

Either the APU generator, or external power, may supply the complete system.



EXTERNAL POWER ONLY

APU GEN + GEN 2

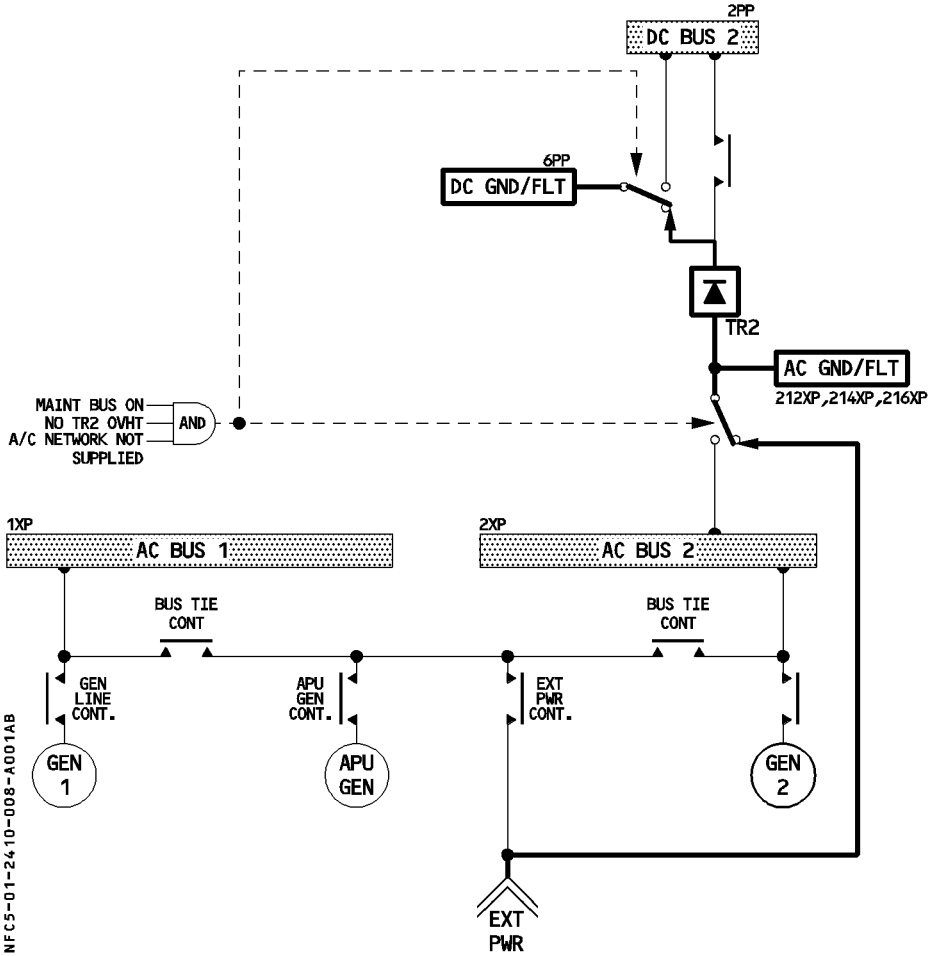


APU GEN ONLY

NFC5-01-2410-007-A100AA

On ground, when only ground services are required, external power can supply the AC and DC GND/FLT BUSES directly without supplying the entire aircraft network.
Personnel select this configuration with the MAINT BUS switch in the forward entrance area.

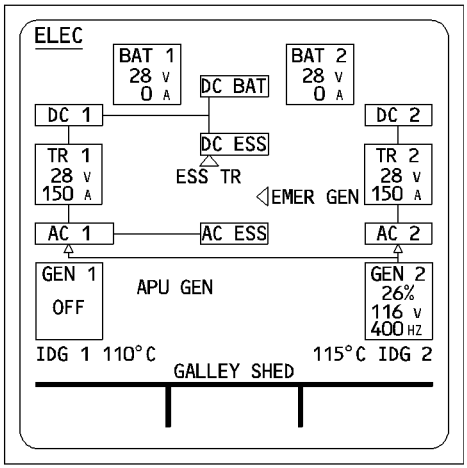
FOR INFO



ABNORMAL CONFIGURATIONS

FAILURE OF ONE ENGINE GENERATOR

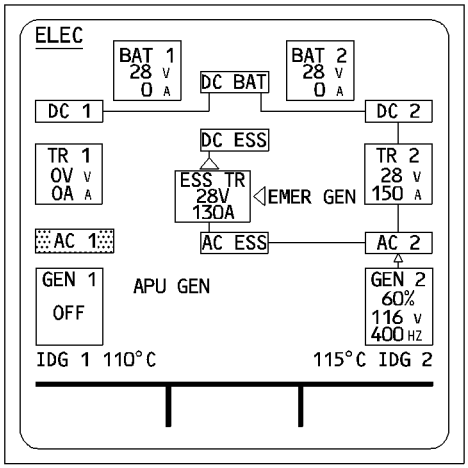
The system automatically replaces the failed generator, with the :
- APU GEN, if available, or
- Other engine generator (automatically shedding part of the galley load).



NFC5-01-2410-009-A150AA

FAILURE OF AC BUS 1

- AC BUS 2 can supply AC ESS BUS, and ESS TR can supply DC ESS BUS, both via the AC ESS FEED pushbutton.
- DC BUS 2 supplies DC BUS 1 and DC BAT BUS automatically after 5 seconds.

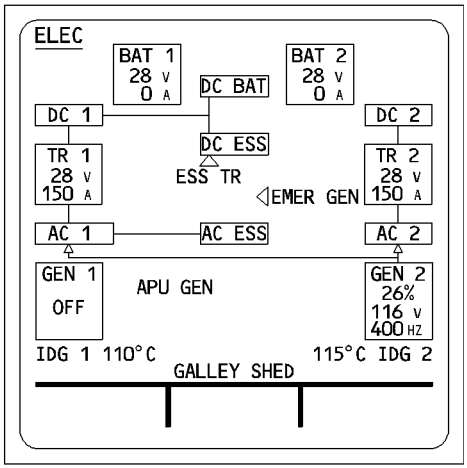


NFCS-01-2410-010-A100AA

ABNORMAL CONFIGURATIONS

FAILURE OF ONE ENGINE GENERATOR

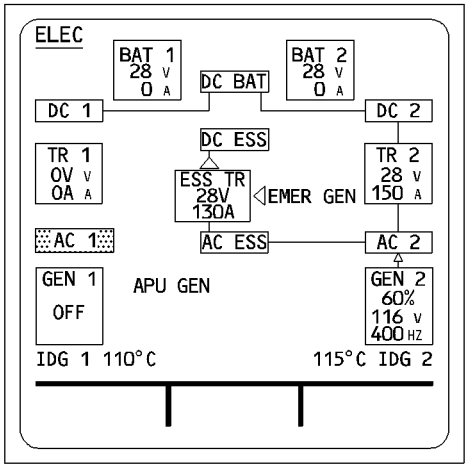
The system automatically replaces the failed generator, with the :
- APU GEN, if available, or
- Other engine generator (automatically shedding part of the galley load).



NFC5-01-2410-009-A150AA

FAILURE OF AC BUS 1

– AC BUS 2 automatically supplies AC ESS BUS, and DC ESS BUS via the ESS TR.
– DC BUS 2 supplies DC BUS 1 and DC BAT BUS automatically after 5 seconds.

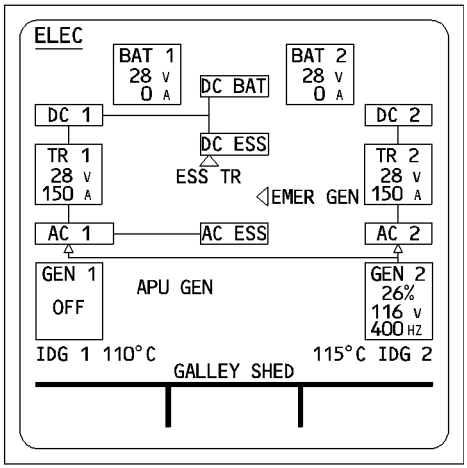


NFCS-01-2410-010-A205AA

ABNORMAL CONFIGURATIONS

FAILURE OF ONE ENGINE GENERATOR

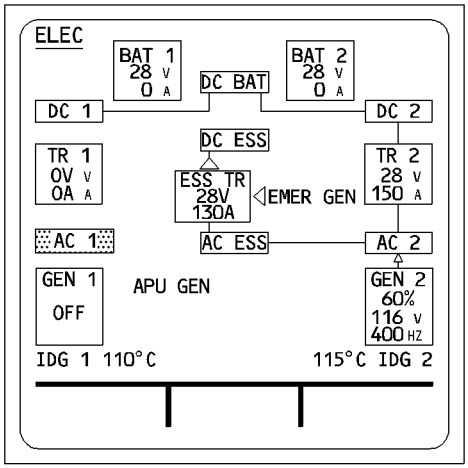
The system automatically replaces the failed generator with the :
– APU GEN, if available, or
– Other engine generator (automatically shedding all of the galley load).



NFC5-01-2410-009-A200AA

FAILURE OF AC BUS 1

- AC BUS 2 can supply AC ESS BUS, and ESS TR can supply DC ESS BUS, both via the AC ESS FEED pushbutton.
- DC BUS 2 supplies DC BUS 1 and DC BAT BUS automatically after 5 seconds.

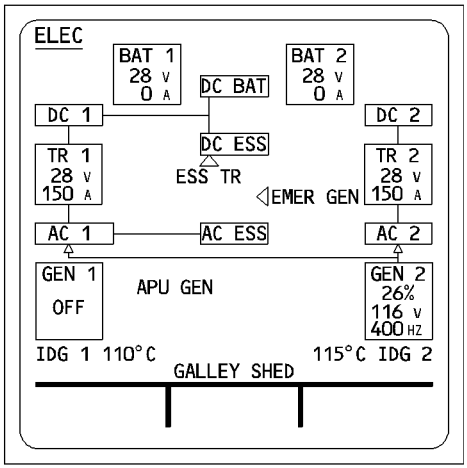


NFCS-01-2410-010-A100AA

ABNORMAL CONFIGURATIONS

FAILURE OF ONE ENGINE GENERATOR

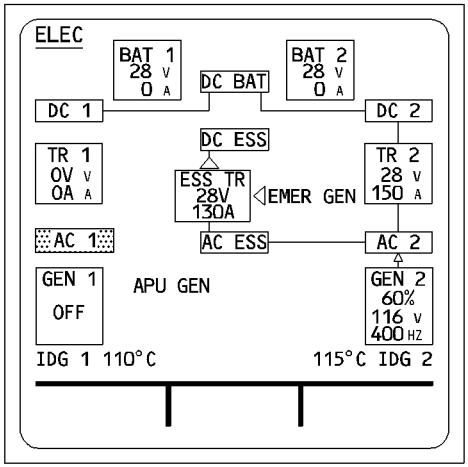
The system automatically replaces the failed generator with the :
– APU GEN, if available, or
– Other engine generator (automatically shedding all of the galley load).



NFC5-01-2410-009-A200AA

FAILURE OF AC BUS 1

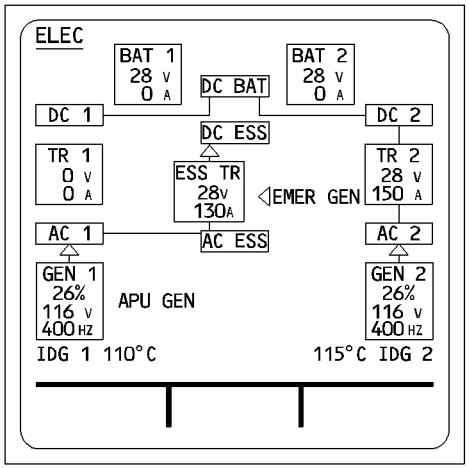
– AC BUS 2 automatically supplies AC ESS BUS, and DC ESS BUS via the ESS TR.
– DC BUS 2 supplies DC BUS 1 and DC BAT BUS automatically after 5 seconds.



NFCS-01-2410-010-A205AA

FAILURE OF ONE TR

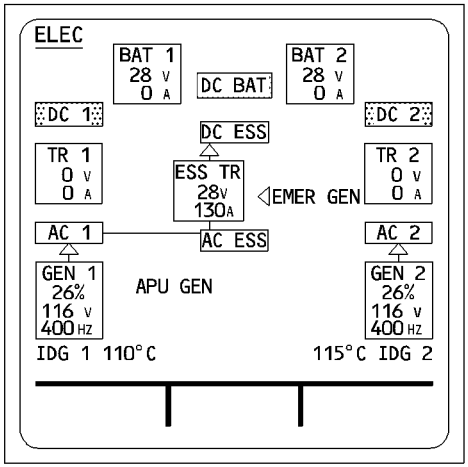
The contactor of each TR opens automatically, in case of :
– Overheat
– Minimum current
The other TR automatically replaces the faulty one.
The ESS TR supplies the DC ESS BUS.



NFC5-01-2410-011-A100AA

FAILURE OF TR 1 AND TR 2

If TR 1 and TR 2 are lost, DC BUS 1, DC BUS 2, and DC BAT BUS are lost. The DC ESS BUS is supplied by the ESS TR.



NFCS-01-2410-012-A100AA

EMERGENCY GENERATION AFTER LOSS OF ALL MAIN GENERATORS

If both AC BUS 1 and AC BUS 2 are lost and the aircraft speed is above 100 knots, the Ram Air Turbine (RAT) extends automatically. This powers the blue hydraulic system, which drives the emergency generator by means of a hydraulic motor. This generator supplies the AC ESS BUS, and the DC ESS BUS via the ESS TR.

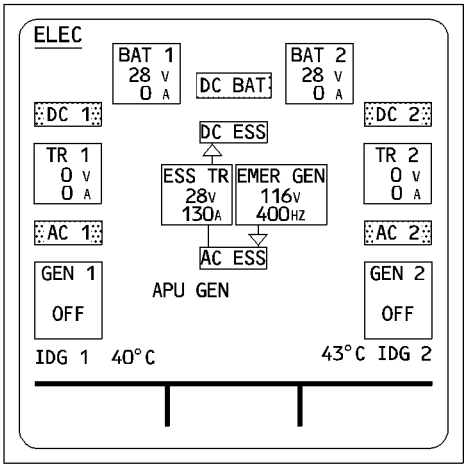
If the RAT stalls, or if the aircraft is on the ground with a speed below 100 knots, the emergency generator has nothing to drive it. The emergency generation network automatically transfers to the batteries and static inverter, and the system automatically sheds the AC SHED ESS and DC SHED ESS buses.

When the aircraft is on ground :

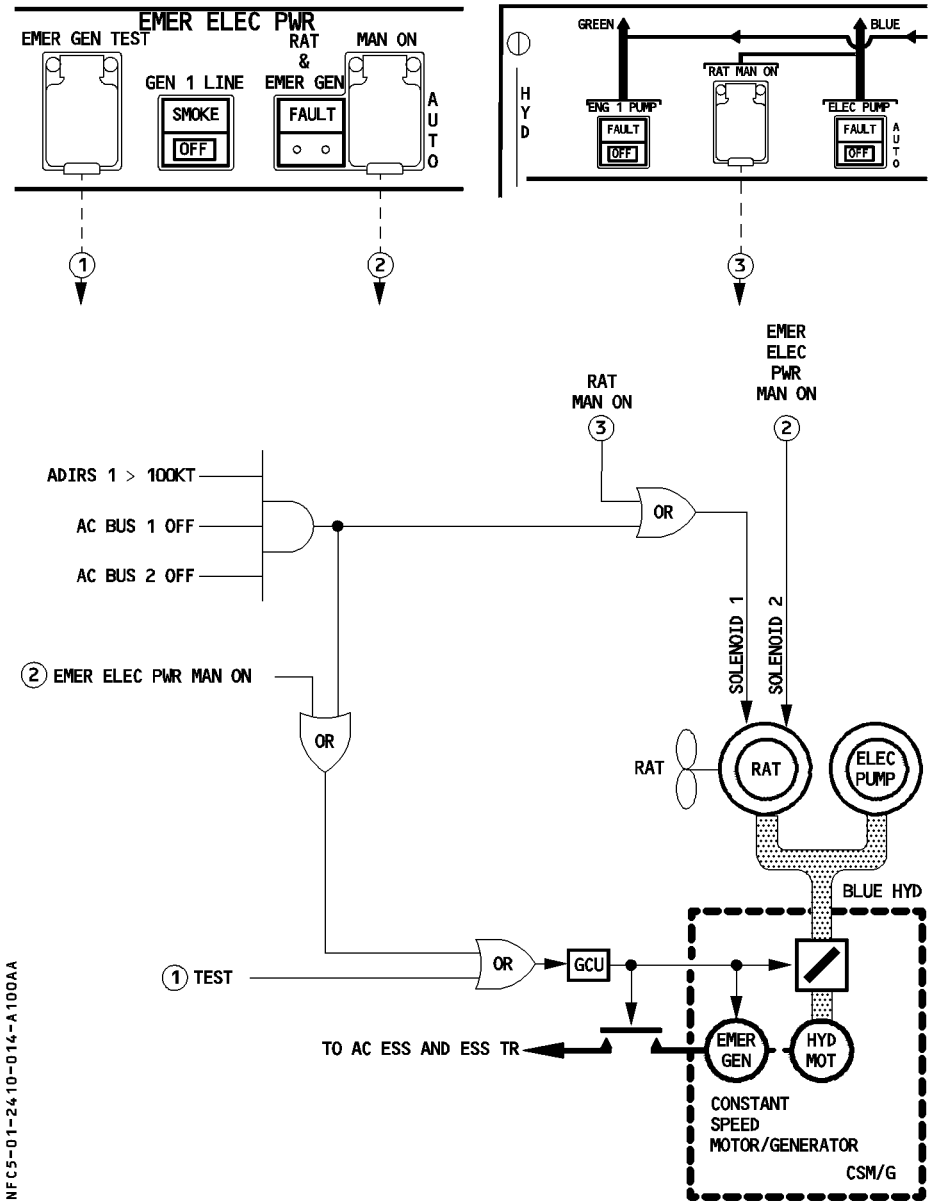
- Below 100 knots, DC BAT BUS is automatically connected to the batteries.
- Below 50 knots, AC ESS BUS is automatically shed, leading to the loss of all CRTs.

Note : During RAT extension and emergency generator coupling (about 8 seconds), the batteries power the emergency generation network.

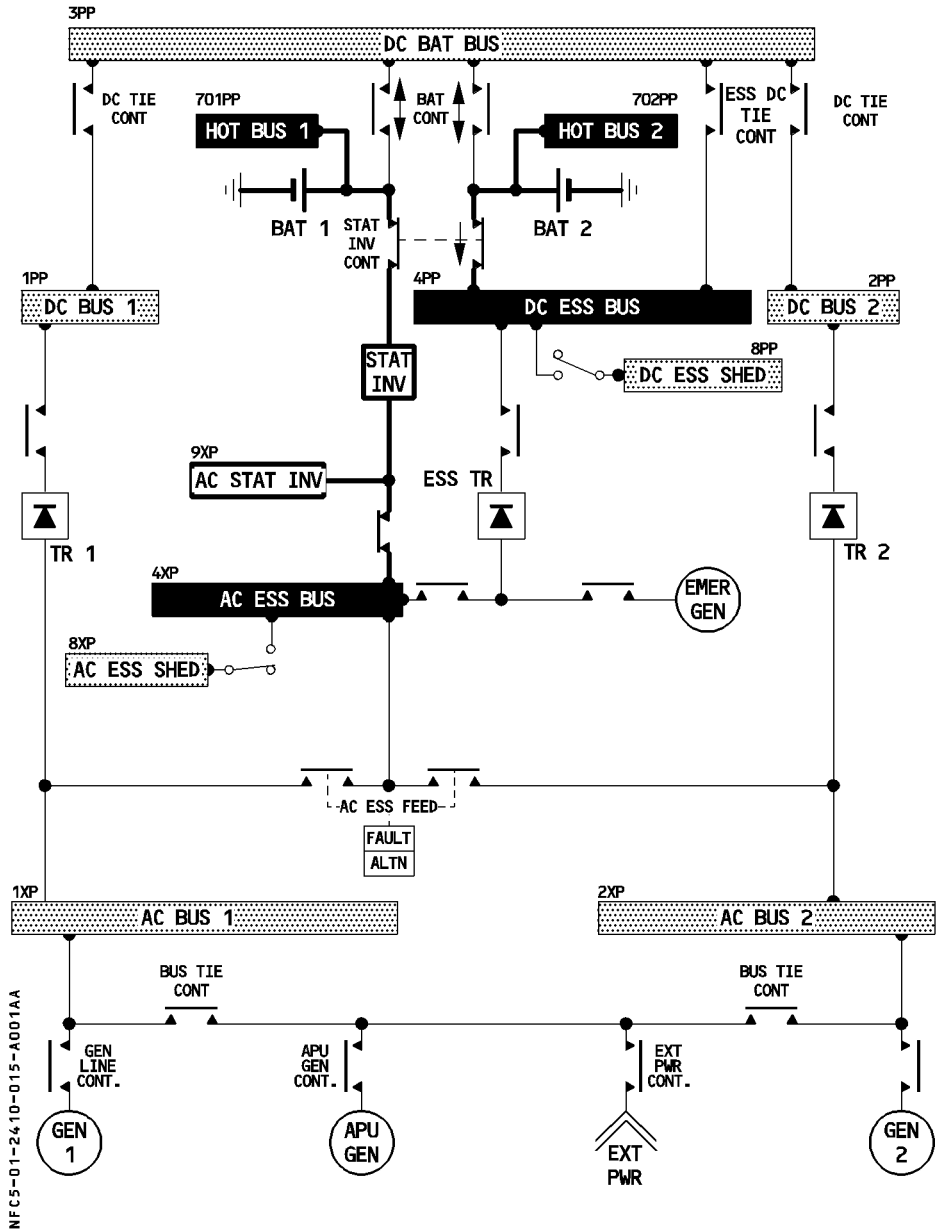
EMER GEN RUNNING



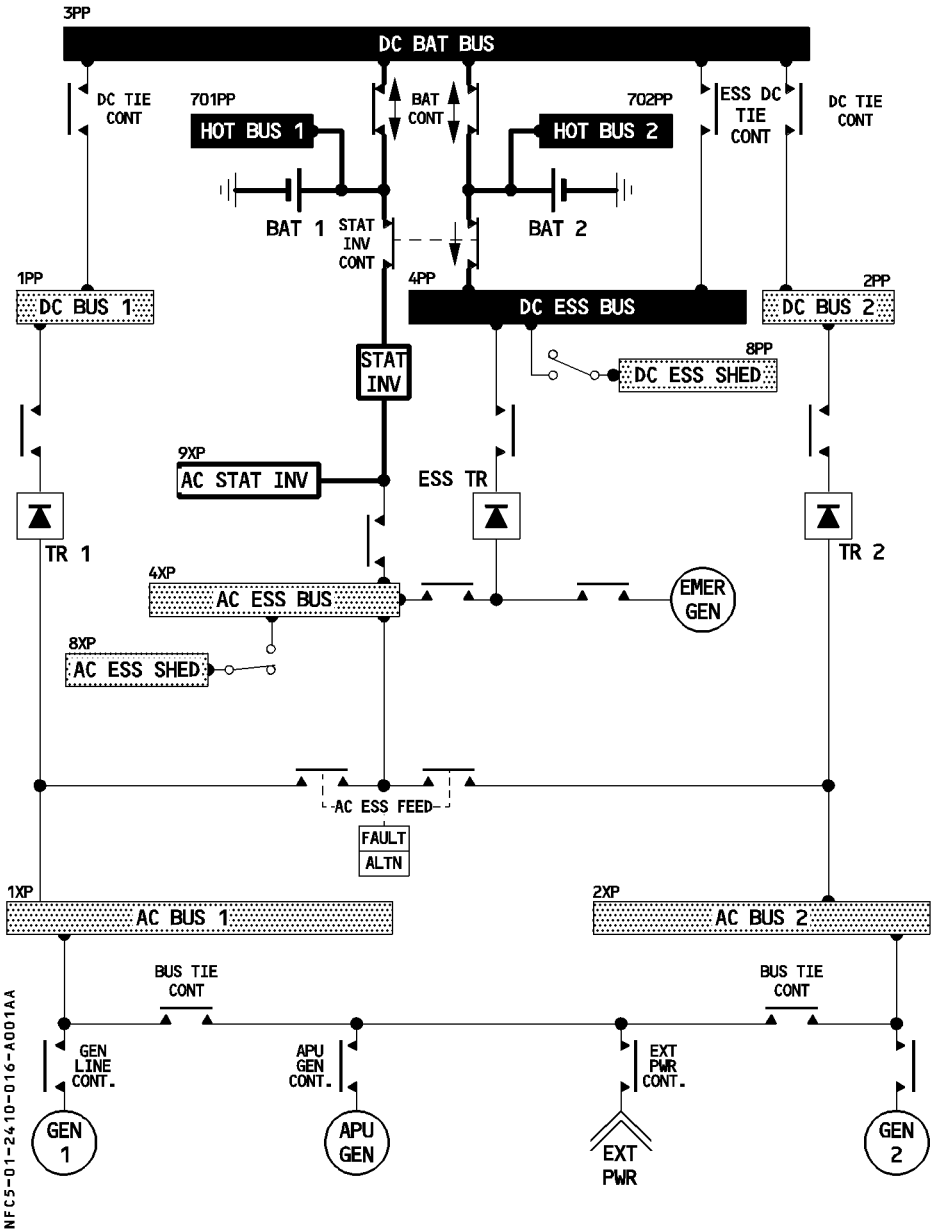
NFC5-01-2410-013-A150AA


EMER ELEC PWR
EMER GEN TEST
GEN 1 LINE
SMOKE
OFF
RAT
&
EMER GEN
FAULT
MAN ON
AUTO
GREEN
BLUE
RAT MAN ON
HYD
ENG 1 PUMP
FAULT
OFF
ELEC PUMP
FAULT
OFF
AUTO
1
2
3
RAT
MAN ON
3
EMER
ELEC
PWR
MAN ON
2
ADIRS 1 > 100KT
AC BUS 1 OFF
AC BUS 2 OFF
OR
SOLENOID 1
SOLENOID 2
2 EMER ELEC PWR MAN ON
OR
RAT
RAT
ELEC
PUMP
BLUE HYD
1 TEST
OR
GCU
TO AC ESS AND ESS TR
EMER
GEN
HYD
MOT
CONSTANT
SPEED
MOTOR/GENERATOR
CSM/G
NFC5-01-2410-014-A100AA

FLIGHT WITH BATTERIES ONLY

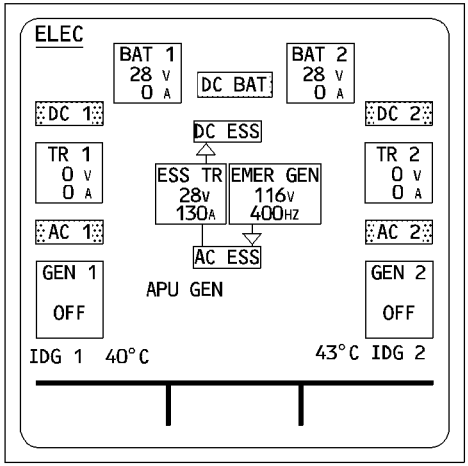


ON GROUND, BATTERIES ONLY (speed < 50 kt)



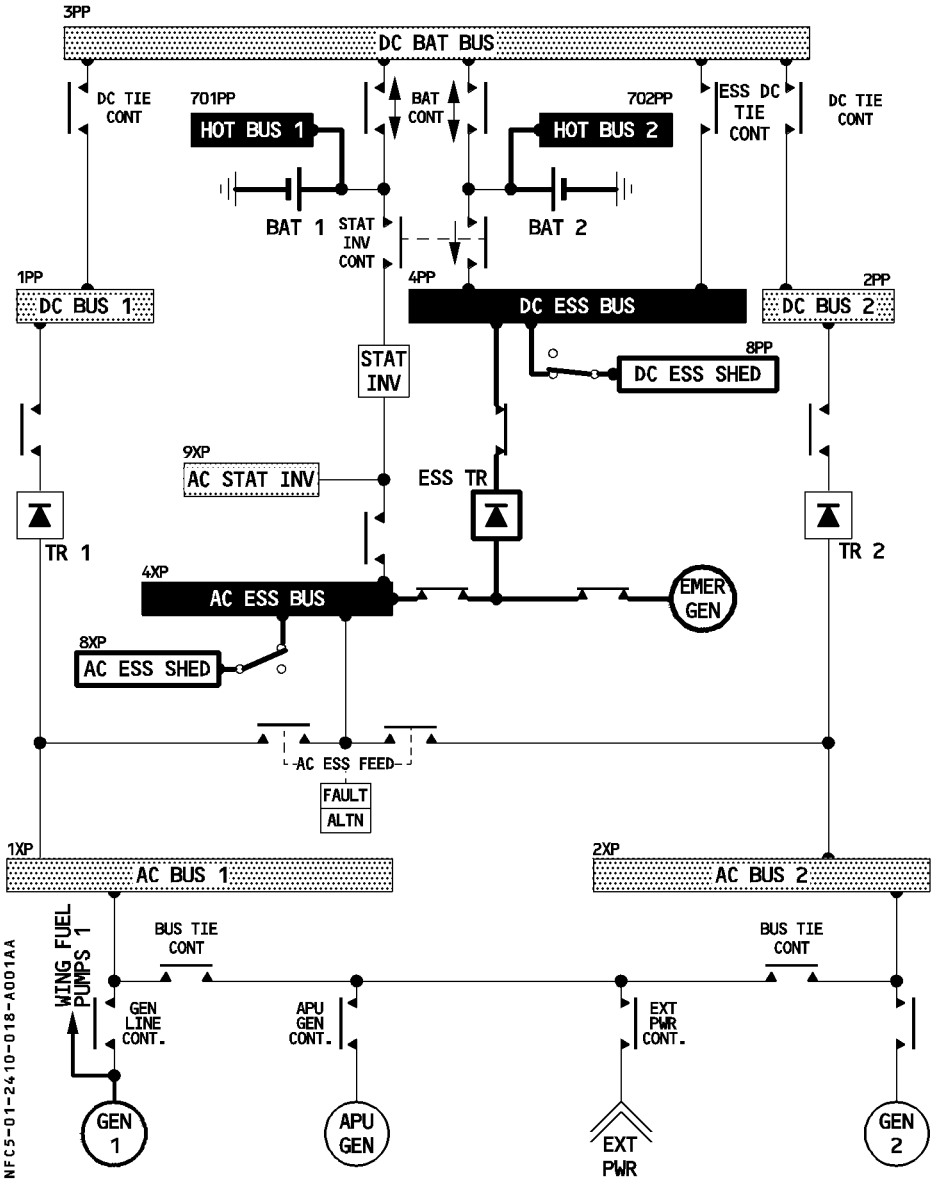
SMOKE CONFIGURATION

In this configuration, the main busbars are shedded. The electrical distribution is the same, as it is in the emergency configuration (loss of main generators), except that the fuel pumps are connected upstream of the GEN 1 line connector.
The procedure sheds about 75 % of electrical equipment. All equipment that remains powered is supplied via the circuit breakers on the overhead panel (except for that which is supplied by hot buses).



NFC5-01-2410-017-A100AA

SMOKE configuration



Note : ECAM ELEC page is identical to that for emergency generator running.

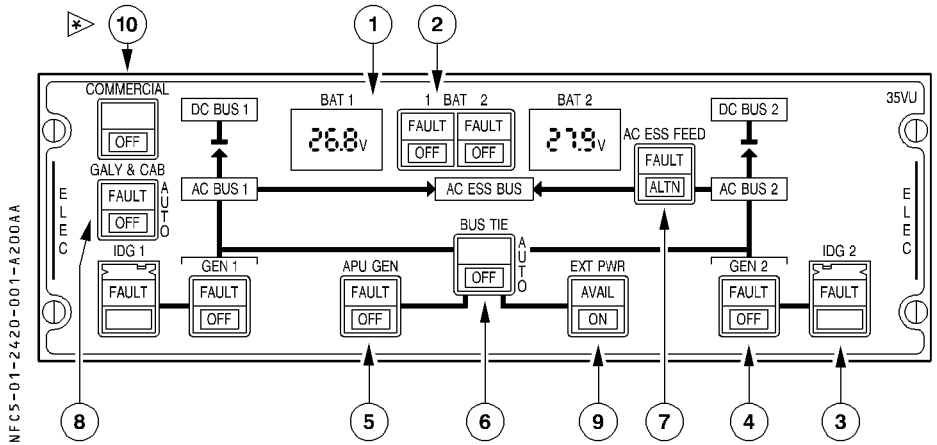
DISTRIBUTION TABLE

R

	AC BUS 1	AC BUS 2	AC ESS BUS	AC SHED ESS	AC STAT INV	TR1	TR2	ESS TR	DC BUS 1	DC BUS 2	DC BAT BUS	DC ESS BUS	DC SHED ESS	HOT BUS 1	HOT BUS 2
NORM CONF	GEN1	GEN2	GEN1	GEN1	–	GEN1	GEN2	–	TR1 GEN1	TR2 GEN2	TR1 GEN1	TR1 GEN1	TR1 GEN1	BAT1	BAT2
ONE GEN INOP AVAIL-X- (1,2 or APU)	GENX	GENX	GENX	GENX	–	GENX	GENX	–	TR1 GENX	TR2 GENX	TR1 GENX	TR1 GENX	TR1 GENX	BAT1	BAT2
EMER CONF · BEFORE EMER GEN AVAILABILITY (about 8 sec)	–	–	ST INV BAT1	–	ST INV BAT1	–	–	–	–	–	–	BAT2	–	BAT1	BAT2
· EMER GEN RUNNING	–	–	EMER GEN	EMER GEN	–	–	–	EMER GEN	–	–	–	ESS TR EMER GEN	ESS TR EMER GEN	BAT1	BAT2
TR1 FAULT	GEN1	GEN2	GEN1	GEN1	–	–	GEN2	GEN1	TR2 GEN2	TR2 GEN2	TR2 GEN2	ESS TR GEN1	ESS TR GEN1	BAT1	BAT2
TR2 FAULT	GEN1	GEN2	GEN1	GEN1	–	GEN1	–	GEN1	TR1 GEN1	TR1 GEN1	TR1 GEN1	ESS TR GEN1	ESS TR GEN1	BAT1	BAT2
TR1 + 2 FAULT	GEN1	GEN2	GEN1	GEN1	–	–	–	GEN1	–	–	–	ESS – TR GEN1	ESS – TR GEN1	BAT1	BAT2

ON GROUND BAT. ONLY	AC BUS 1	AC BUS 2	AC ESS BUS	AC SHED ESS	AC STAT INV	TR1	TR2	ESS TR	DC BUS 1	DC BUS 2	DC BAT BUS	DC ESS BUS	DC SHED ESS	HOT BUS 1	HOT BUS 2
Speed > 100kt	–	–	EMER GEN	EMER GEN	–	–	–	EMER GEN	–	–	–	ESS TR EMER GEN	ESS TR EMER GEN	BAT1	BAT2
rat stall or 50 kt ≤ speed ≤100 kt	–	–	ST INV BAT1	–	ST INV BAT1	–	–	–	–	–	BAT 1-2	BAT2	–	BAT1	BAT2
speed < 50 kt	–	–	–	–	ST INV BAT1	–	–	–	–	–	BAT 1-2	BAT2	–	BAT1	BAT2

OVERHEAD PANEL



(1) BAT 1(2) ind.

Shows battery voltage in white.

(2) BAT 1 (2) pb sw

Controls the operation of the corresponding battery charge limiter.

Auto : The battery charge limiter controls automatically the connection and the disconnection of the corresponding battery to the DC BAT BUS (3 PP) by closing and opening of the battery line contactor.

- The batteries are connected to the DC BAT BUS in the following cases :
  - APU starting (MASTER SW at ON and N < 95%).

    Note : The connection is limited to 3 minutes when the emergency generator is running.

  - Battery voltage below 26.5 V (battery charge). The charging cycle ends when battery charge current goes below 4 amperes.
    - on ground, immediately
    - in flight, after a time delay of 30 minutes.
  - Loss of AC BUS 1 and 2 when below 100 knots (EMER GEN not supplying).
- If AC BUS 1 and 2 are not energized and emergency generator is not supplying :
  - battery 1 supplies the AC STAT INV BUS, and, if speed is greater than 50 kt, the AC ESS BUS.
  - battery 2 supplies the DC ESS BUS.

  Note : In normal configuration the batteries are disconnected most of the time.

  Note : A battery automatic cut-off logic prevents the batteries from discharging completely when the aircraft is on the ground (parking).
  Automatic battery contactors open when :
  - *The aircraft is on the ground.*
  - *The BAT pushbutton switches are at AUTO.*
  - *The main power supply (EXT PWR + GEN) is cut off.*
  - *Battery voltage is low.*

  The flight crew can reset the contactors by switching the BAT pushbutton switch to OFF then to AUTO.

OFF : The battery charge limiter is not operating : the battery line contactor is open.
OFF comes on white if the DC BAT BUS is supplied. Hot buses remain supplied.

FAULT lt : Comes on amber, accompanied by an ECAM caution, when the charging current for the corresponding battery is outside limits.
In this case the battery contactor opens.

③ IDG 1 (2) (Integrated Drive Generator) pb sw (guarded)

CAUTION

1. Holding this pusbutton switch in for more than about 3 seconds may damage the disconnection mechanism.
2. Do not disconnect the IDG when the engine is not running (or not windmilling), because starting the engine after having done so will damage the IDG.

The IDG switches are normally springloaded out.
Pressing this switch disconnects the IDG from its driveshaft : only maintenance personnel can reconnect it.
FAULT lt : Lights up amber, and ECAM caution comes on, if :
– IDG oil outlet overheats (above 185°C), or
– IDG oil pressure is low (inhibited at low engine speed : N2 below 14 %)
It extinguishes when the IDG is disconnected.

④ GEN 1 (2) pb sw

ON : The generator field is energized and the line contactor closes if electrical parameters are normal.
OFF : The generator field is de-energized and the line contactors opens.
The fault circuit is reset.
FAULT lt : Lights up amber, and an ECAM caution comes on, if :
– The associated generator control unit (GCU) trips it.

Note : If a differential fault trips the protection, reset action has no effect after two attempts.

– Opening of the line contactor (except if the GEN pushbutton switch is selected OFF)

⑤ APU GEN pb sw

ON : The APU generator field is energized and the line contactor closes if parameters are normal and the EXT PWR line contactor is open.
The bus tie contactor 1 (2) closes automatically if GEN 1 (2) is not operating.
OFF : The generator field is de-energized and the line contactor opens. The fault circuit is reset.
FAULT lt : Same as GEN 1 or 2 FAULT
The APU GEN FAULT light is inhibited when APU speed is too low or if the APU GEN line contactor opens after EXT PWR or ENG GEN takes over.

⑥ BUS TIE pushbutton

AUTO : The bus tie contators (BTCs) automatically open or close to maintain power supply to both AC BUS 1 and 2.
- One contactor is closed, when :
  · One engine generator supplies the associated AC BUS, and
  · The APU generator, or external power supplies the other side.
- Both contactors are closed during single-engine operation, or operation on the APU generator, or external power supply.

OFF : Both bus tie contactors open.

⑦ AC ESS FEED pushbutton

The AC ESS BUS is normally supplied by AC BUS 1.
It may be supplied by AC BUS 2, via the AC ESS FEED pushbutton.
NORMAL : The AC ESS BUS is supplied by AC BUS 1.
ALTN : The AC ESS BUS is supplied by AC BUS 2.
FAULT lt : The amber light, and ECAM caution come on, when the AC ESS BUS is not electrically supplied.

Note : In case of a total loss of the main generators, the AC ESS BUS is automatically supplied by the emergency generator, or by the static inverter, pushbutton if the emergency generator is not available.

⑧ GALY & CAB pushbutton

AUTO : Main galley, secondary galley, in-seat power supply ◁ and the IFE system ◁ (prerecorded announcement, telephone system, video/airshow, music ...), are supplied.
The main galley, the in-seat power supply ◁ and the IFE system ◁ are automatically shed :
- In flight : when only one generator is operating.
- On the ground : when only one engine generator is operating. (All galleys are available when the APU GEN or EXT PWR is supplying power.)

OFF : The main galley, secondary galley, in-seat power supply ◁ and the IFE system ◁ are not supplied.
FAULT lt : The amber light, and ECAM caution come on, when the load on any generator is more than 100 % of rated output.

③ IDG 1 (2) (Integrated Drive Generator) pb sw (guarded)

CAUTION

1. Holding this pusbutton switch in for more than about 3 seconds may damage the disconnection mechanism.
2. Do not disconnect the IDG when the engine is not running (or not windmilling), because starting the engine after having done so will damage the IDG.

The IDG switches are normally springloaded out.
Pressing this switch disconnects the IDG from its driveshaft : only maintenance personnel can reconnect it.
FAULT lt : Lights up amber, and ECAM caution comes on, if :
– IDG oil outlet overheats (above 185°C), or
– IDG oil pressure is low (inhibited at low engine speed : N2 below 14 %)
It extinguishes when the IDG is disconnected.

④ GEN 1 (2) pb sw

ON : The generator field is energized and the line contactor closes if electrical parameters are normal.
OFF : The generator field is de-energized and the line contactors opens.
The fault circuit is reset.
FAULT lt : Lights up amber, and an ECAM caution comes on, if :
– The associated generator control unit (GCU) trips it.

Note : If a differential fault trips the protection, reset action has no effect after two attempts.

– Opening of the line contactor (except if the GEN pushbutton switch is selected OFF)

⑤ APU GEN pb sw

ON : The APU generator field is energized and the line contactor closes if parameters are normal and the EXT PWR line contactor is open.
The bus tie contactor 1 (2) closes automatically if GEN 1 (2) is not operating.
OFF : The generator field is de-energized and the line contactor opens. The fault circuit is reset.
FAULT lt : Same as GEN 1 or 2 FAULT
The APU GEN FAULT light is inhibited when APU speed is too low or if the APU GEN line contactor opens after EXT PWR or ENG GEN takes over.

(6) BUS TIE pushbutton

AUTO : The bus tie contactors (BTCs) automatically open or close to maintain power supply to both AC BUS 1 and 2.
- One contactor is closed, when :
  · One engine generator supplies the associated AC BUS, and
  · The APU generator, or external power supplies the other side.
- Both contactors are closed during single-engine operation, or operation on the APU generator, or external power supply.

OFF : Both bus tie contactors open.

(7) AC ESS FEED pushbutton

The AC ESS BUS is normally supplied by AC BUS 1.
It may be supplied by AC BUS 2, via the AC ESS FEED pushbutton.
NORMAL : AC ESS BUS is supplied by AC BUS 1.
ALTN : AC ESS BUS is supplied by AC BUS 2.
FAULT lt : The amber light, and ECAM caution come on, when the AC ESS BUS is not electrically-supplied.

Note : In case of a total loss of the main generators, the AC ESS BUS is automatically supplied by the emergency generator, or by the static inverter, if the emergency generator is not available.

(8) GALY & CAB pushbutton

AUTO : Main galley, secondary galley, in-seat power supply ◁ and IFE system ◁ (prerecorded announcement, telephone system, video/airshow, music ...) are supplied.
The above-mentioned equipment ◁ is automatically shed :
- In flight : When only one generator is operating.
- On ground : When only one engine generator is operating. (All galleys are available when the APU GEN or EXT PWR is supplying power.)

OFF : The main galley, secondary galley, in-seat power supply ◁ and IFE system ◁ (prerecorded announcement, telephone system, video/airshow, music ...) are not supplied.
FAULT lt : The amber light, and ECAM caution come on, when the load on any generator is more than 100 % of rated output.

③ IDG 1 (2) (Integrated Drive Generator) pb sw (guarded)

CAUTION

1. Holding this pusbutton switch in for more than about 3 seconds may damage the disconnection mechanism.
2. Do not disconnect the IDG when the engine is not running (or not windmilling), because starting the engine after having done so will damage the IDG.

The IDG switches are normally springloaded out.
Pressing this switch disconnects the IDG from its driveshaft : only maintenance personnel can reconnect it.
FAULT lt : Lights up amber, and ECAM caution comes on, if :
– IDG oil outlet overheats (above 185°C), or
– IDG oil pressure is low (inhibited at low engine speed : N2 below 14 %)
It extinguishes when the IDG is disconnected.

④ GEN 1 (2) pb sw

ON : The generator field is energized and the line contactor closes if electrical parameters are normal.
OFF : The generator field is de-energized and the line contactors opens.
The fault circuit is reset.
FAULT lt : Lights up amber, and an ECAM caution comes on, if :
– The associated generator control unit (GCU) trips it.

Note : If a differential fault trips the protection, reset action has no effect after two attempts.

– Opening of the line contactor (except if the GEN pushbutton switch is selected OFF)

⑤ APU GEN pb sw

ON : The APU generator field is energized and the line contactor closes if parameters are normal and the EXT PWR line contactor is open.
The bus tie contactor 1 (2) closes automatically if GEN 1 (2) is not operating.
OFF : The generator field is de-energized and the line contactor opens. The fault circuit is reset.
FAULT lt : Same as GEN 1 or 2 FAULT
The APU GEN FAULT light is inhibited when APU speed is too low or if the APU GEN line contactor opens after EXT PWR or ENG GEN takes over.

(6) BUS TIE pushbutton

AUTO : The bus tie contactors (BTCs) automatically open or close to maintain power supply to both AC BUS 1 and 2.
- One contactor is closed, when :
  · One engine generator supplies the associated AC BUS, and
  · The APU generator, or external power supplies the other side.
- Both contactors are closed during single-engine operation, or operation on the APU generator, or external power supply.

OFF : Both bus tie contactors open.

(7) AC ESS FEED pushbutton

NORMAL : The AC ESS BUS is normally supplied by AC BUS 1. It is automatically supplied by AC BUS 2, when AC BUS 1 is lost.

ALTN : Comes on when manually selected. The AC ESS BUS is supplied by AC BUS 2.

FAULT lt : The amber light, and ECAM caution come on, when the AC ESS BUS is not electrically supplied.

Note : In case of a total loss of the main generators, the AC ESS BUS is automatically supplied by the emergency generator, or by the static inverter, if the emergency generator is not available.

(8) GALY & CAB pushbutton

AUTO : Main galley, secondary galley, in-seat power supply ◁ and the IFE system ◁ (prerecorded announcement, telephone system, video/airshow, music ...), are supplied.
The main galley, the in-seat power supply ◁ and the IFE system ◁ are automatically shed :
- In flight : when only one generator is operating.
- On the ground : when only one engine generator is operating. (All galleys are available when the APU GEN or EXT PWR is supplying power.)

OFF : The main galley, secondary galley, in-seat power supply ◁ and the IFE system ◁ are not supplied.

FAULT lt : The amber light, and ECAM caution come on, when the load on any generator is more than 100 % of rated output.

③ IDG 1 (2) (Integrated Drive Generator) pb sw (guarded)

CAUTION

1. Holding this pusbutton switch in for more than about 3 seconds may damage the disconnection mechanism.
2. Do not disconnect the IDG when the engine is not running (or not windmilling), because starting the engine after having done so will damage the IDG.

The IDG switches are normally springloaded out.
Pressing this switch disconnects the IDG from its driveshaft : only maintenance personnel can reconnect it.
FAULT lt : Lights up amber, and ECAM caution comes on, if :
– IDG oil outlet overheats (above 185°C), or
– IDG oil pressure is low (inhibited at low engine speed : N2 below 14 %)
It extinguishes when the IDG is disconnected.

④ GEN 1 (2) pb sw

ON : The generator field is energized and the line contactor closes if electrical parameters are normal.
OFF : The generator field is de-energized and the line contactors opens.
The fault circuit is reset.
FAULT lt : Lights up amber, and an ECAM caution comes on, if :
– The associated generator control unit (GCU) trips it.

Note : If a differential fault trips the protection, reset action has no effect after two attempts.

– Opening of the line contactor (except if the GEN pushbutton switch is selected OFF)

⑤ APU GEN pb sw

ON : The APU generator field is energized and the line contactor closes if parameters are normal and the EXT PWR line contactor is open.
The bus tie contactor 1 (2) closes automatically if GEN 1 (2) is not operating.
OFF : The generator field is de-energized and the line contactor opens. The fault circuit is reset.
FAULT lt : Same as GEN 1 or 2 FAULT
The APU GEN FAULT light is inhibited when APU speed is too low or if the APU GEN line contactor opens after EXT PWR or ENG GEN takes over.

(6) BUS TIE pushbutton

AUTO : The bus tie contactors (BTCs) automatically open or close to maintain power supply to both AC BUS 1 and 2.
- One contactor is closed, when :
  · One engine generator supplies the associated AC BUS, and
  · The APU generator, or external power supplies the other side.
- Both contactors are closed during single-engine operation, or operation on the APU generator, or external power supply.

OFF : Both bus tie contactors open.

(7) AC ESS FEED pushbutton

NORMAL : The AC ESS BUS is normally supplied by AC BUS 1. It is automatically supplied by AC BUS 2, when AC BUS 1 is lost.

ALTN : Comes on when manually selected. The AC ESS BUS is supplied by AC BUS 2.

FAULT lt : The amber light, and ECAM caution come on, when the AC ESS BUS is not electrically-supplied.

Note : In case of a total loss of the main generators, the AC ESS BUS is automatically supplied by the emergency generator, or by the static inverter, if the emergency generator is not available.

(8) GALY & CAB pushbutton

AUTO : Main galley, secondary galley, in-seat power supply ◁ and IFE system ◁ (prerecorded announcement, telephone system, video/airshow, music ...) are supplied.
The above-mentioned equipment ◁ is automatically shed :
- In flight : When only one generator is operating.
- On ground : When only one engine generator is operating. (All galleys are available when the APU GEN or EXT PWR is supplying power.)

OFF : The main galley, secondary galley, in-seat power supply ◁ and IFE system ◁ (prerecorded announcement, telephone system, video/airshow, music ...) are not supplied.

FAULT lt : The amber light, and ECAM caution come on, when the load on any generator is more than 100 % of rated output.

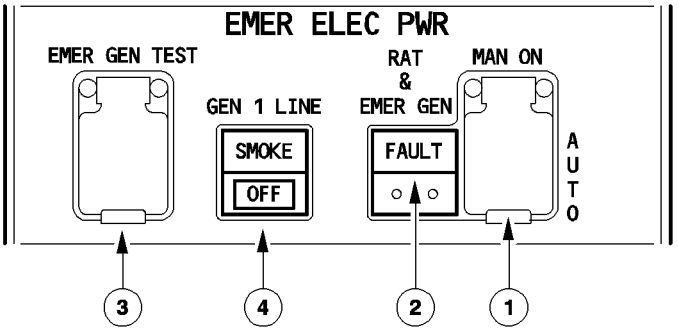
(9) EXT PWR pb (momentary action)

AVAIL light comes on green if :
– external power is plugged in, and
– external power parameters are normal.
Pressed momentarily :
– If the AVAIL light was on :
  · The external power line contactor closes.
  · The AVAIL light goes off.
  · The ON light comes on blue.
– If the ON light was on :
  · The external power line contactor opens.
  · The ON light goes off.
  · The AVAIL light comes on.

Note : 1. External power has priority over the APU generator. The engine generators have priority over external power.
2. The ON light stays on even when the engine generators supply the aircraft.

(10) COMMERCIAL pb sw ◁

ON : All aircraft commercial electrical loads are supplied :
  – cabin and cargo lights
  – water and toilet system
  – drain mast ice protection
  – galley
  – passengers' entertainment
  – semi-automatic cargo loading (if installed)
OFF : Switches off all aircraft commercial electrical loads.



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(1) MAN ON pb (guarded)

AUTO : When the following conditions are met :
- AC BUS 1 is not electrically supplied.
- AC BUS 2 is not electrically supplied.
- Aircraft speed is greater than 100 knots.
  - The RAT extends.
  - The blue hydraulic system drives the emergency generator.
  - As soon as the emergency generator electrical parameters are within tolerance the emergency generator is connected to the aircraft network.

Pressed : This selects manual RAT extension.

R Emergency generator coupling occurs 3 seconds after the RAT is supplying
R the emergency generator.

(2) FAULT lt

This light comes on red if the emergency generator is not supplying power when AC BUS 1 and AC BUS 2 are not powered.

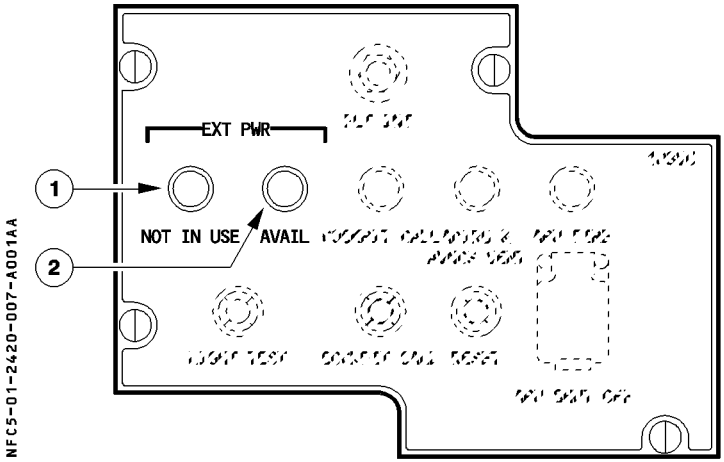
(3) EMER GEN TEST pb (guarded)

Pressed and held :
- If AC NORMAL BUSES are supplied :
  - The EMER GEN is driven hydraulically if the blue electric pump is running. The AC ESS BUS and the DC ESS BUS are connected to the emergency generator. (The DC ESS SHED and AC ESS SHED buses are not powered.)
  - ECAM displays the ELEC page automatically (only on the ground).
- If only the batteries supply the aircraft :
  - The static inverter powers the AC ESS BUS.

④ GEN 1 LINE pb sw

OFF : GEN 1 line contactor opens.
The AC BUS 1 channel is supplied from GEN 2 through bus tie contactors. This is used for smoked drill.
SMOKE lt : (Refer to 1.26)

EXTERNAL POWER PANEL



① EXT PWR NOT IN USE

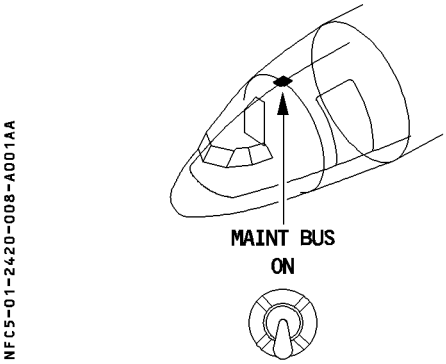
This white light comes on to inform ground personnel that the ground power unit is not supplying the aircraft network and can be removed.

② EXT PWR AVAIL

This amber light comes on to indicate that external power is available and the voltage is correct.

FORWARD CABIN

MAINT BUS sw :



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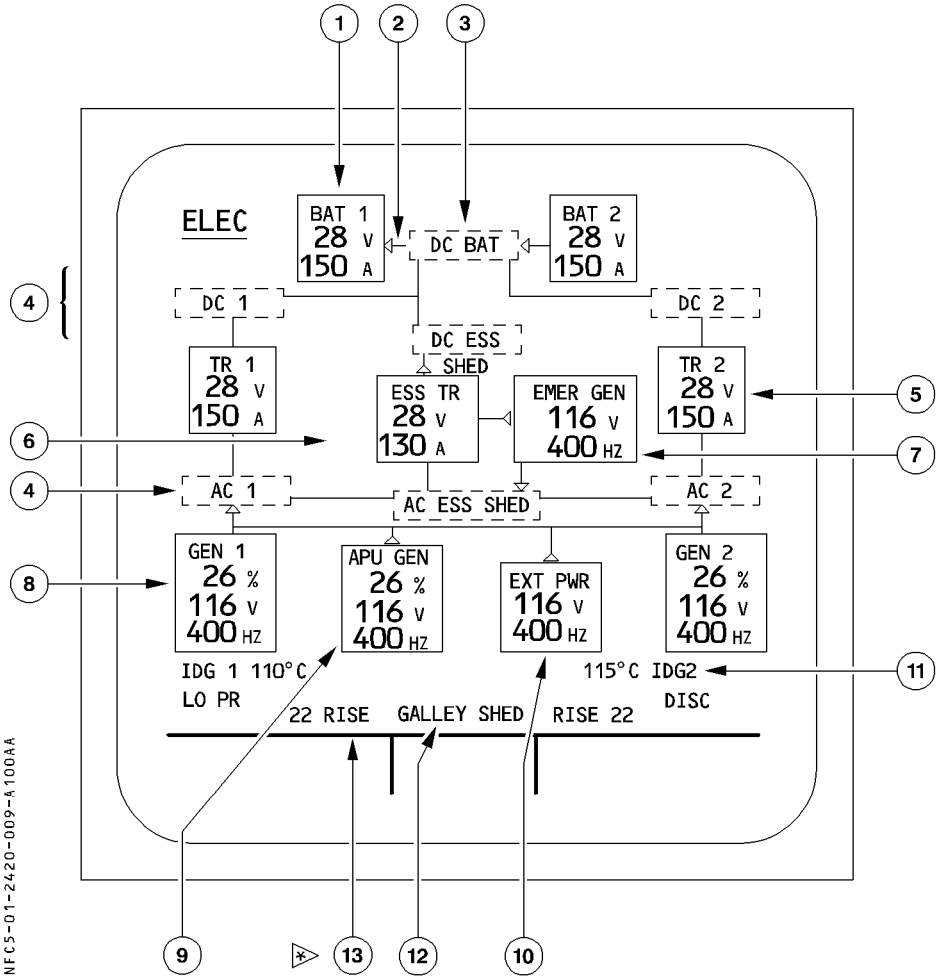
This switch allows personnel to energize electrical circuits for ground servicing without energizing the entire aircraft electrical system.

ON : The switch latches magnetically if external power is connected and normal (AVAIL light on).
The AC and DC GND/FLT buses have power and the following loads can be energized :
- passenger compartment lighting
- galley lighting
- entrance area lights
- lavatory lighting and service
- vacuum cleaner sockets
- flight compartment service outlets
- hydraulic pump (yellow system)
- flight compartment flood lighting
- fuel quantity indications
- refueling
- cargo hold lighting
- main and nose landing gear compartment lighting
- belly fairing panel service outlets
- ground call
- equipment compartment lights and service outlets
- navigation lights.

The switch trips when the external source is removed.

OFF : The AC and DC GND/FLT buses are connected to AC BUS 2 and DC BUS 2.

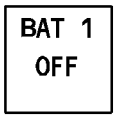
ECAM ELEC PAGE



(1) Battery indications

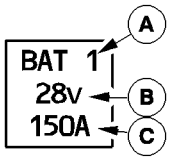
– BAT pushbutton switch at OFF :
Legend is in white.

NFC5-01-2420-010-A001AA



– BAT pushbutton switch at Auto :

NFC5-01-2420-010-B001AA



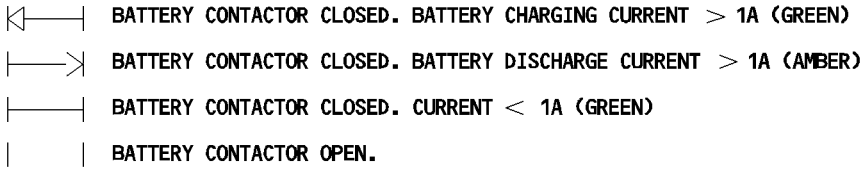
(A) Legend is normally white, but becomes amber
· when voltage and current indications change to amber, or
· in case of a BAT FAULT warning.

(B) Battery voltage is normally green, but becomes amber if V > 31 V or V < 25 V.

(C) Battery current is normally green, but becomes amber if discharge current > 5 A.

(2) Battery charge/discharge indication

NFC5-01-2420-010-C001AA



(3) DC BAT indication

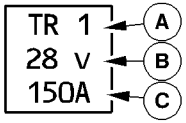
It is normally in green. It becomes amber, if DC BAT voltage ≤ 25 V.

(4) Bus indication

It is normally in green. It becomes amber, when the corresponding bus is off.
SHED appears in amber, when AC or DC SHED ESS BUS is off.

(5) TR 1 (2) indication

NFCS-01-2420-011-A100AA



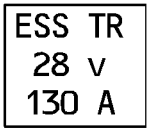
(A) It is normally in white. It becomes amber when legends B and C do.

(B) The TR voltage is normally in green. It becomes amber, if V > 31 V, or V < 25 V.

(C) The TR current is normally in green. It becomes amber, when the TR current ≤ 5 A.

(6) ESS TR indication

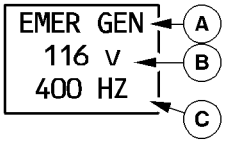
NFCS-01-2420-011-B100AA



This legend follows the logic of the above-noted TR 1 (2) legend.
The voltage and current are not displayed, when the essential TR contactor is open.

(7) EMER GEN indication

NFCS-01-24-20-012-A100AA



(A) This legend is normally in white. It becomes amber when either the voltage or frequency legend becomes amber.

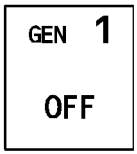
(B) This legend is normally in green. It becomes amber if :
– V > 120 V, or
– V < 110 V.

(C) This legend is normally in green. It becomes amber if :
– F > 410 Hz, or
– F < 390 Hz.
Voltage and frequency indications are not displayed, when the EMER GEN line contactor is open.

(8) GEN 1/2 indications

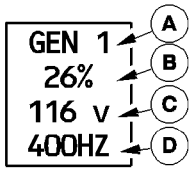
– GEN pushbutton switch is OFF :
GEN is amber.
OFF indication is white
1 or 2 indication is white if the associated engine is running, amber if it is not.

NFC5-01-2420-013-A001AA



– GEN pushbutton switch is ON.

NFC5-01-2420-013-B001AA



(A) GEN1 or GEN2, normally white, becomes amber if any of the following legends become amber.

(B) The load legend, normally green, becomes amber if load > 100 %.

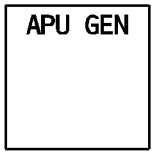
(C) The voltage legend, normally green, becomes amber if V > 120 V or V < 110 V.

(D) The frequency legend, normally green, becomes amber if F > 410 Hz or F < 390 Hz.

(9) APU GEN indications

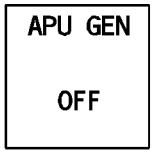
– When the APU MASTER switch is OFF this legend is white regardless of the position of the APU GEN pushbutton switch.

NFCS-01-2420-014-A001AA



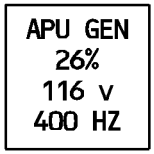
– When the APU MASTER switch is ON, and the APU GEN pushbutton switch is OFF:
The APU GEN legend is amber.
The OFF legend is white.

NFCS-01-2420-014-B001AA



– When the APU MASTER switch is ON and the APU GEN pushbutton switch is ON :
The indications are the same as for GEN 1 (2).

NFCS-01-2420-014-C001AA



(10) EXT PWR indications

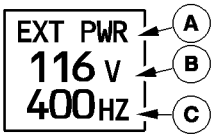
– External power is not available.

NFCS-01-2420-015-A001AA



– When external power is available :

NFCS-01-2420-015-B001AA

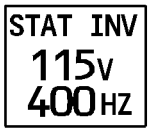


(A) This legend is normally white, but becomes amber, if either of the following legends turns amber.

(B) This legend is normally green, but becomes amber, if V > 120 V or if V < 110 V.

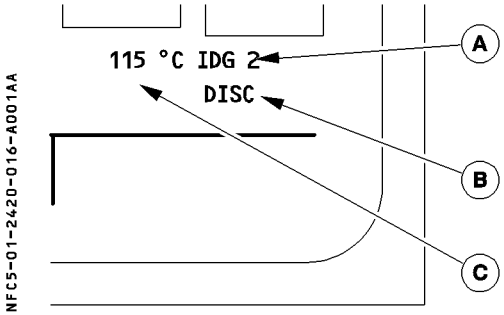
(C) This legend is normally green, but becomes amber, if F > 410 Hz or if F < 390 Hz.

NFCS-01-2420-015-C001AA



R – This legend appears during the static inverter test, and when pressing the ELEC
R pushbutton on the ECAM control panel while ESS BUSES are supplied by the
R batteries. It is normally green, but becomes amber, if :
V < 110 V or V> 120V.
F < 390 Hz or F > 410 hz.

(11) IDG indications



(A) IDG1 (2) legend

The IDG legend, normally white, becomes amber if
· Oil outlet temperature > 185° C.
· Oil pressure gets too low.
· IDG becomes disconnected.
The 1 or 2 is white if the corresponding engine is running, amber if it is not and the FADEC is powered.

(B) DISC/LO PR indication

The DISC legend appears in amber when the IDG is disconnected.
LO PR appears in amber when IDG low pressure is detected and the associated engine is running.

(C) Oil outlet temperature

This legend, normally green, appears amber if T > 185° C. It flashes if 147° C < T < 185° C (advisory).

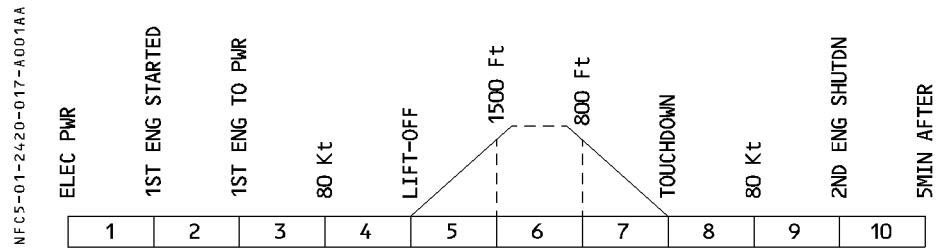
(12) GALLEY SHED indication

This legend appears in white when :
– GALLEY pushbutton switch is OFF, or
– the main galleys are shed, meaning :
· In flight, only one generator is operating.
· On the ground, the aircraft is being supplied by one engine generator only.
The legend is not displayed when the aircraft is in its normal configuration.

(13) RISE indication ◁

This number, displayed in green, is the difference between the temperature at the IDG inlet and that at the IDG outlet.

WARNINGS AND CAUTIONS



R

E / WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNINGS	FLT PHASE INHIB
EMER CONFIG Loss of main generators.	CRC	MASTER WARN	NIL *	RAT and EMER GEN FAULT lt	4, 8
ESS BUSES ON BAT DC and AC ESS BUSES are supplied by batteries			ELEC	NIL	1, 2, 3, 4, 8, 9, 10
AC BUS 1 FAULT AC BUS 2 FAULT AC ESS BUS SHED DC BUS 1 FAULT DC BUS 2 FAULT DC BUS 1 + 2 FAULT DC ESS BUS FAULT DC ESS BUS SHED Bus(es) is (are) no longer supplied.	SINGLE CHIME	MASTER CAUTION	ELEC		4, 8
AC ESS BUS FAULT Bus is no longer supplied.				AC ESS FEED FAULT lt	
DC BAT BUS FAULT Bus is no longer supplied.				NIL	4, 5, 7, 8
DC EMER CONFIG DC BUS 1 and 2 and DC ESS BUS are not supplied.					4, 8
GEN 1(2) FAULT · Protection trip initiated by associated GCU, or · Opening of line contactor with GEN pb ON.				GEN 1(2) FAULT	1, 4, 5, 7, 8,10
GEN 1(2) OFF. GEN 1(2) pb OFF with no FAULT.				NIL	1, 3, 4 5, 7, 8 10

* The flight crew must call up the ELEC page on the upper ECAM by pressing and holding the ELEC pushbutton on the ECAM control panel.

R

E / WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNINGS	FLT PHASE INHIB
APU GEN FAULT · Protection trip initiated by associated GCU, or · Opening of line contactor with APU GEN pb ON	SINGLE CHIME	MASTER CAUTION	ELEC	APU GEN FAULT lt	4, 5, 7, 8
GEN 1(2) or APU GEN OVERLOAD Load of one generator is above 100 % of rated output				GALLEY FAULT lt	3, 4, 5, 7, 8
IDG 1(2) OIL LO PR IDG oil pressure low				IDG 1(2) FAULT lt	1, 4, 5 7, 8, 10
IDG 1(2) OIL OVHT IDG outlet oil temp above 185°C.					
BAT 1(2) FAULT Charging current increases at an abnormal rate.				BAT 1(2) FAULT lt	3, 4, 5 7, 8
ESS TR FAULT				NIL	
C/B TRIPPED ON OVHD PNL C/B TRIPPED ON L (R) ELEC BAY C/B TRIPPED REAR PNL J-M or N-R or S-V or W-Z One C/B tripped in the designated zone.			NIL		3, 4, 5, 7, 8, 9, 10
BAT 1(2) OFF BAT pb OFF without fault.	NIL	NIL	ELEC		1, 3, 4, 5 7, 8, 9, 10
TRI 1(2) FAULT					3, 4, 5 7, 8
BCL 1(2) FAULT					
STATIC INV FAULT					
EMER GEN 1 LINE OFF GEN 1 LINE pb in OFF position.			NIL		1, 3, 4, 5 7, 8, 9, 10

MEMO DISPLAY

EMER GEN is displayed in green, when the emergency generator is running.

25.00 CONTENTS

25.10 FLIGHT DECK

– GENERAL 1
– COCKPIT PLAN 3
– SEATS 6
– COCKPIT WINDOW 10
– PILOT'S INSTRUMENT PANELS 11
– PEDESTAL 13
– OVERHEAD PANEL 14
– C/B PANELS 15
– FOOT WARMERS ◁ 16

25.11 COCKPIT DOOR SECURITY SYSTEM

– DOOR DESCRIPTION 1
– COCKPIT DOOR LOCKING SYSTEM 2
– CONTROLS 3

25.15 IN SEAT POWER SUPPLY SYSTEM ◁

– GENERAL 1
– CONTROLS 1

25.20 ELECTRICAL SUPPLY

– BUS EQUIPMENT LIST 1

25.00 CONTENTS

25.10 FLIGHT DECK

– GENERAL 1
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25.11 COCKPIT DOOR SECURITY SYSTEM

– DOOR DESCRIPTION 1
– COCKPIT DOOR LOCKING SYSTEM 2
– CONTROLS 3
– COCKPIT DOOR SURVEILLANCE SYSTEM 7

25.15 IN SEAT POWER SUPPLY SYSTEM ◁

– GENERAL 1
– CONTROLS 1

25.20 ELECTRICAL SUPPLY

– BUS EQUIPMENT LIST 1

GENERAL

The aircraft and system controls, required for piloting the aircraft, are arranged in such a way that the crew faces forward and all crewmembers can monitor instruments and systems.
The designers concentrated system controls on the overhead panel by making extensive use of pushbuttons, directly installed in the system synoptic.

R *Note : This section of the FCOM is designed to provide Operators with a general overview*
R *of the most common cockpit system configurations and cockpit panel layouts. Due*
R *to the large number of possible configurations and layouts, there may be a slight*
R *difference between these illustrations and the exact aircraft configuration.*
R *For the applicable panel that corresponds to your aircraft configuration, refer to the*
R *panel layout illustrations provided in the related FCOM chapter.*

PRINCIPLES FOR PUSHBUTTONS WITH INTEGRATED INDICATIONS

Whenever possible, pushbuttons used for corrective actions, have integrated status and failure indications.
The pushbutton positions, and their illuminated indications, follow the 'lights out" principle.

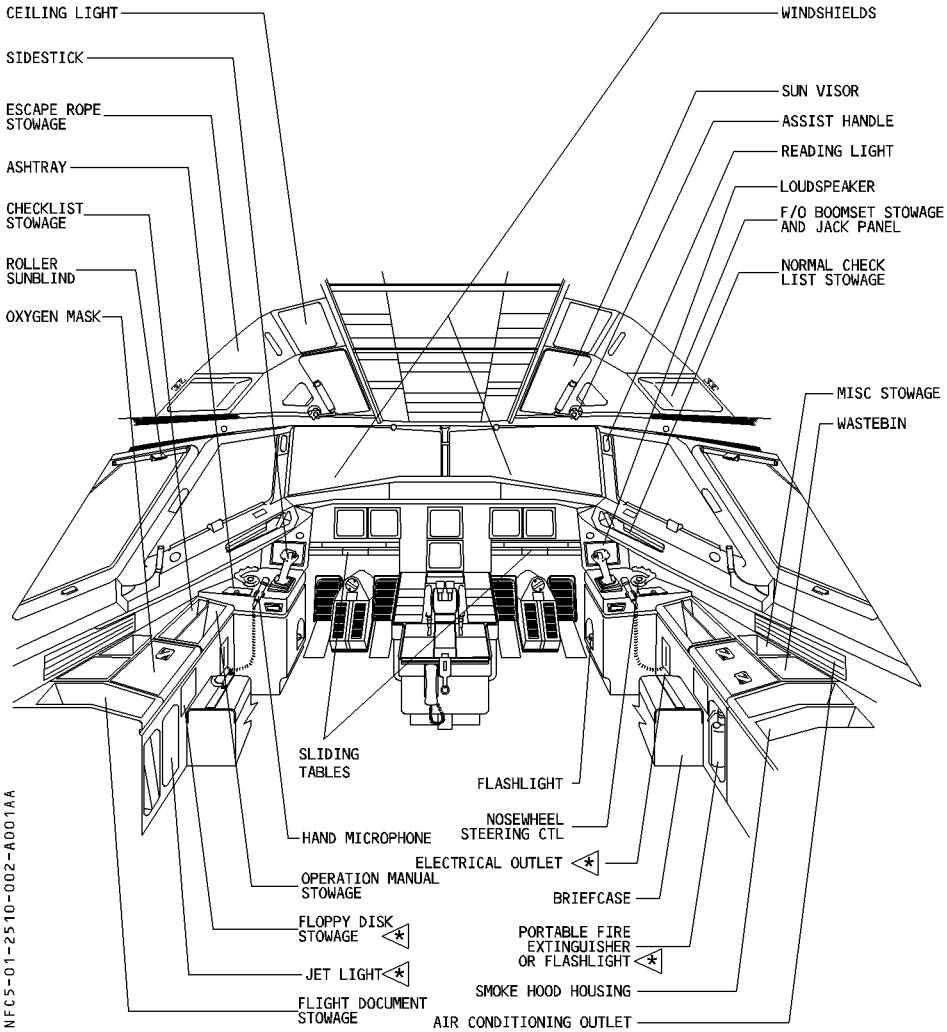
– While corresponding to particular aircraft configurations, indications also have the following color codes :
  · Warnings
    RED : A failure requiring immediate action.
  · Cautions
    AMBER : A failure, of which the flight crew should be aware, but does not call for immediate action.
  · Indications
    GREEN : For normal system operation.
    BLUE : For normal operation of a system used temporarily
    WHITE : – For an abnormal pushbutton position.
    – For a test result or maintenance information.
  When the aircraft is in a normal configuration, only green lights can be permanently lit, whereas blue lights can be intermittently.
– Pushbutton positions :

POSITION	BASIC FUNCTION
Pressed In	ON, AUTO, OVRD, OPEN
Released Out	OFF, MAN, ALTN, SHUT

Note : 1. Certain pushbutton lights have two dots, indicating that the corresponding part of the pushbutton is not used.
2. Certain pushbuttons do not remain pressed in. These are referred to as "Momentary Action" pushbuttons.

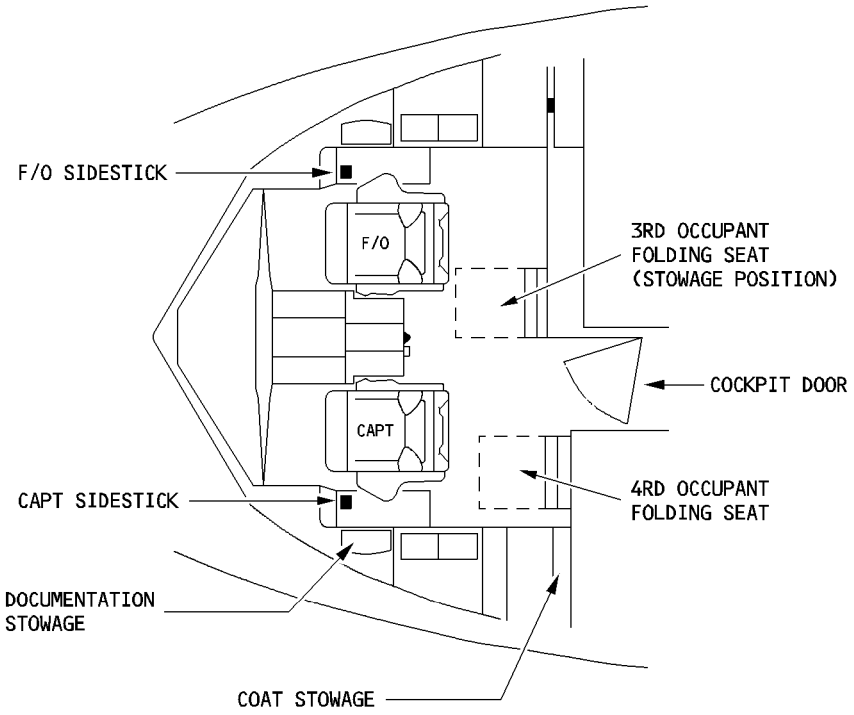
GENERAL ARRANGEMENT

R



COCKPIT PLAN

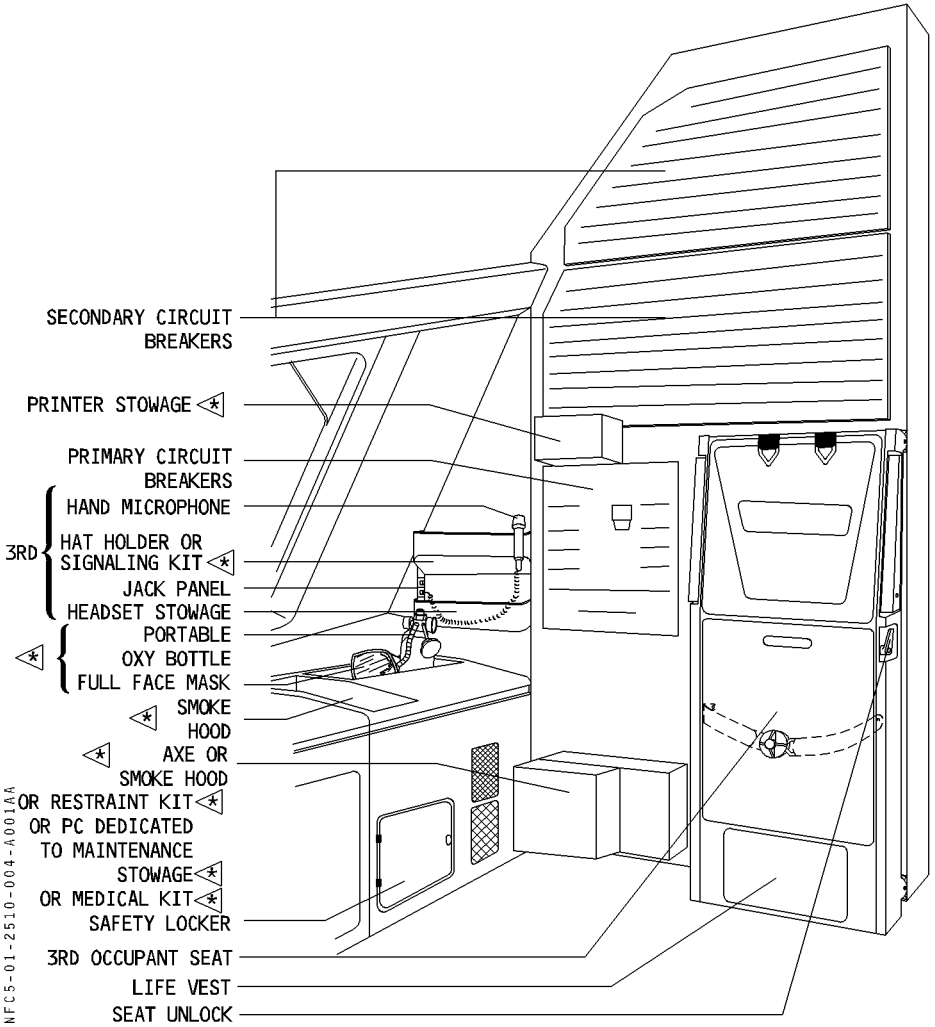
The cockpit can accommodate two crewmembers, plus a third and fourth occupant.
The two pilot seats are mounted on columns.
The third and fourth occupant seats are folding seats.



NFC5-01-2510-003-A100AA

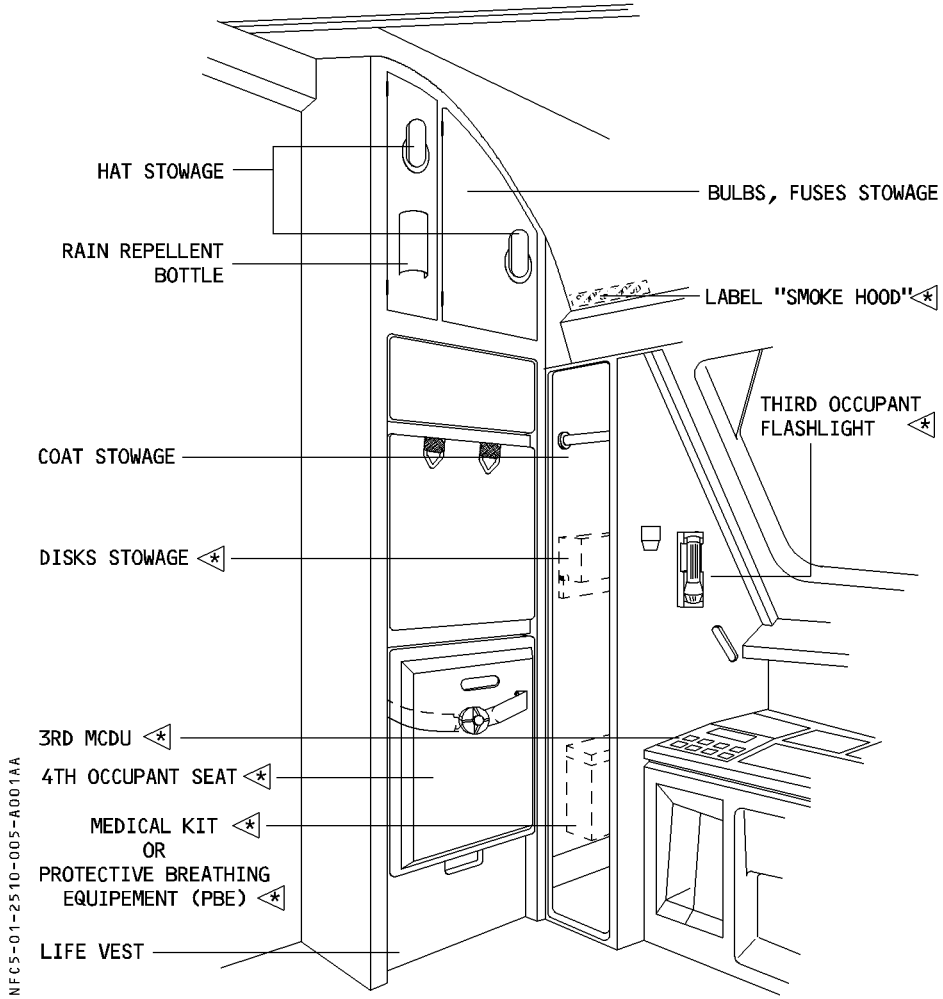
R

RIGHT REAR CORNER



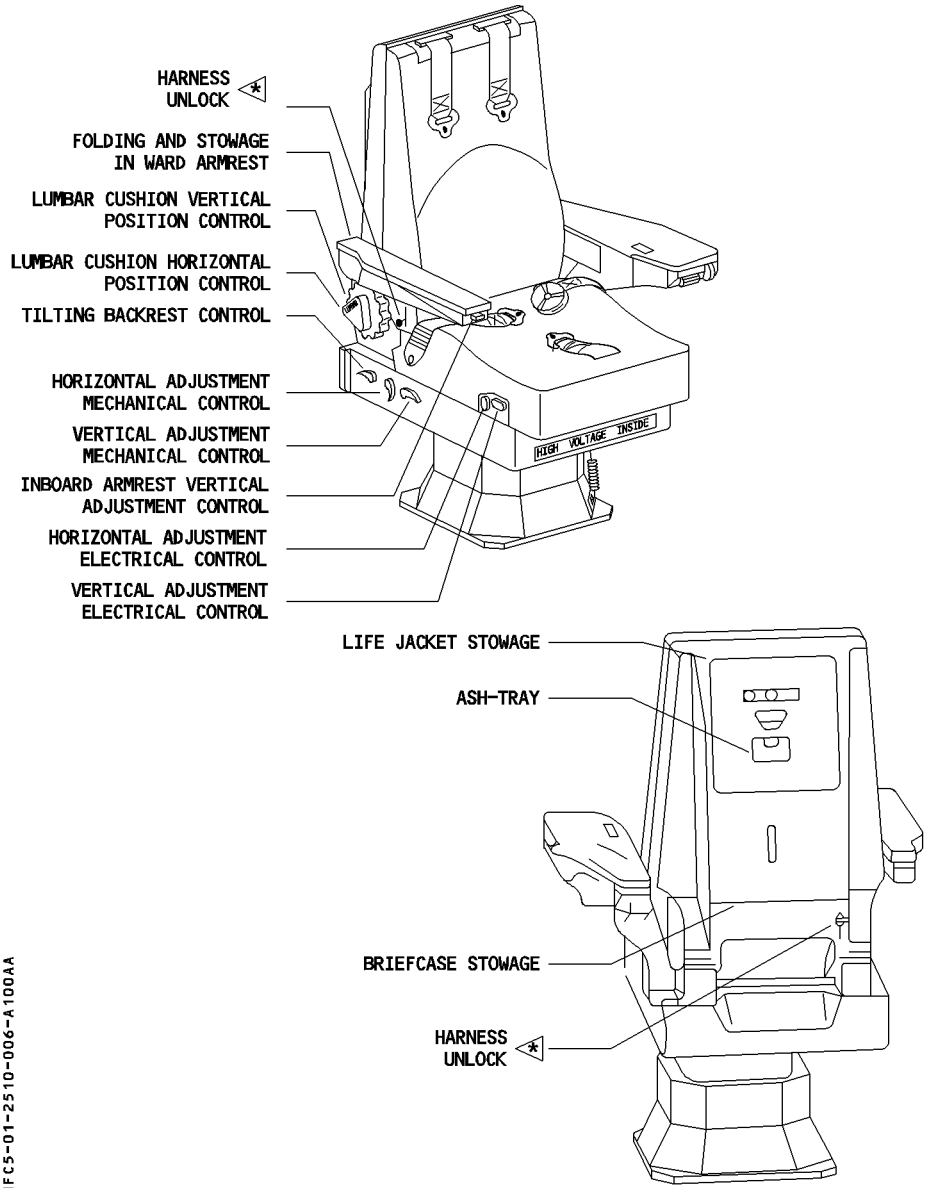
LEFT REAR CORNER

R



SEATS

PILOT SEATS



NFC5-01-2510-006-A100AA

PILOT SEAT MECHANICAL ADJUSTMENT

To adjust a seat mechanically, the occupant must lift the appropriate control handle. This unlocks the seat so that it may be moved. Releasing the control handle returns it to
R springloaded locked position. On electrically powered ◁ seats, the mechanical adjustment
R is a backup : the seat should be adjusted electrically.

PILOT SEAT ELECTRICAL ADJUSTMENT ◁

To adjust a seat electrically, the occupant must press the appropriate control switch in the desired direction and release it when the seat reaches the desired position. The switch then returns to the springloaded neutral position.
To adjust vertical position of the lumbar cushion, the occupant must :
– pull the control out to the unlocked position,
– turn the control to adjust the position of the cushion, and
– push the control into the locked position.

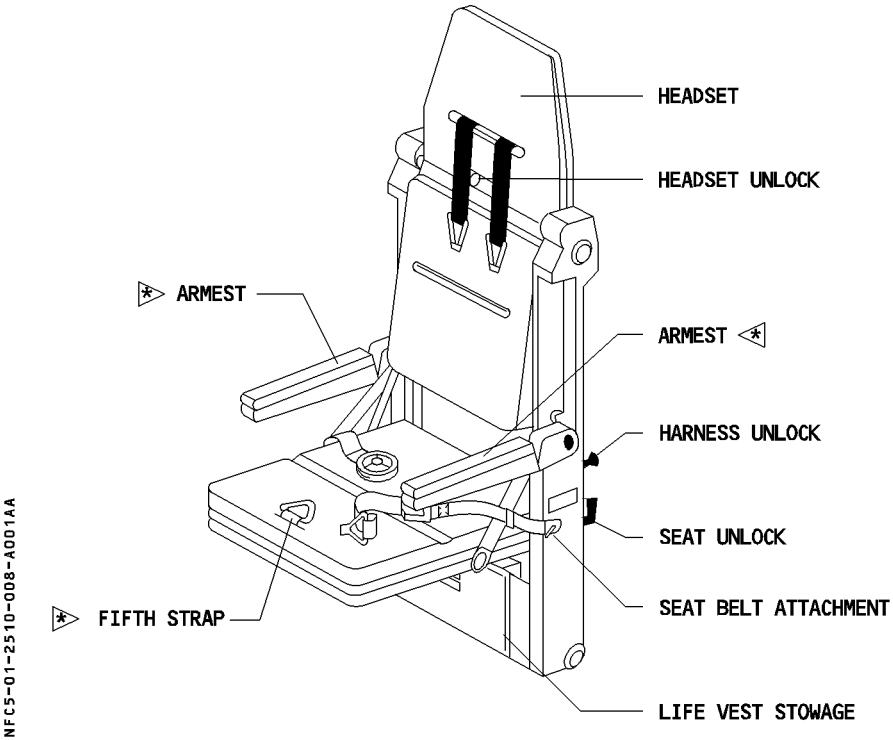
HEADREST ADJUSTMENT ◁

To adjust the headrest in inclination, the occupant presses the inclination control button. He releases it to lock the position.
To control the height of the headrest, the occupant must push it horizontaly, then adjust the height. Released it locks the position.

ARMREST ADJUSTMENT

To adjust inboard armrest the occupant turns the knurled knob located on the bottom surface of the armrest.

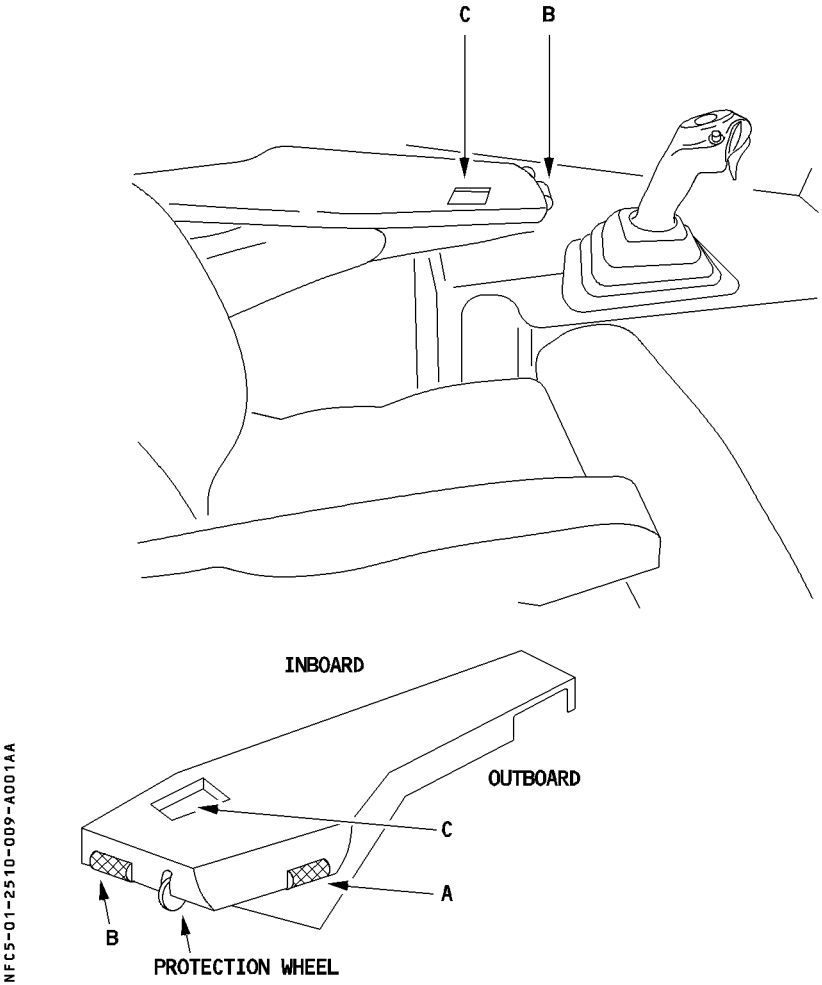
OBSERVER SEAT



OBSERVER SEAT ADJUSTMENT

This seat has three positions :
- normal : centred on aircraft axis.
- intermediate : clear of the cockpit entrance.
- stowed : seat vertical and headrest folded back. The seat is usable in this position, which is out of the way of access to the documents and equipment on the right side of the cockpit.

ARM REST



The position of the arm rest is adjustable as follows :
A – Height adjustment
B – Pitch adjustment
The armrest also has a memory display (C) that shows pitch and height.

COCKPIT WINDOW

The cockpit has fixed and sliding windows.

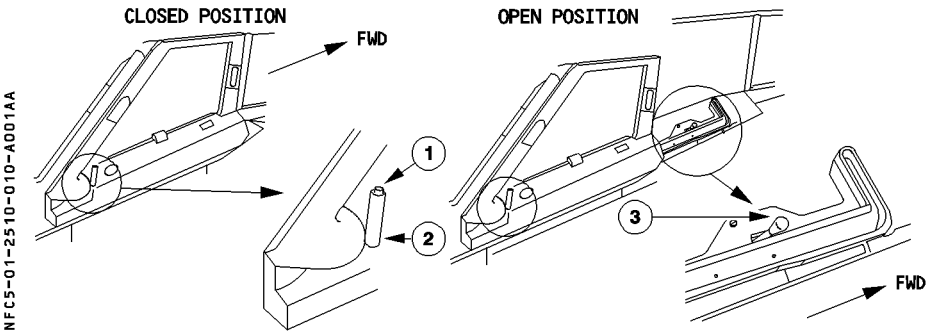
FIXED WINDOWS

There are four fixed windows :
- two windshields
- two fixed side windows

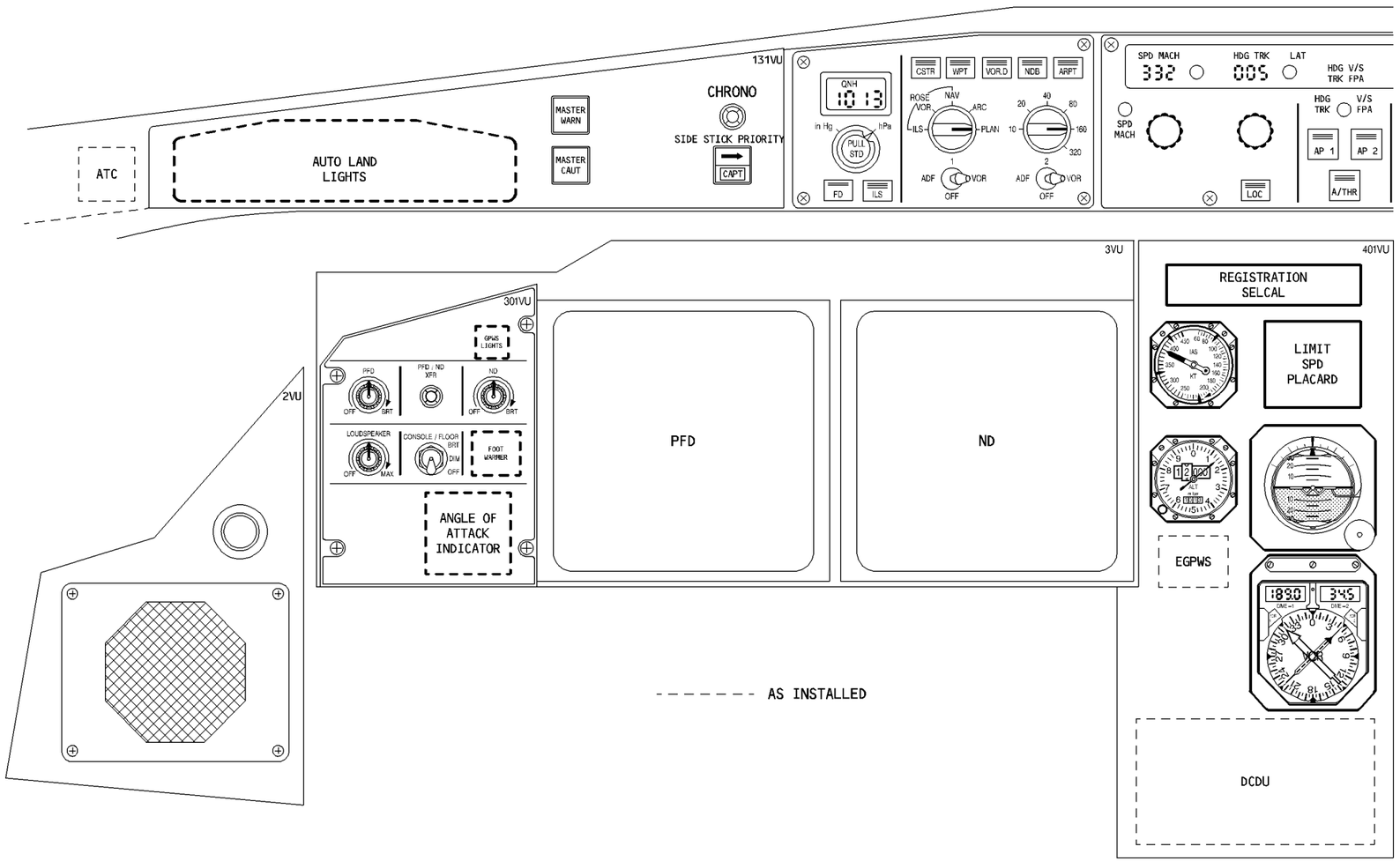
SLIDING WINDOWS

The flight crew can use the sliding windows as emergency exits. Therefore they are not permitted to stow any object so that it protrudes into the window area from the side console. Members of the flight crew can use the control handle to slide each of the windows rearward, and can use a locking pin to lock each window open.

1. Unlocking button
   Flight crew presses this button to unlock the control handle.
2. Control handle
   - To open the window, the crew member pulls inward and rearward.
   - To close the window, the crew member pushes forward.
3. Locking pin
   This pin locks the window open.
   It is near the window's lower guide track and is visible when the window is open.
   - Forward
     Between the closed position and the one-third open position, the window is free to move forward and aft.
     When the window is more than one-third open, this pin prevents it from moving forward.
   - Aft
     Flight crew must move the locking pin aft in order to close the window. Left sliding window.

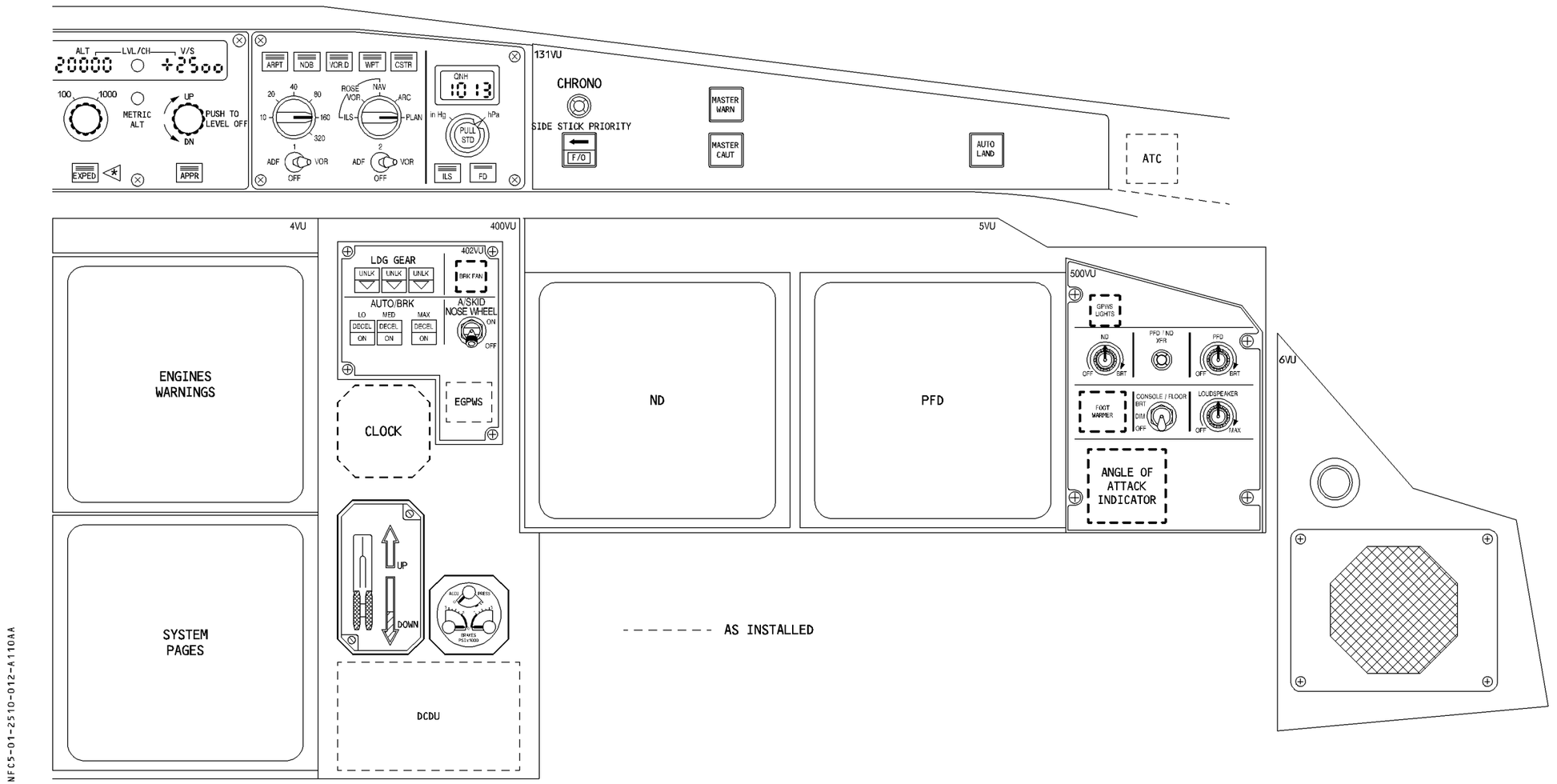


PILOT's INSTRUMENT PANELS



NFC5-01-2510-011-A110AA

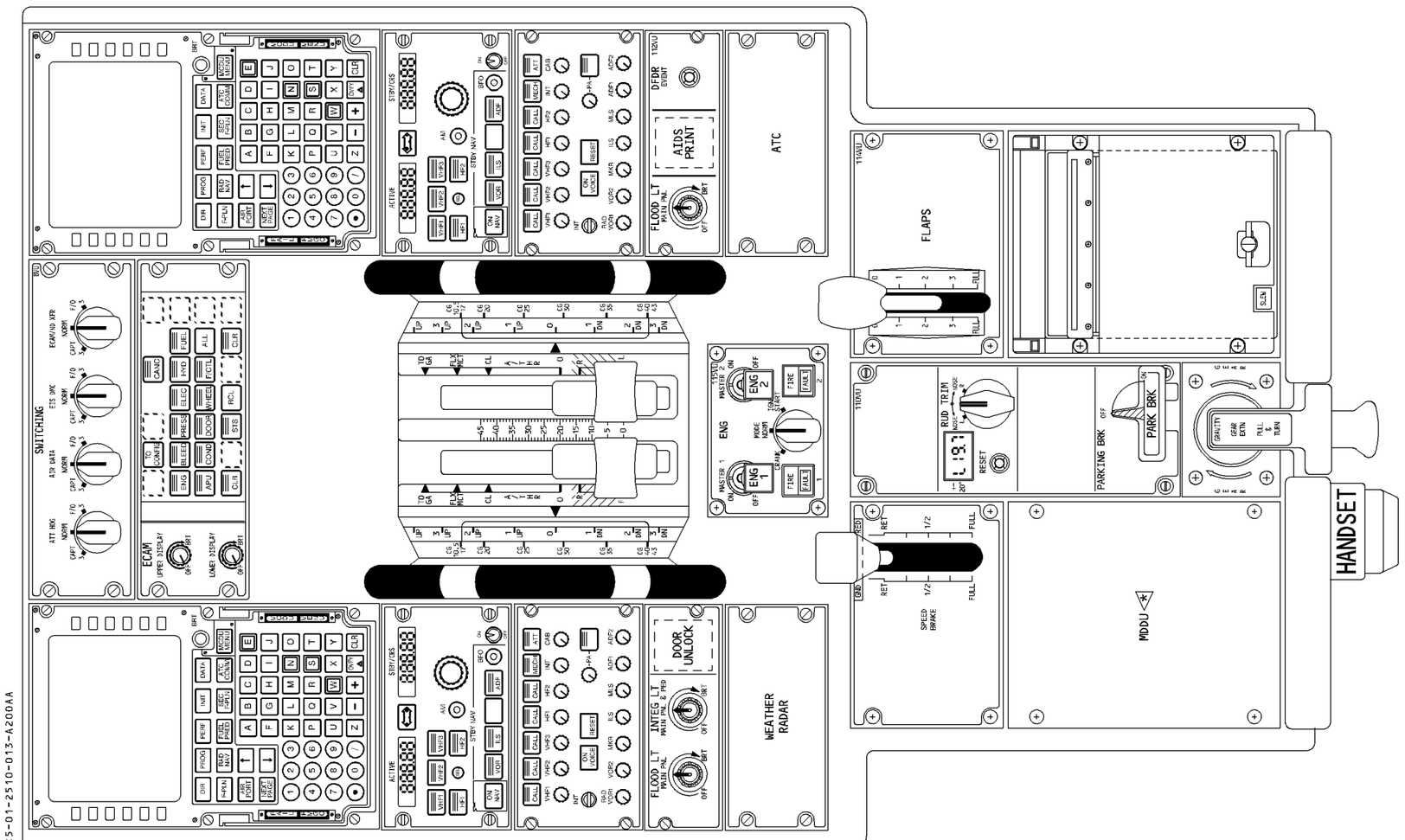
PILOT's INSTRUMENT PANEL (cont'd)



NFCS-01-2510-012-A110AA

PEDESTAL

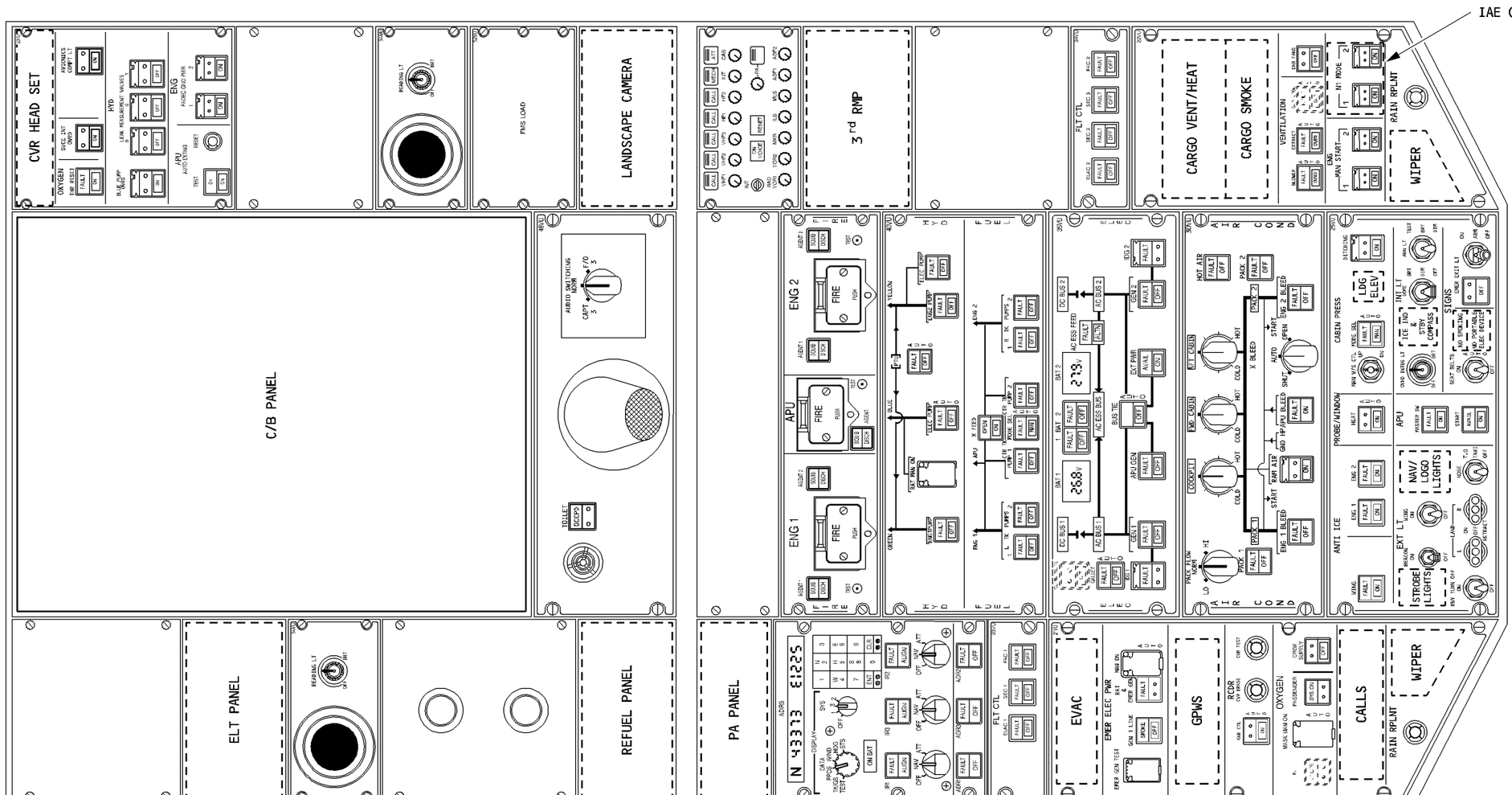
R



NFCS-01-2510-013-A200AA

OVERHEAD PANEL

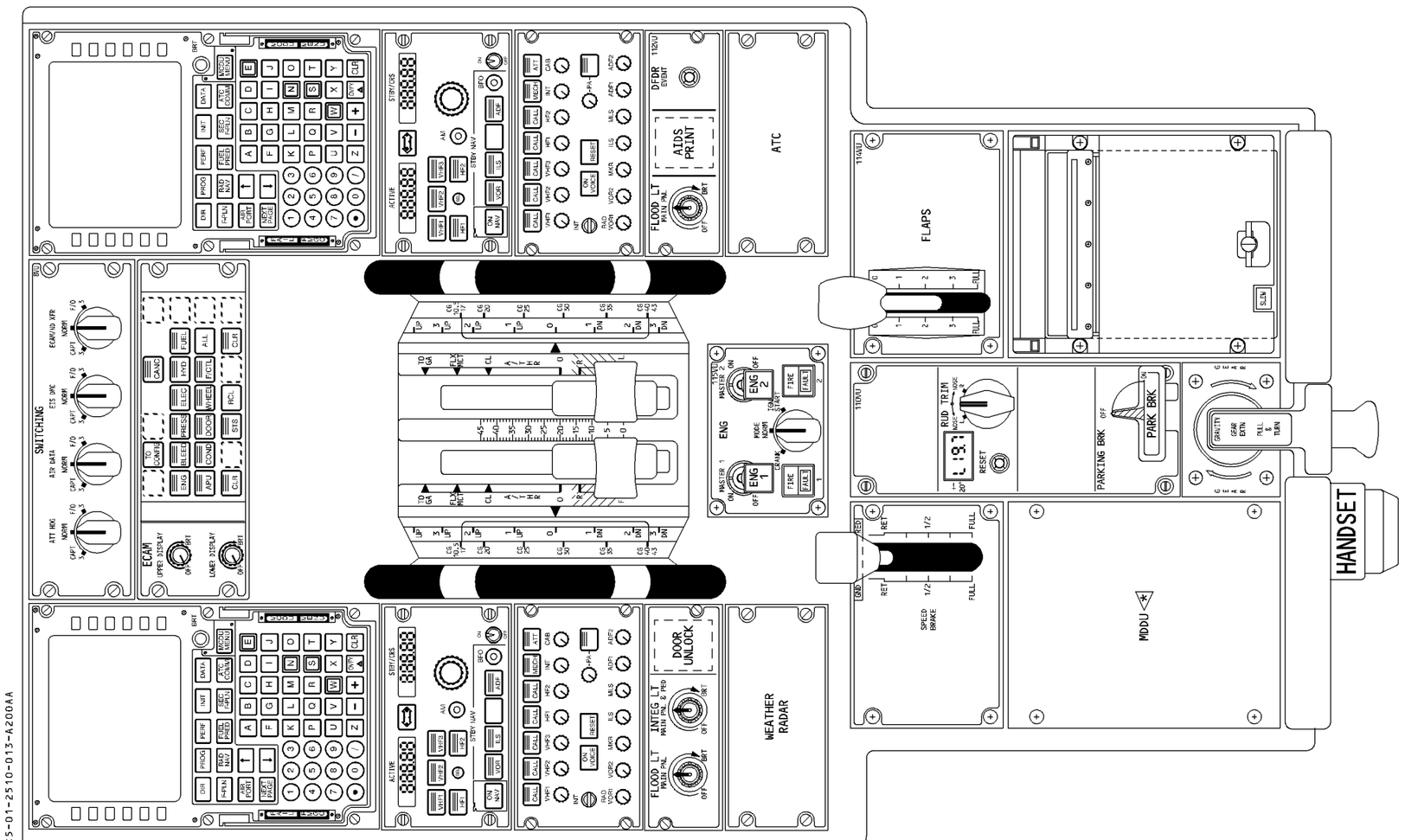
R



NFCS-01-2510-014-A206AA

PEDESTAL

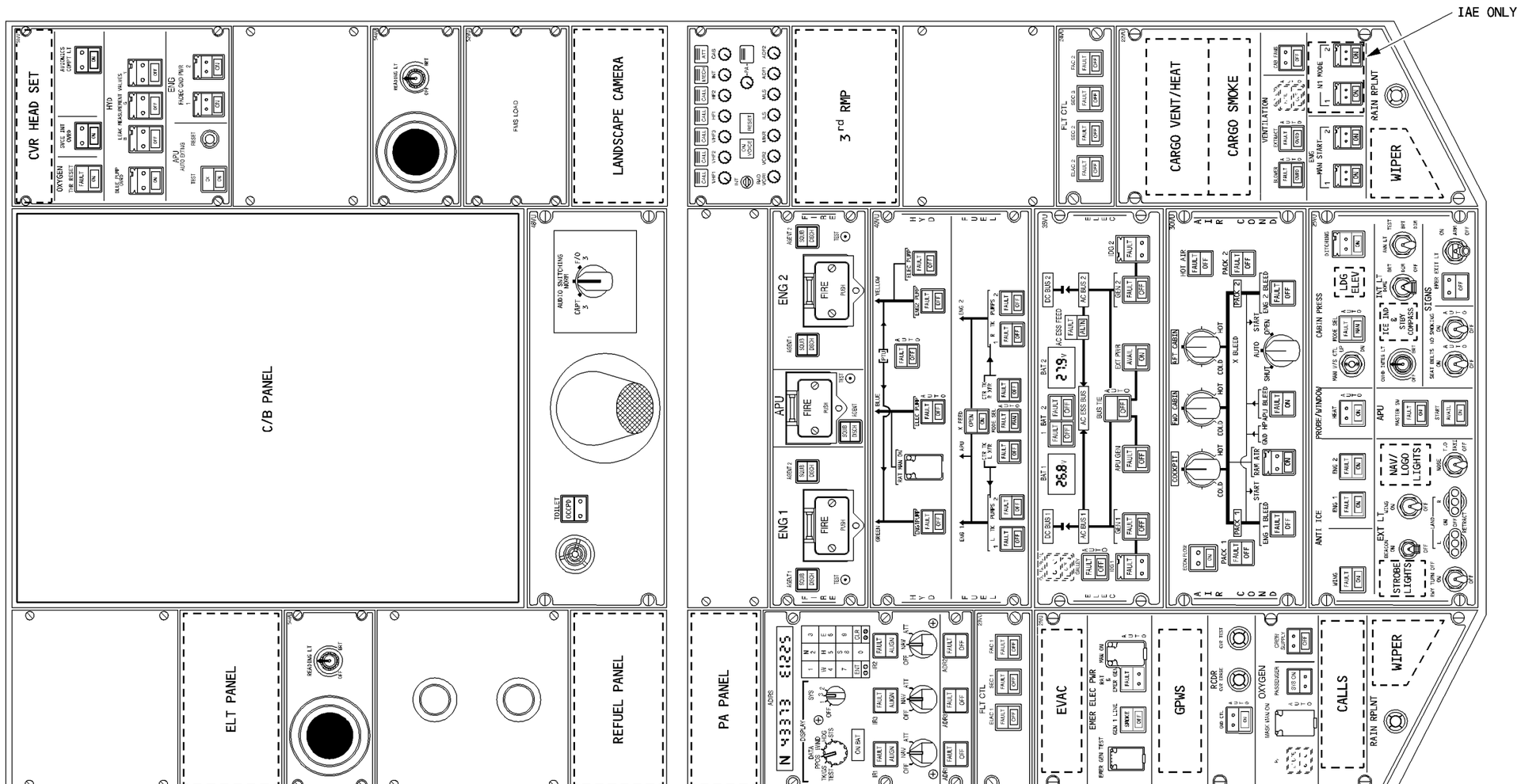
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NFCS-01-2510-013-A200AA

OVERHEAD PANEL

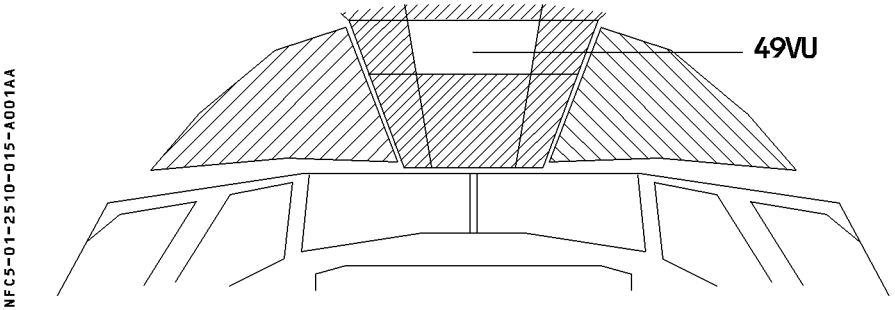
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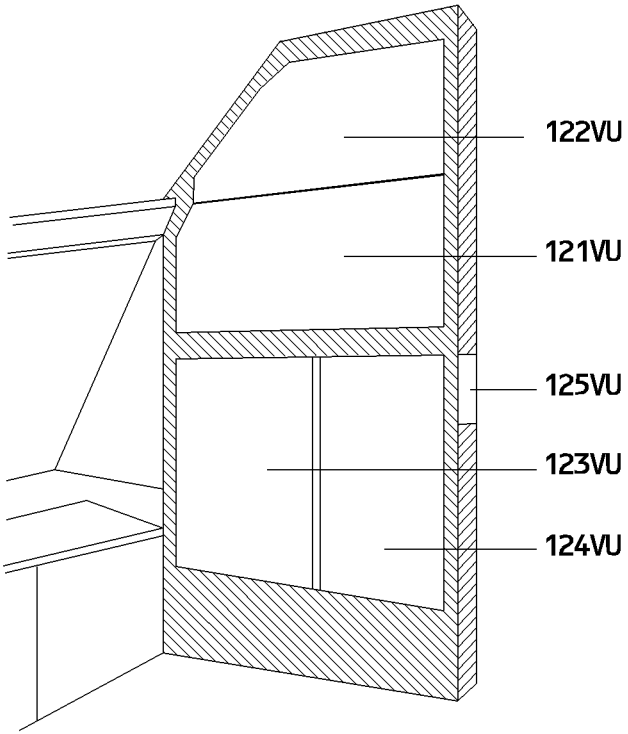
C / B PANELS

OVERHEAD PANEL



NFC5-01-2510-015-A001AA

RIGHT REAR PANEL

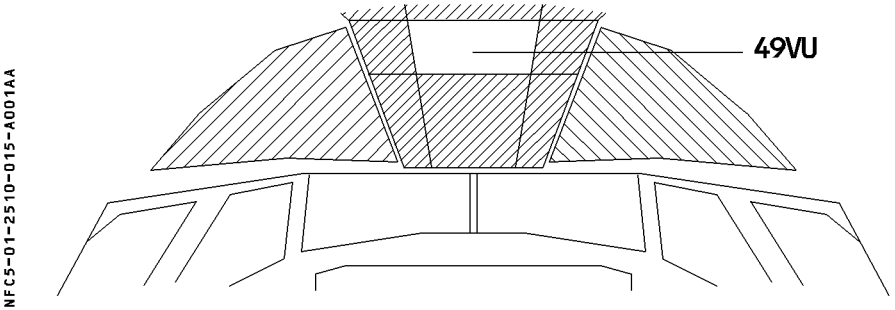


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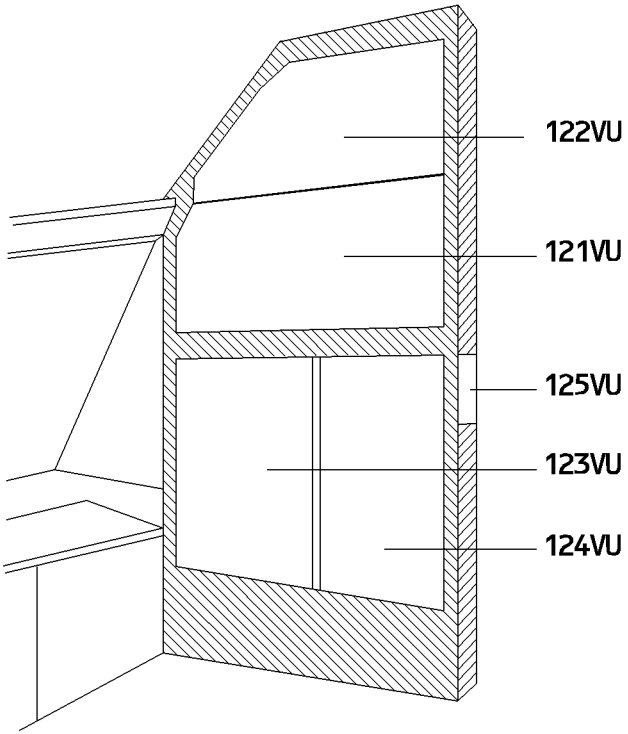
C / B PANELS

OVERHEAD PANEL



NFC5-01-2510-015-A001AA

RIGHT REAR PANEL



NFC5-01-2510-015-B001AA

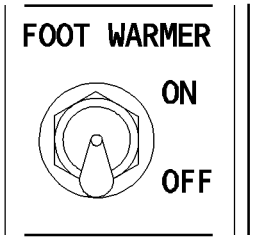
FOOT WARMER

A heating panel is attached to each pedal. The temperature of the panels is about 20°C (68°F).

CONTROLS

At main instrument panel on captain and first officer side.

NFC5-01-2510-016-A100AA



FOOT WARMER sw
Operation of foot warmer panels on related pedals.

COCKPIT DOOR DESCRIPTION

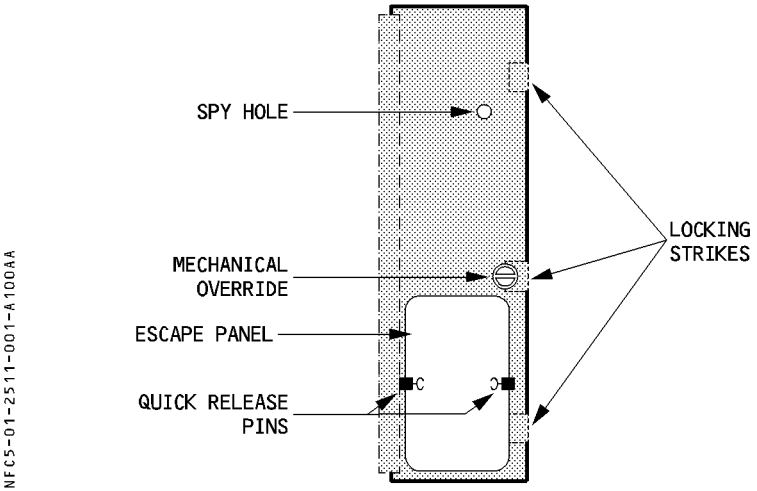
A forward-opening hinge door separates the cockpit from the passenger compartment. It
R has three electric locking strikes, controlled by the flight crew. In normal conditions, when
R the door is closed, they remain locked. When there is a request to enter the cockpit, the flight crew can authorize entry by unlocking the door, that remains closed until it is pushed open.

When the flight crew does not respond to requests for entry, the door can also be unlocked by the cabin crew, by entering a two to seven digit code (programmed by the airline) on the keypad, installed on the lateral side of the Forward Attendant Panel (FAP).

The door is bulletproof and fully compliant with rapid decompression requirements.

A mechanical override enables the flight crew to open the door from the cockpit side.

R



Note : 1. The escape panel enables the flight crew to evacuate the cockpit, in case of an emergency when the door is jammed or stuck. This panel can only be removed from the cockpit side by pulling the quick release pins towards the center of the flap and kicking the panel open.

2. In case of an electrical supply failure, the door is automatically unlocked, but remains closed.

COCKPIT DOOR LOCKING SYSTEM (CDLS)

The Cockpit Door Locking System (CLDS) provides a means of electrically locking and unlocking the cockpit door. This system is mainly composed of :

- A keypad, located in the forward cabin, near the cockpit door,
- A toggle switch, located on the center pedestal's Cockpit Door panel,
- A control unit and its CKPT DOOR CONT panel, located on the overhead panel,
- A buzzer.

The keypad enables the cabin crew to request access to the cockpit. There are two different access request types : "Routine" and "Emergency" access request (Refer to 3.04.25).

The toggle switch enables the flight crew to lock or unlock the cockpit door, following an access request, thereby allowing or denying entry into the cockpit.

The cockpit door control unit is the system controller, in charge of :

- Locking or unlocking the door latches, upon flight crew action.
- Unlocking the door, in case of cockpit decompression (the door then opens towards the cockpit under differential pressure).
- Indicating system failures of electrical latches and pressure sensors.
- Activating the access request buzzer and turning on the keypad LEDs.

The buzzer sounds in the cockpit for 1 to 9 seconds to indicate that a routine access request has been made, or sounds continuously if an emergency access has been initiated.

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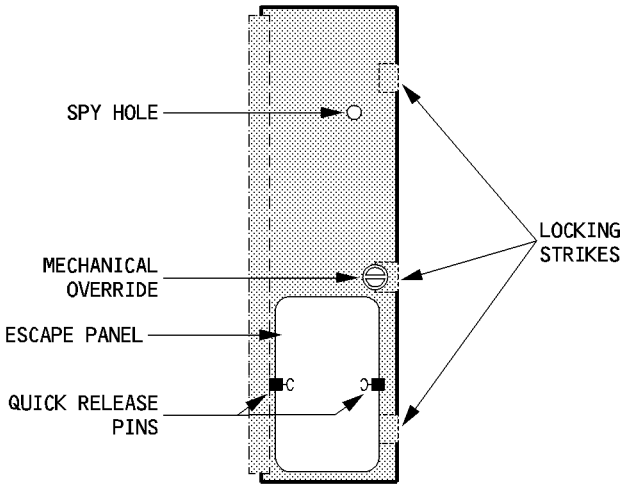
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The door is bulletproof and fully compliant with rapid decompression requirements.

A mechanical override enables the flight crew to open the door from the cockpit side.

A deadbolt is installed at the level of the center latch area of the cockpit door. This deadbolt bolts the door from the cockpit side, in the event that more than one locking latch strike fails, or in the case of a total CLS failure.

R



NFC5-01-2511-001-A200AA

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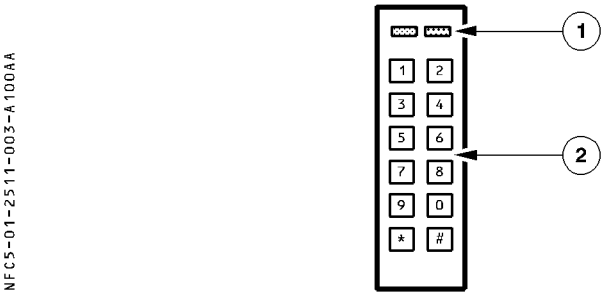
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- Indicating system failures of electrical latches and pressure sensors.
- Activating the access request buzzer and turning on the keypad LEDs.

The buzzer sounds in the cockpit for 1 to 9 seconds to indicate that a routine access request has been made, or sounds continuously if an emergency access has been initiated.

CONTROLS

KEYPAD

The keypad is used by the cabin crew to request pilots to open the door (Refer to 3.04.25).



(1) LOCKED/UNLOCKED DOOR INDICATOR

GREEN light ON : The door has been unlocked either by a flight crew action, or automatically (during 5 seconds) when no flight crew action is performed during the delay following an emergency access request. The door can be pushed open.

GREEN light flashes : An emergency request to enter the cockpit has been made ; the buzzer will sound continuously in the cockpit, but no action has yet been taken by the flight crew.

RED light ON : The flight crew has denied access, and the door remains locked.

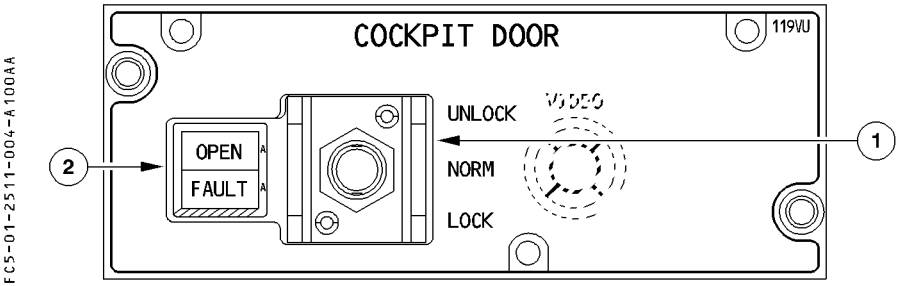
(2) DIGITAL KEYPAD

The keypad is used to sound the buzzer in the cockpit for one to nine seconds (three seconds by default), by entering a zero to seven-digit code, as programmed by the airline, followed by the '#' key.
It is also used to enter the two to seven-digit emergency code, followed by the '#' key, when the flight crew does not respond.

R *Note : During the test performed by the cockpit door control unit, the CDLS keypad*
R *remains operational, and the CDLS operates as follows :*
R *The control unit will store access codes that are entered, and the*
R *LOCKED/UNLOCKED DOOR INDICATOR (RED/GREEN LEDs) of the keypad will*
R *remain on, as long as the test is running.*
R *– If the correct access code is entered on the keypad, the buzzer will not sound,*
R *until the test is completed.*
R *– If the emergency access code is entered, the door will unlock. The cockpit*
R *buzzer and the LOCKED/UNLOCKED DOOR INDICATOR will be inoperative.*

CENTRAL PEDESTAL COCKPIT DOOR PANEL

The secured cockpit door opening is controlled by a toggle switch, located on the central pedestal.



(1) COCKPIT DOOR toggle switch

UNLOCK position : This position is used to enable the cabin crewmember to open the door. The switch must be pulled and maintained in the unlock position until the door is pushed open.

NORM position : All latches are locked, and EMERGENCY access is possible for the cabin crew.

LOCK position : Once the button has been moved to this position, the door is locked ; emergency access, the buzzer, and the keypad are
R inhibited for a preselected time (5 to 20 minutes).

R *Note : 1. If the LOCK position has not been used by the pilot, for at least 5 to 20 minutes, the cabin crew is able to request emergency access to open the cockpit door.*
2. The UNLOCK position overrides and resets any previous selection.
3. In case of an electrical supply failure, the cockpit door is automatically unlocked, but remains closed.

(2) COCKPIT DOOR Fault Open indicator

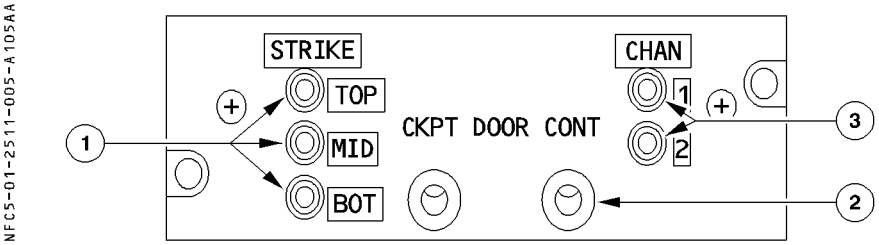
R OPEN light ON : The door is not closed, or not locked.

OPEN light flashes : The cabin crew has started an emergency access procedure. If there is no reaction from the flight crew, the door will unlock at the end of the adjustable time delay (15 to 120 seconds).

FAULT : This light comes on when a system failure has been identified (Example : Latch, pressure sensors, control unit).
R The inoperative item can be identified by checking the strike
R and pressure sensor status lights on the CKPT DOOR CONT
R panel.

OVERHEAD CONTROL PANEL

The Cockpit Door Locking System's control panel is located on the overhead panel.



(1) Strikes' status lights

Off : The corresponding (upper, mid, or lower) locking latch is operative.
On : The corresponding (upper, mid, or lower) locking latch is faulty.

(2) Pressure sensor

Two redundant differential pressure sensors enable rapid pressure variation in the cockpit to be detected, in order to command simultaneous opening of all latches when a defined pressure drop is detected.

(3) Pressure sensor status lights

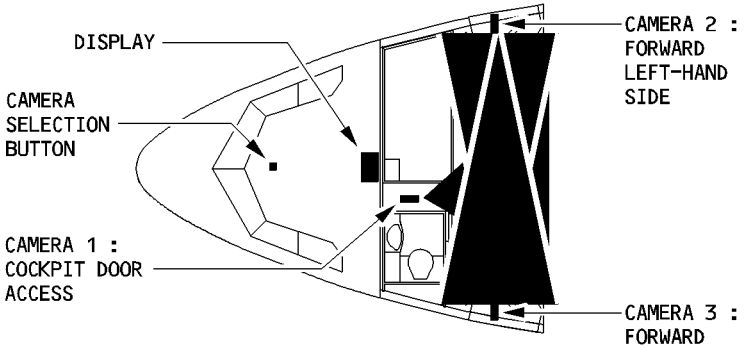
Off : The corresponding (1 or 2) pressure sensor is operative.
On : The corresponding (1 or 2) pressure sensor is faulty.

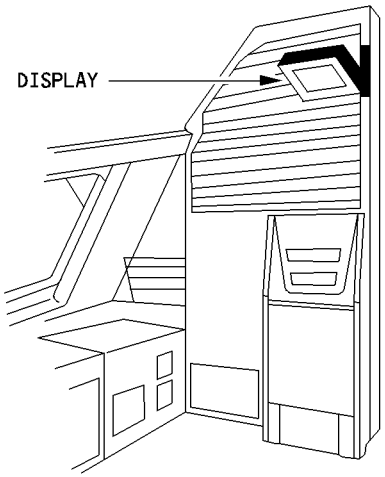
Note : These indicators enable the crew to identify the faulty item, when the Central Pedestal Fault indicator light is ON.

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COCKPIT DOOR SURVEILLANCE SYSTEM

The Cockpit Door Surveillance system consists of three video cameras, which enable the flight crew to identify persons prior to authorizing their entry into the cockpit. An LCD display, located on the rear panel, shows the various camera views. It has automatic brightness adjustment and is activated by the Cockpit Door Video pushbutton.

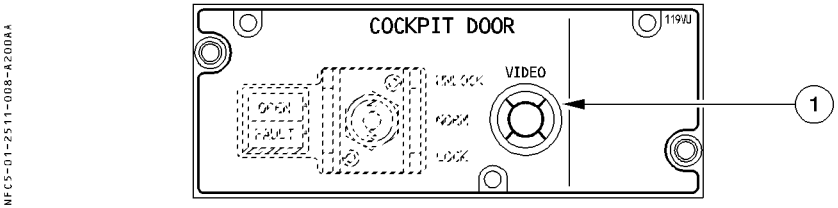




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CONTROLS

CENTRAL PEDESTAL



(1) Cockpit Door Video pushbutton

Selects the various camera image displays.

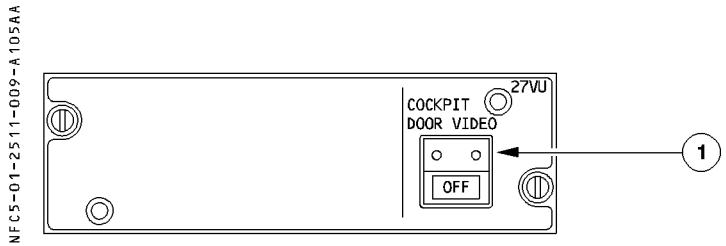
Camera 1 image : Displayed by pressing the pushbutton when the screen is on standby, or after Camera 2 and 3 images have been displayed. Automatically displayed, after an entry request is performed on the keypad.

Camera 2 and 3 images : Displayed on a split screen, when the pushbutton is pressed after Camera 1's image has been displayed.

Standby : If the pushbutton is maintained pressed for at least two seconds, or if no action has been taken for 5 minutes, the screen goes blank and remains on standby.

Note : An entry request, performed on the keypad within 30 seconds following an earlier entry request, will not lead to the automatic selection of Camera 1, since the flight crew is given authority to select any desired camera image via the cockpit door video pushbutton. After these 30 seconds, the system reverts to its normal operation.

OVERHEAD PANEL



(1) Cockpit Door Video pushbutton

OFF : The Cockpit Door Surveillance System is manually de-energized.

GENERAL

NOT APPLICABLE

CONTROLS

NOT APPLICABLE

BUS EQUIPMENT LIST

R

	NORM			EMER ELEC		
	AC	DC	DC BAT	AC ESS	DC ESS	HOT
CAPTAIN SEAT motors ◁	AC1					
F/O SEAT motors ◁	AC2					
FOOT WARMERS ◁	AC2					
IN SEAT POWER SUPPLY ◁	AC2					
COCKPIT DOOR LOCKING SYSTEM ◁		DC2				
COCKPIT DOOR LOCKING SYSTEM BACKUP ◁		DC1				
COCKPIT DOOR SURVEILLANCE SYSTEM ◁		DC1				

26.00 CONTENTS

26.10 GENERAL

26.20 ENGINE AND APU
– DESCRIPTION 1
– CONTROLS AND INDICATORS 3
– WARNINGS AND CAUTIONS 10

26.30 AVIONICS BAY
– DESCRIPTION 1
– CONTROLS AND INDICATORS 2
– WARNINGS AND CAUTIONS. 3

26.40 LAVATORY
– DESCRIPTION 1
– WARNINGS AND CAUTIONS 2

26.50 CARGO COMPARTMENTS
– SMOKE DETECTION 1
R – FIRE EXTINGUISHING 2
– CONTROLS AND INDICATORS 3
– WARNINGS AND CAUTIONS 4

26.60 ELECTRICAL SUPPLY

DESCRIPTION

Aircraft Fire Protection Systems are comprised of :

- Fire and overheat detection and extinguishing systems for the :
  - Engines
  - APU
- Smoke detection and extinguishing systems for the :
  - Cargo compartments
  - Lavatories
- Smoke detection for the :
  - Avionic bay
- Portable fire extinguishers for the :
  - Flight compartment
  - Passenger cabin

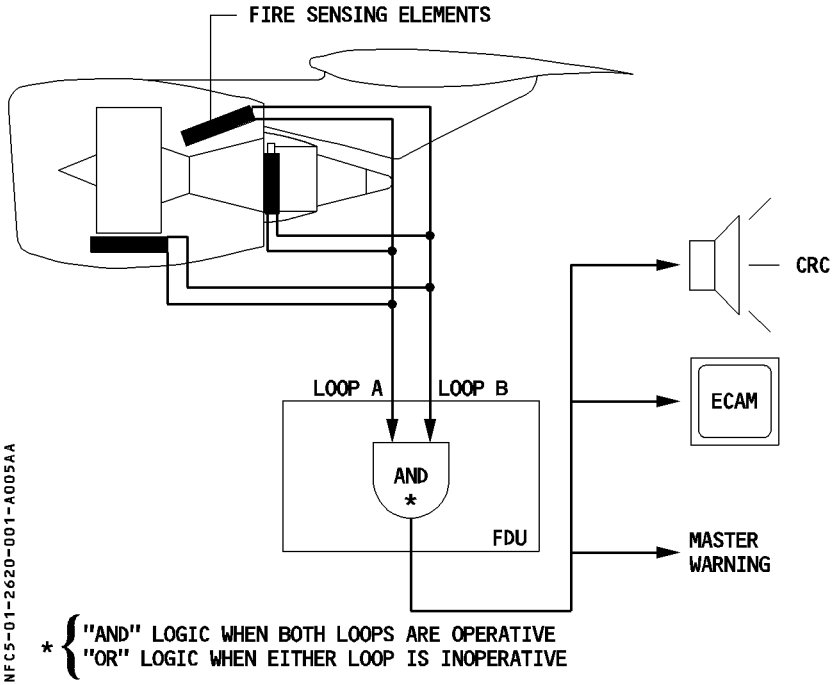
DESCRIPTION

DETECTION

The engines and the APU each have a fire and overheat detection system consisting of :
- Two identical gas detection loops (A and B) mounted in parallel.
- A Fire Detection Unit (FDU).

The gas detection loops consist of :
- Three sensing elements for each engine, one in the pylon nacelle, one in the engine core and one in the engine fan section.
- One sensing element in the APU compartment.

When a sensing element is subjected to heat, it sends a signal to the fire detection unit.
R As soon as loops A and B detect temperature at a preset level, they trigger the fire warning system.
A fault in one loop (break or loss of electrical supply) does not affect the warning system. The unaffected loop still protects the aircraft.
If the system detects an APU fire while the aircraft is on the ground, it shuts down the APU automatically and discharges extinguishing agent.



EXTINGUISHING

Each engine has two extinguisher bottles equipped with electrically operated squibs to discharge their contents. Each squib has a dual electric supply. The flight crew controls the discharge from the ENG FIRE panel in the cockpit.

The APU has one fire extinguisher bottle that has an electrically operated squib to discharge its agent. The flight crew controls the discharge from the APU FIRE panel in the
R cockpit. This bottle also discharges automatically if there is an APU fire when the aircraft is on the ground.

FIRE WARNINGS AND LOOP CAUTIONS

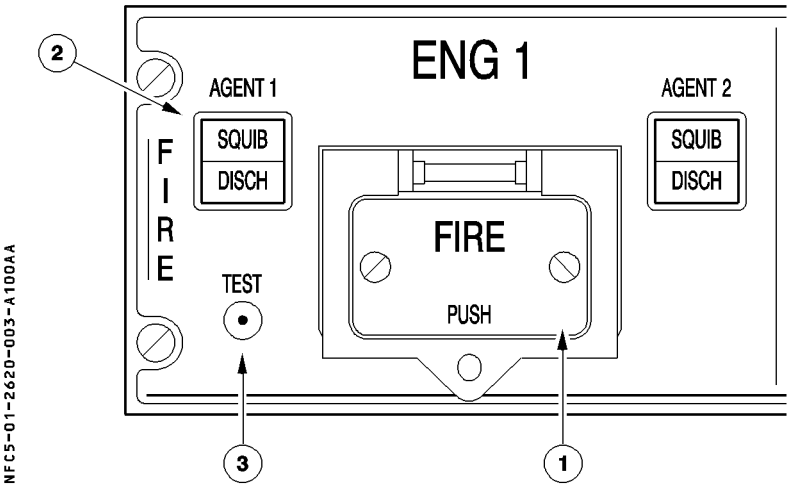
Fire detection units process all the warnings and cautions originating in the sensing elements :

- The fire warning appears in case of :
  - a fire signal from both loop A and B or,
  - a fire signal from one loop when the other is faulty, or
  - breaks in both loops occuring within 5 seconds of each other (flame effect), or
  - a test performed on the control panel.
- The loop-fault cautions appear if :
  - one loop is faulty or,
R - both loops are faulty or,
  - the fire detection unit fails.

CONTROLS AND INDICATORS

OVERHEAD PANEL

ENG FIRE PANEL



The aircraft has two identical ENG FIRE panels, which contain the following switches and indicators :

(1) ENG 1 (2) FIRE pb

This pushbutton's normal position is in, and guarded.
The pilot pushes it to release it. It pops out, sending an electrical signal that performs the following for the corresponding engine :
- Silences the aural fire warning
- Arms the fire extinguisher squibs
- Closes the low-pressure fuel valve
- Closes the hydraulic fire shut off valve
- Closes the engine bleed valve
- Closes the pack flow control valve

R — Cuts off the FADEC power supply

R — Deactivates the IDG

ENG 1 (2) FIRE lt

This red light comes on, regardless of the pushbutton's position, whenever the fire warning for the corresponding engine is activated.

(2) AGENT 1 and AGENT 2 pb

Both of these buttons become active when the flight crew pops the ENG FIRE button for their engine.
A brief push on the button discharges the corresponding fire bottle.
- "SQUIB" lights up white when the flight crew pops the ENG FIRE button for its engine to help the flight crew identify the AGENT pushbutton to be activated.
- "DISCH" lights up amber when its fire extinguisher bottle has lost pressure.

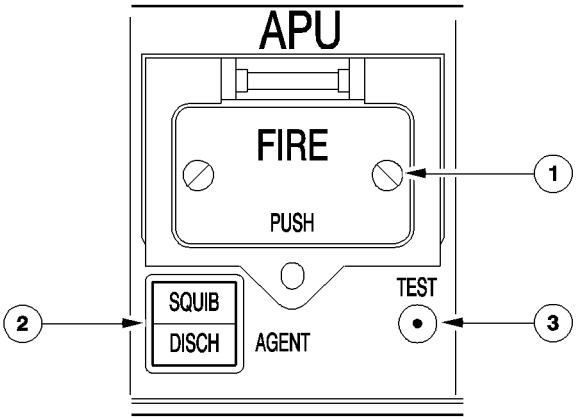
(3) TEST pb

This button permits the flight crew to test the operation of the fire detection and extinguishing system.
- When the flight crew presses it :
  - A continuous repetitive chime sounds.
  - The MASTER WARN lights flash.
  - ENG FIRE warning appears on ECAM.

  On the FIRE panel :
  - The ENG FIRE pushbutton lights up red.
  - The SQUIB lights come on white if discharge supplies are available.
  - The DISCH lights come on amber.

  On the ENG panel (pedestal) :
  - The FIRE lights come on red.

APU FIRE PANEL



NFC5-01-2620-005-A100AA

(1) APU FIRE pb sw

This switch's normal position is in and guarded.
The pilot pushes it to release it. It pops out, sending an electrical signal that performs the following for the APU :
– shuts down the APU
– silences the aural warning
– arms the squib on the APU fire extinguisher
– closes the low-pressure fuel valve
– shuts off the APU fuel pump
– closes the APU bleed valve and X bleed valve and deactivates the APU generator.
The red APU FIRE light comes when the APU fire warning is activated, regardless of the position of the pushbutton.

(2) AGENT pb

This button becomes active when the pilot pops the APU FIRE button.
The flight crew presses it briefly to discharge the fire bottle.
– SQUIB lights up white when the pilot pops the APU FIRE button.
– DISCH lights up amber on when the fire extinguisher bottle has lost pressure.

R *Note : A red disk, which is outside at the rear of the fuselage, signals that the agent*
R *is not discharged overboard due to bottle overpressure.*

③ TEST pb

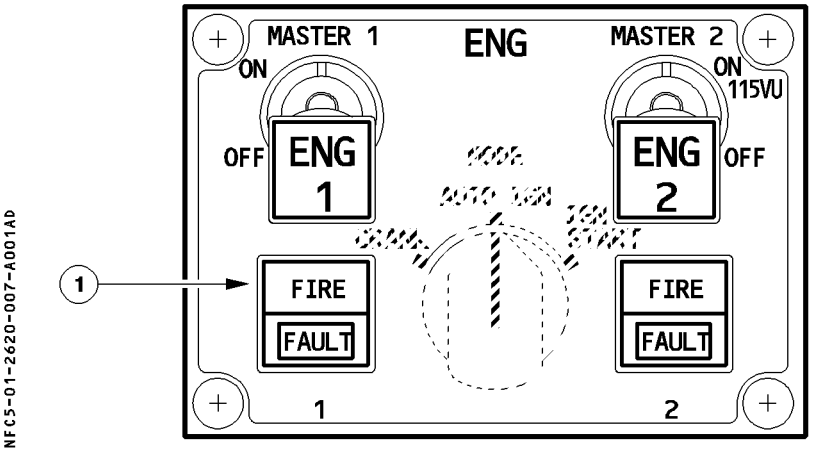
This button permits the flight crew to test the operation of the fire detection and extinguishing system for the APU.

– When the flight crew presses it :
  – A continuous repetitive chime sounds.
  – The MASTER WARN lights flash.
  – APU FIRE warning appears on ECAM.

  On the APU FIRE panel :
  – The APU FIRE pushbutton lights up red.
  – The SQUIB light comes on white.
  – The DISCH light comes on amber.

Note : The automatic shutdown of the APU on the ground will not occur while the flight crew is performing this test.

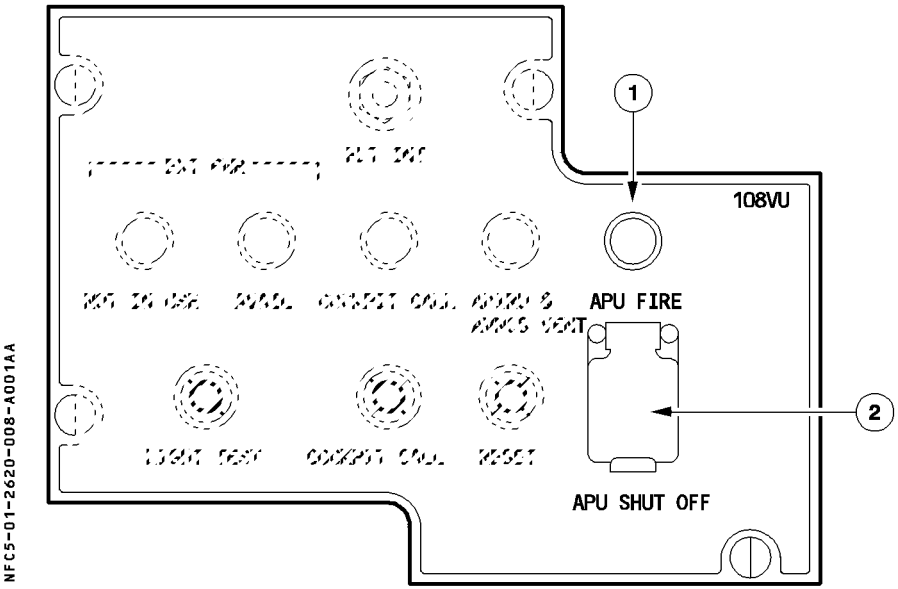
PEDESTAL



(1) FIRE lt

This light identifies the engine to be shutdown because of fire.
Light comes on red when an engine fire warning is triggered.

EXTERNAL POWER PANEL



When the aircraft is on the ground, an APU fire causes an additional external warning.

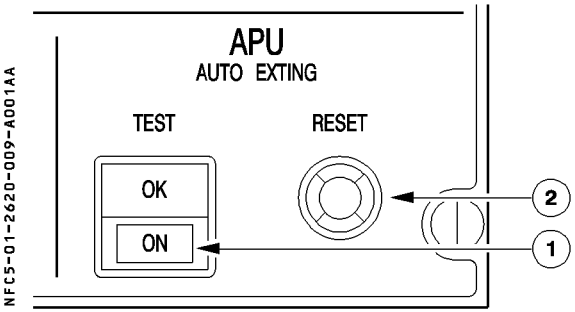
(1) APU FIRE lt

The red APU FIRE light comes on and an external warning horn sounds when the system detects an APU fire.
The APU fire extinguisher discharges automatically three seconds after the appearance of the fire warning.
The light goes out when the fire has been extinguished.

(2) APU SHUT OFF guarded pushbutton

R This pushbutton is used for manual APU Emergency shutdown, if an emergency situation
R is detected on ground by the ground crew. When this pushbutton is pressed, the APU
R low pressure fuel shutoff valve closes, and the ECB receives a signal that starts the
R shutdown sequence. The shutdown sequence is the same as the APU automatic
R shutdown sequence, except that there is no cool down cycle. Pressing this pushbutton
R also silences the external warning horn.

MAINTENANCE PANEL



(1) TEST pushbutton-switch

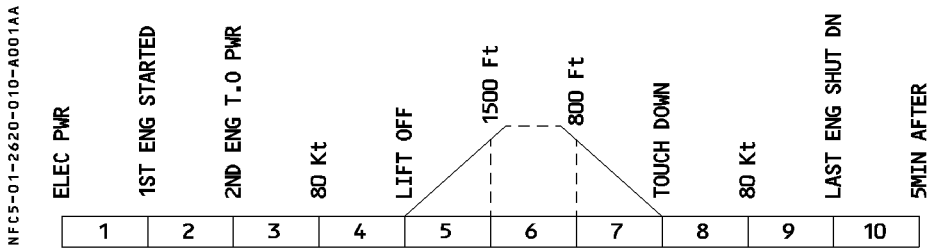
R Tests the following APU circuits : Fire warning, auto extinguishing, and shutdown.
R The test sequence lasts for 10 seconds.
R During the test sequence, the APU MASTER switch must be ON.
R If all circuits are operating correctly, the OK light comes on.

Note : If the APU was running, it shuts down.

(2) RESET pushbutton

Resets, the test circuit.

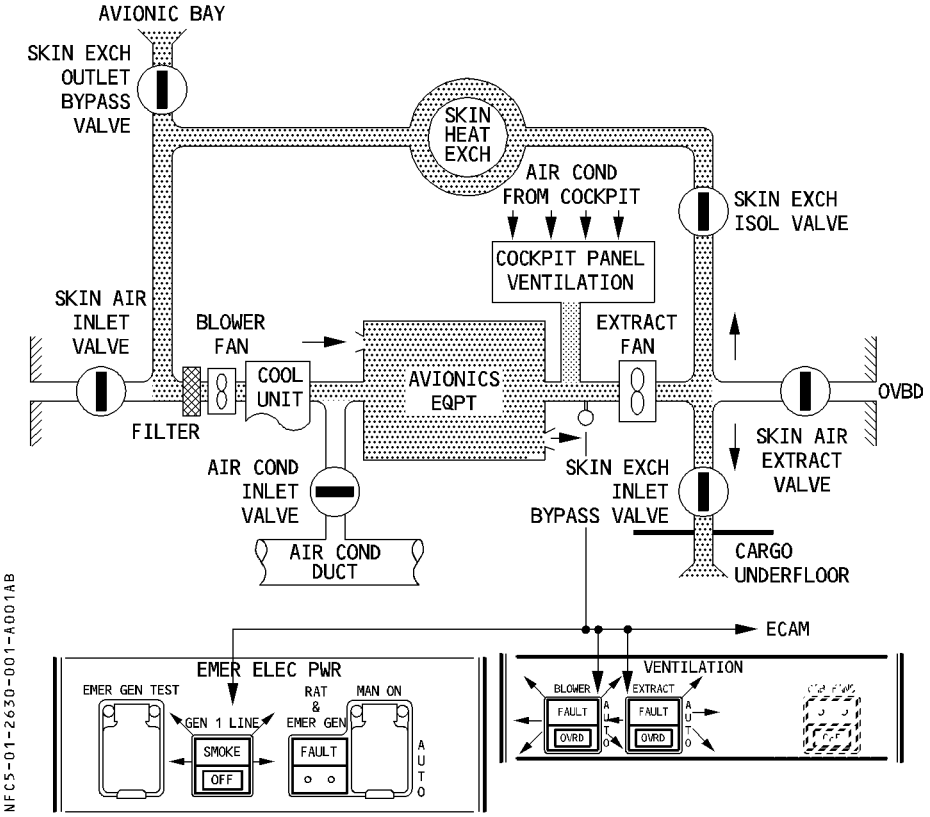
WARNINGS AND CAUTIONS



E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
ENG 1 (2) FIRE Fire detected by both loops or by one loop, the other one being faulty, or break in both loops occuring within 5 seconds	CRC	MASTER WARN	ENGINE	FIRE lts on ENG FIRE pb and on ENG panel	NIL
APU FIRE Fire detected by both loops or by one loop, the other one being faulty, or break in both loops occuring within 5 seconds			APU	FIRE lt on APU FIRE pb	
ENG 1 (2) APU FIRE DET FAULT Both loops inoperative or Fire Detector Unit inoperative	SINGLE CHIME	MASTER CAUT	NIL	NIL	3, 4, 5, 7, 8
ENG 1 (2) APU LOOP A (B) FAULT	NIL	NIL			

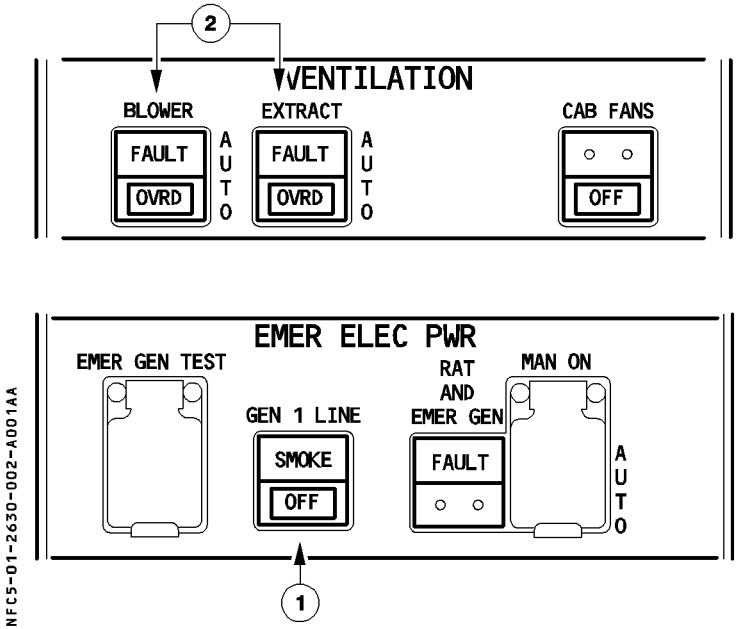
DESCRIPTION

R One smoke detector in the air extraction duct of the avionics ventilation system detects smoke in the avionics compartment.
It signals the ECAM to display a warning in the cockpit.
When it detects smoke for more than 5 seconds :
– A single chime sounds.
– The MASTER CAUTION lights, on the glareshield, light up.
– The ECAM displays a caution on the E/WD.
– The SMOKE light, on the EMER ELEC PWR panel, lights up.
– The BLOWER and EXTRACT FAULT, on the VENTILATION panel, light up.
If smoke is detected for more than 5 minutes, the caution can be cleared ; but, it remains latched, and can be recalled. On the ground, a dual FWC reset will unlatch the caution.



CONTROLS AND INDICATORS

OVERHEAD PANEL



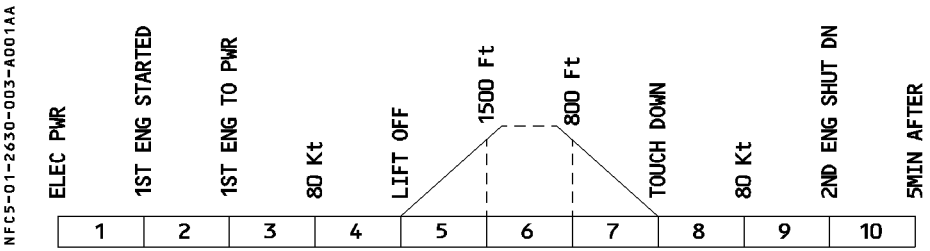
(1) GEN 1 LINE (See 1.24.10)

SMOKE lt : Comes on amber, along with a warning on ECAM, when smoke is detected in the avionics ventilation duct.

(2) BLOWER and EXTRACT pb sw (See 1.21.30)

FAULT lts : Both FAULT lights come on amber, along with a warning on ECAM, when smoke is detected in the avionics ventilation duct.

WARNINGS AND CAUTIONS



E / WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
AVNCS SMOKE Smoke detected in ventilation extraction duct	SINGLE CHIME	MASTER CAUT	ELEC	. SMOKE lt on EMER ELEC PWR panel . FAULT lts on BLOWER and EXTRACT pb sw	4, 5, 7, 8

DESCRIPTION

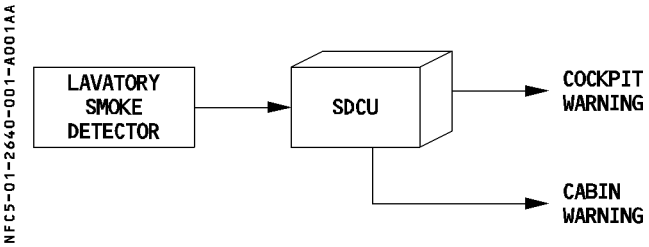
SMOKE DETECTION

The lavatory smoke detection system consists of :

R — One smoke detector in each lavatory.

— A double channel Smoke Detection Control Unit (SDCU).

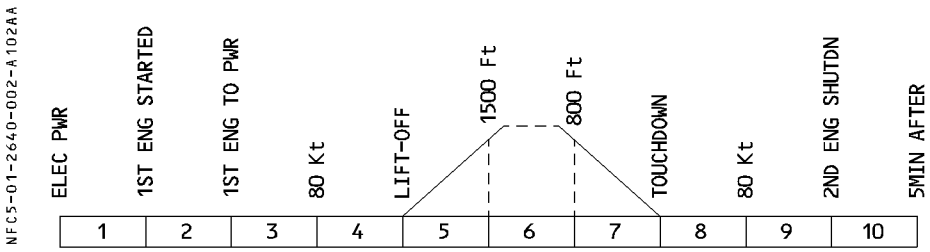
When a detector finds smoke in a lavatory, it sends a signal to the SDCU. The SDCU transmits it to the flight warning computer (for warning display in the cockpit) and to the CIDS (for warning in the cabin).



WASTEBIN FIRE EXTINGUISHING

Each lavatory wastebin has an automatic fire extinguishing system.

WARNINGS AND CAUTIONS

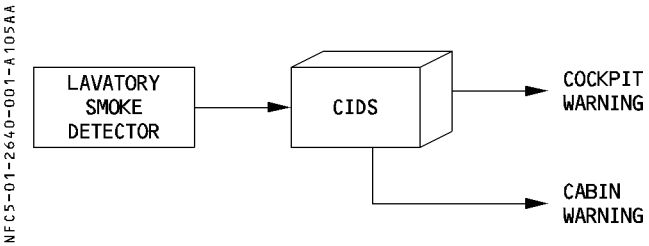


E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNINGS	FLT PHASE INHIB
LAVATORY SMOKE Smoke detected in one lavatory.	CRC	MASTER WARN	NIL	NIL	4, 5, 7, 8
LAVATORY DET FAULT Lavatory smoke detection fault, or Lavatory and galley fan faulty.	NIL	NIL			3, 4, 5, 7, 8
LAV + CRG DET FAULT Both SDCU channels failed.	SINGLE CHIME	MASTER CAUT			

DESCRIPTION

SMOKE DETECTION

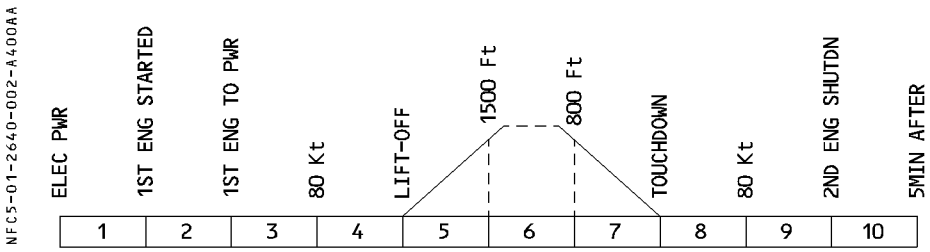
The lavatory smoke detection system consists of :
– One smoke detector in each lavatory.
– A CIDS Decoder Encoder Unit that links the detector to the entire CIDS system.
When a detector finds smoke in a lavatory, it sends a signal to the CIDS, which transmits it to the Flight Warning Computer (FWC), for Warning in the cockpit, and generates an indication in the cabin.



WASTEBIN FIRE EXTINGUISHING

Each lavatory wastebin has an automatic fire extinguishing system.

WARNINGS AND CAUTIONS



E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNINGS	FLT PHASE INHIB
LAVATORY SMOKE Smoke detected in one lavatory.	CRC	MASTER WARN	NIL	NIL	4, 5, 7, 8
LAVATORY DET FAULT Lavatory smoke detection fault	NIL	NIL			3, 4, 5, 7, 8
LAV + CRG DET FAULT Both CIDS Smoke Detection functions are failed.	SINGLE CHIME	MASTER CAUT			

SMOKE DETECTION

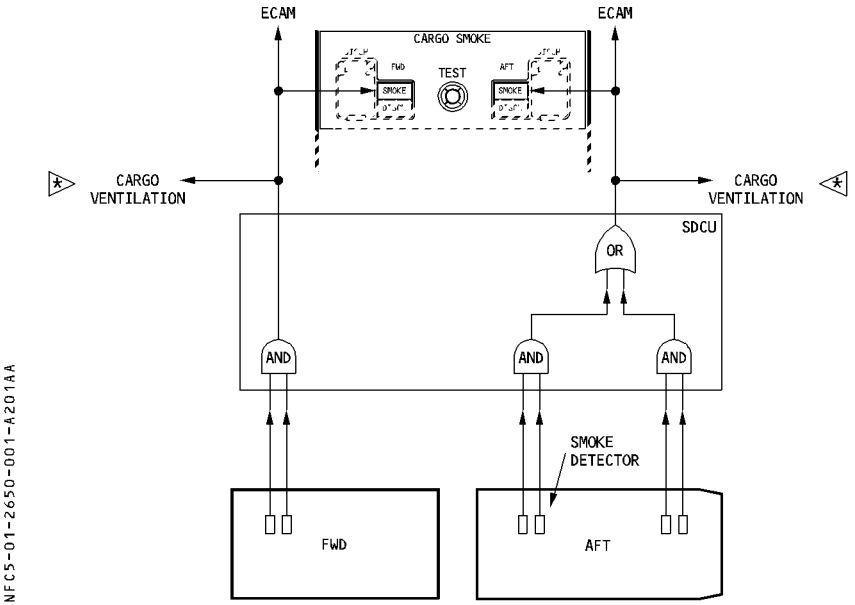
The cargo compartments have a smoke detection system.

R
- Cavities in the cargo compartment ceiling panels each hold two smoke detectors. Each detector is linked to one of the two detection loops (dual loop principle).
- The forward cargo compartment has one cavity.
- The aft cargo compartment has two cavities.
- The Smoke Detection Control Unit (SDCU) receives signals from the detectors and transmits them to the ECAM, which displays a warning in the cockpit. The SDCU has two identical channels.

Smoke in one cavity activates the cargo smoke warning if :
- Both smoke detectors detect it, or
- One smoke detector detects it and the other is inoperative.

If cargo ventilation is installed, and the cargo smoke warning is activated in either compartment, the associated isolation valves (◁) automatically close and the extraction fan stops. ◁

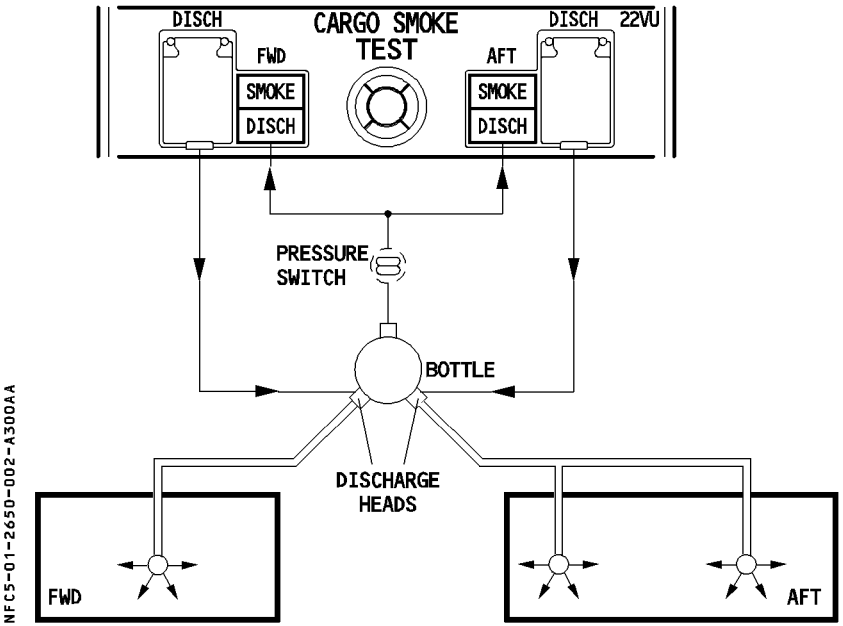
R



NFC5-01-2650-001-A201AA

FIRE EXTINGUISHING

A fire extinguishing system protects the FWD and AFT cargo compartments.
One fire bottle supplies three nozzles (one in FWD compartment and two in AFT compartment). The bottle has two discharge heads, one for each compartment. When a member of the flight crew presses the DISCH pushbutton for either compartment, the action ignites the corresponding squib on the fire bottle, which then discharges extinguishing agent into that compartment.
When the bottle has discharged, the amber DISCH light comes on.



SMOKE DETECTION

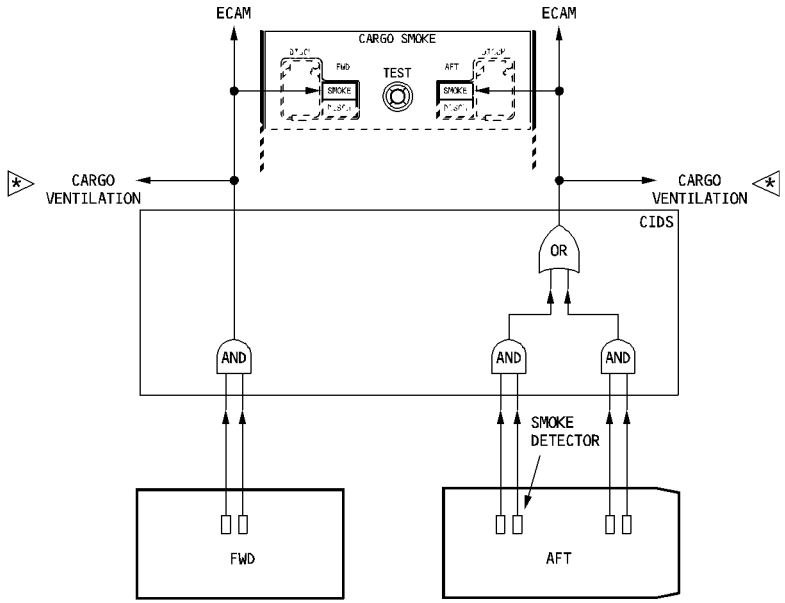
The cargo compartments have a smoke detection system.

- Cavities in the cargo compartment ceiling panels each hold two smoke detectors. Each detector is linked to one of the two detection loops (dual loop principle).
- The forward cargo compartment has one cavity.
- The aft cargo compartment has two cavities.
- The Cabin Intercommunication Data System (CIDS) receives signals from the smoke detectors and transmits them to the ECAM, which displays a warning in the cockpit. The CIDS has two identical channels.

Smoke in one cavity activates the cargo smoke warning, if :

- Both smoke detectors detect it, or
- One smoke detector detects it, and the other is inoperative.

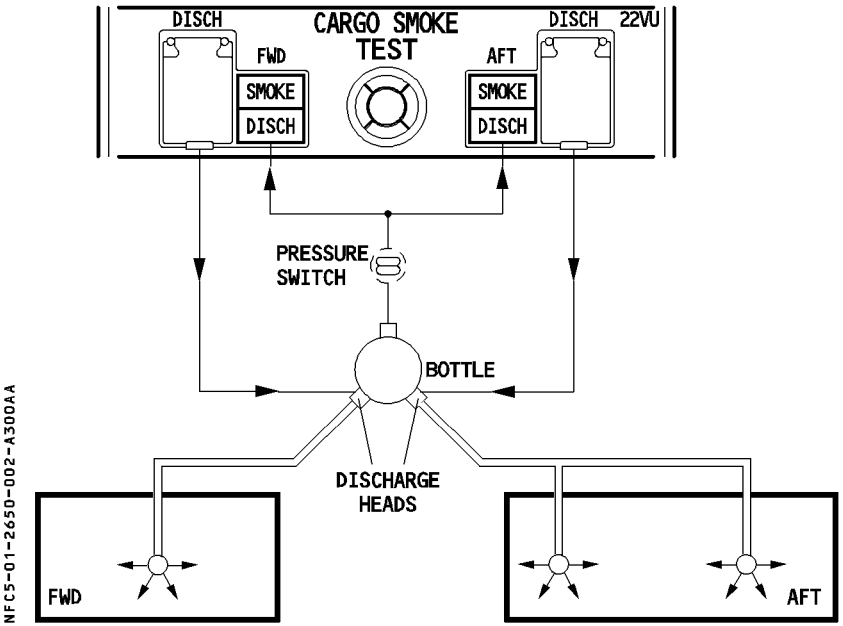
If cargo ventilation is installed, and the cargo smoke warning is activated in either compartment, the associated isolation valves (◁) automatically close and the extraction fan stops. ◁



NFCS-01-2650-001-A300AA

FIRE EXTINGUISHING

A fire extinguishing system protects the FWD and AFT cargo compartments.
One fire bottle supplies three nozzles (one in FWD compartment and two in AFT compartment). The bottle has two discharge heads, one for each compartment. When a member of the flight crew presses the DISCH pushbutton for either compartment, the action ignites the corresponding squib on the fire bottle, which then discharges extinguishing agent into that compartment.
When the bottle has discharged, the amber DISCH light comes on.



SMOKE DETECTION

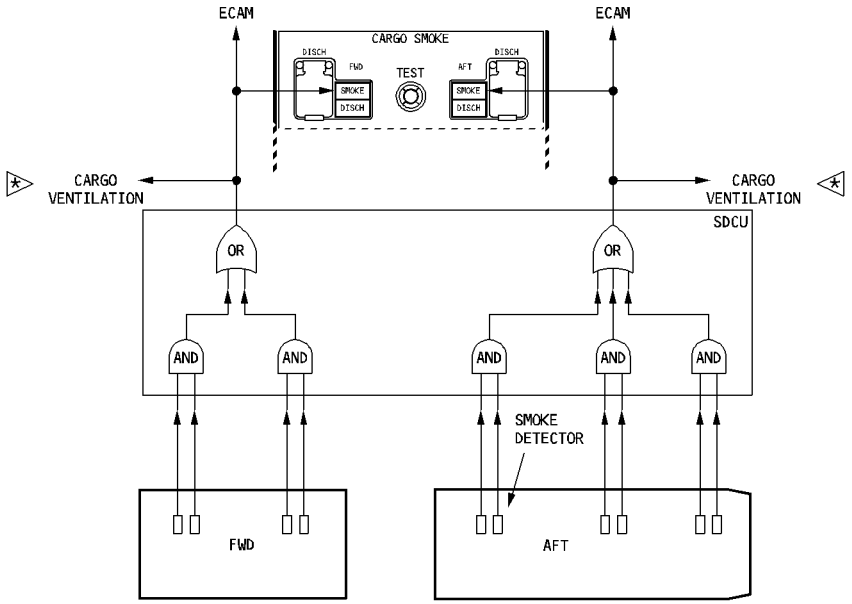
The cargo compartments have a smoke detection system.

- Cavities in the cargo compartment ceiling panels each hold two smoke detectors. Each detector is linked to one of the two detection loops (dual loop principle).
- The forward cargo compartment has two cavities.
- The aft cargo compartment has three cavities.
- The Smoke Detection Control Unit (SDCU) receives signals from the detectors and transmits them to the ECAM, which displays a warning in the cockpit. The SDCU has two identical channels.

Smoke in one cavity activates the cargo smoke warning if :

- Both smoke detectors detect it, or
- One smoke detector detects it and the other is inoperative.

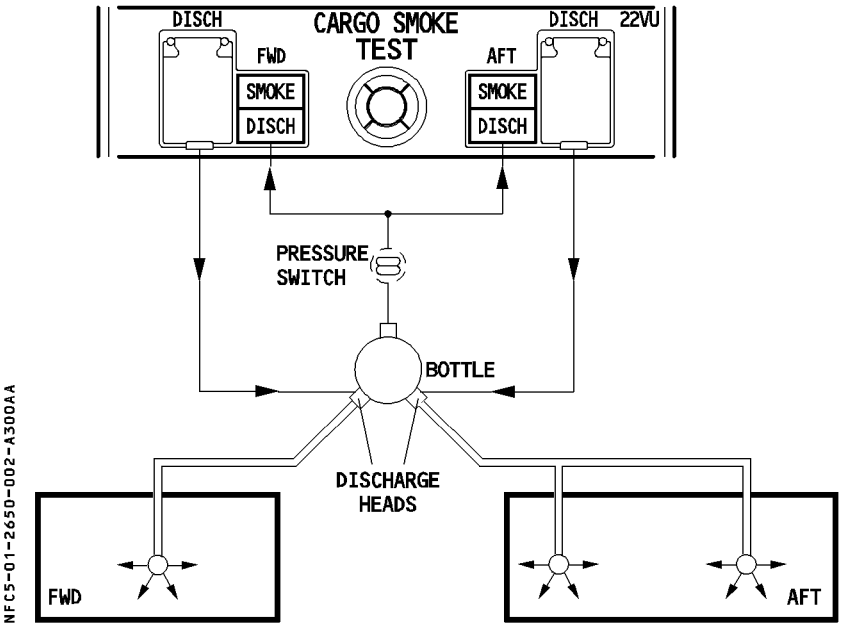
If cargo ventilation is installed, and the cargo smoke warning is activated in either compartment, the associated isolation valves (◁) automatically close and the extraction fan stops. ◁



NFC5-01-2650-001-A301AA

FIRE EXTINGUISHING

A fire extinguishing system protects the FWD and AFT cargo compartments.
One fire bottle supplies three nozzles (one in FWD compartment and two in AFT compartment). The bottle has two discharge heads, one for each compartment. When a member of the flight crew presses the DISCH pushbutton for either compartment, the action ignites the corresponding squib on the fire bottle, which then discharges extinguishing agent into that compartment.
When the bottle has discharged, the amber DISCH light comes on.



SMOKE DETECTION

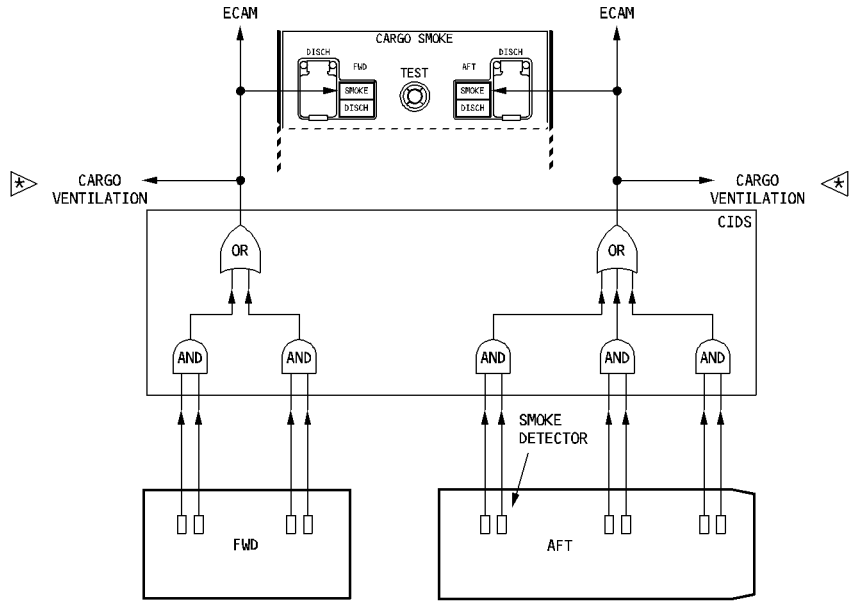
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- The forward cargo compartment has two cavities.
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- The Cabin Intercommunication Data System (CIDS) receives signals from the smoke detectors and transmits them to the ECAM, which displays a warning in the cockpit. The CIDS has two identical channels.

Smoke in one cavity activates the cargo smoke warning if :

- Both smoke detectors detect it, or
- One smoke detector detects it and the other is inoperative.

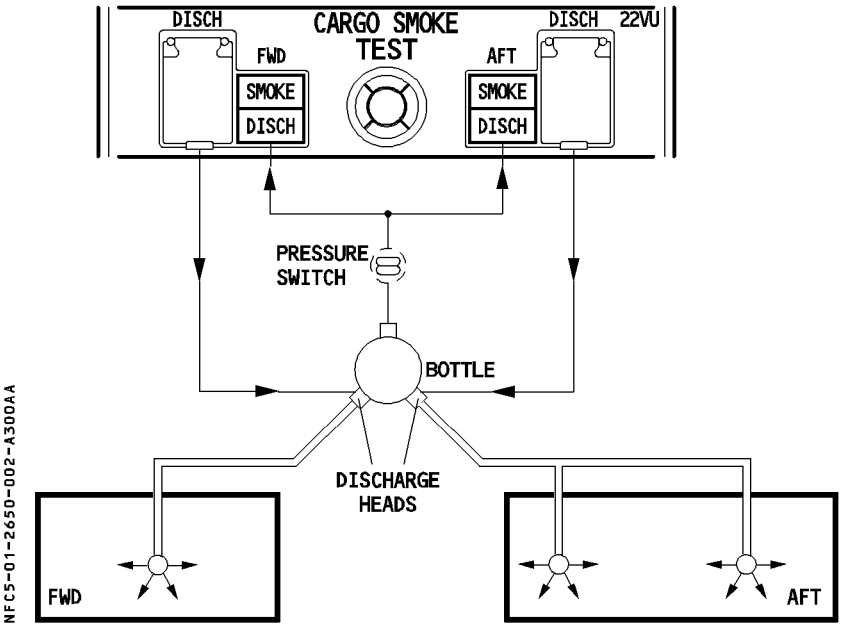
If cargo ventilation is installed, and the cargo smoke warning is activated in either compartment, the associated isolation valves (◁) automatically close and the extraction fan stops. ◁



NFC5-01-2650-001-A405AA

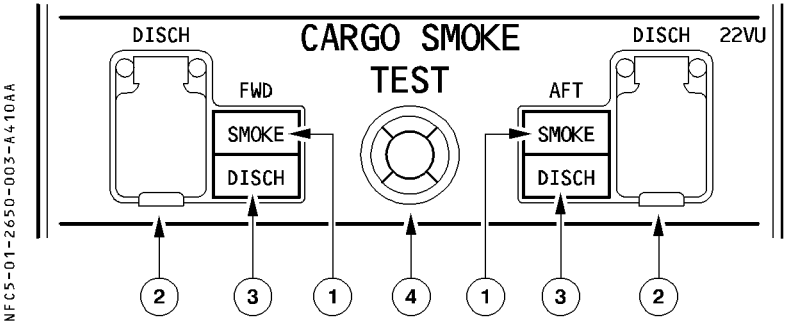
FIRE EXTINGUISHING

A fire extinguishing system protects the FWD and AFT cargo compartments.
One fire bottle supplies three nozzles (one in FWD compartment and two in AFT compartment). The bottle has two discharge heads, one for each compartment. When a member of the flight crew presses the DISCH pushbutton for either compartment, the action ignites the corresponding squib on the fire bottle, which then discharges extinguishing agent into that compartment.
When the bottle has discharged, the amber DISCH light comes on.



CONTROLS AND INDICATORS

OVERHEAD PANEL



(1) SMOKE light

This red light, and the associated ECAM warning, come on when the system detects smoke in the indicated compartment. This light comes on, if :
- Both channels detect smoke, or
- One channel detects smoke and the SDCU finds that the other channel is faulty.

(2) DISCH pushbutton

This button ignites the squib to discharge the extinguishing agent in the corresponding compartment (FWD or AFT).

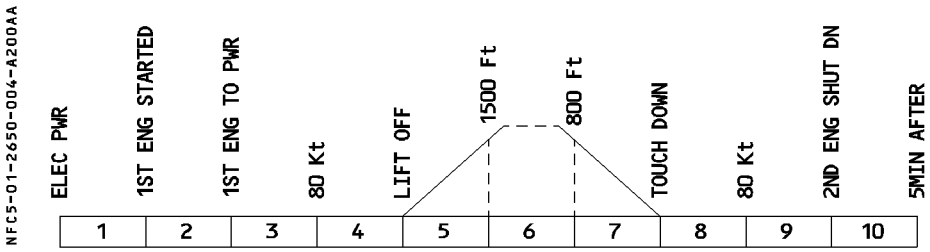
(3) DISCH light

R Within 60 seconds after pressing the discharge pushbutton, this amber light comes on,
R thereby indicating that the agent bottle has fully discharged.

(4) TEST pushbutton

Pressing this button for at least 3 seconds, and until it is released :
- Tests the smoke detectors in sequence,
- Turns on the red smoke lights twice, and displays the ECAM warning,
- Closes the ventilation system's isolation valves.
- Turns on the amber DISCH lights.

WARNINGS AND CAUTIONS

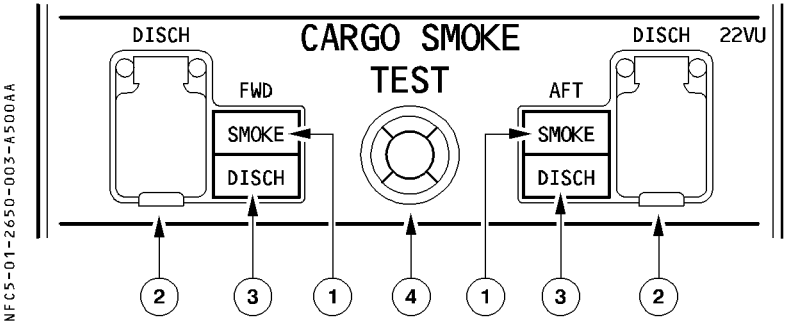


R

E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
FWD (AFT) CARGO SMOKE Smoke detected	CRC	MASTER WARN	COND	SMOKE lt on CARGO SMOKE panel	4, 5, 7, 8
FWD (AFT) CRG DET FAULT Smoke detection fault	NIL	NIL	NIL	NIL	3, 4, 5, 7, 8
LAV + CRG DET FAULT Both SDCU channels failed	SINGLE CHIME	MASTER CAUTION			
FWD (AFT) BTL SQUIB FAULT Forward or aft bottle squib failed					4, 5, 7, 8

CONTROLS AND INDICATORS

OVERHEAD PANEL



(1) SMOKE light

This red light, and the associated ECAM warning, come on when the system detects smoke in the indicated compartment. This light comes on, if :
- Both channels detect smoke, or
- One channel detects smoke and the other channel is faulty.

(2) DISCH pushbutton

This button ignites the squib to discharge the extinguishing agent in the corresponding compartment (FWD or AFT).

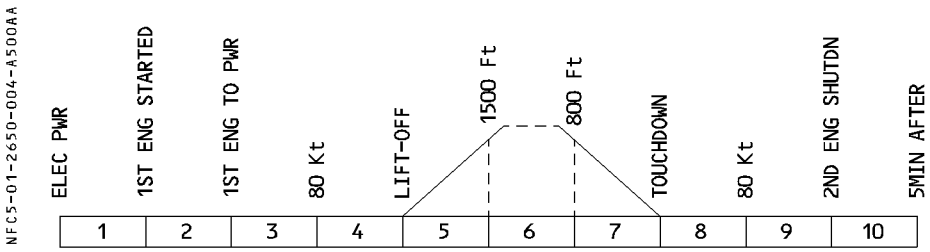
(3) DISCH light

Within 60 seconds after pressing the discharge pushbutton, this amber light comes on, thereby indicating that the agent bottle has fully discharged.

(4) TEST pushbutton

Pressing this button for at least 3 seconds, and until it is released :
- Tests the smoke detectors in sequence,
- Turns on the red smoke lights twice, and displays the ECAM warning,
- Closes the ventilation system's isolation valves.
- Turns on the amber DISCH lights.

WARNINGS AND CAUTIONS



R

E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
FWD (AFT) CARGO SMOKE Smoke detected	CRC	MASTER WARN	COND	SMOKE lt on CARGO SMOKE panel	4, 5, 7, 8
FWD (AFT) CRG DET FAULT Smoke detection fault	NIL	NIL	NIL	NIL	3, 4, 5, 7, 8
LAV + CRG DET FAULT Both CIDS Smoke Detection Functions are failed.	SINGLE CHIME	MASTER CAUTION			
FWD (AFT) CRG BTL (1)(2 ◁) FAULT Forward or aft bottle squib failed or bottle on low pressure.					4, 5, 7, 8

BUS EQUIPMENT LIST

R

			NORM		EMER ELEC		
			AC	DC	AC ESS	DC ESS	HOT
ENG/APU	FIRE DETECTION	ENG 1 LOOP A				X	
		ENG 1 LOOP B		DC2			
		ENG 2 LOOP A		DC2			
		ENG 2 LOOP B				X	
		APU LOOP A		DC BAT			
		APU LOOP B		DC BAT			
	FIRE EXTINGUISHING	ENG 1/2					
		BTL 1 SQUIB A					HOT 1
		BTL 1 SQUIB B					HOT 2
		BTL 2 SQUIB A		DC 2			
		BTL 2 SQUIB B		DC 2			
		APU					
		BTL SQUIB A					HOT 1
		BTL SQUIB B		DC BAT			
		AUTO EXT		DC BAT			
CARGO LAVATORIES		SDCU CH 1				SHED	
		SDCU CH 2		DC 2			
		FWD/AFT CARGO EXTING BOTTLES		DC BAT			

BUS EQUIPMENT LIST

			NORM		EMER ELEC		
			AC	DC	AC ESS	DC ESS	HOT
ENG/APU	FIRE DETECTION	ENG 1 LOOP A				X	
		ENG 1 LOOP B		DC2			
		ENG 2 LOOP A		DC2			
		ENG 2 LOOP B				X	
		APU LOOP A		DC BAT			
		APU LOOP B		DC BAT			
	FIRE EXTINGUISHING	ENG 1/2					
		BTL 1 SQUIB A					HOT 1
		BTL 1 SQUIB B					HOT 2
		BTL 2 SQUIB A		DC 2			
		BTL 2 SQUIB B		DC 2			
		APU					
		BTL SQUIB A					HOT 1
		BTL SQUIB B		DC BAT			
		AUTO EXT		DC BAT			
CARGO LAVATORIES		CIDS CH 1				X	
		CIDS CH 2		DC 2			
		FWD/AFT CARGO EXTING BOTTLES		DC BAT			

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27.60 ELECTRICAL SUPPLY 1

GENERAL

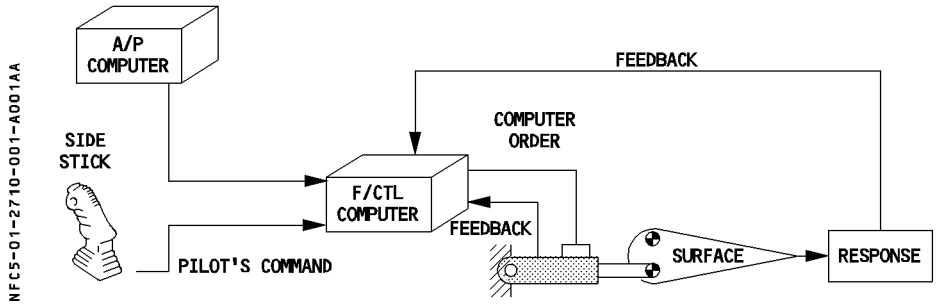
The fly-by-wire system was designed and certified to render the new generation of aircraft even more safe, cost effective, and pleasant to fly.

BASIC PRINCIPLE

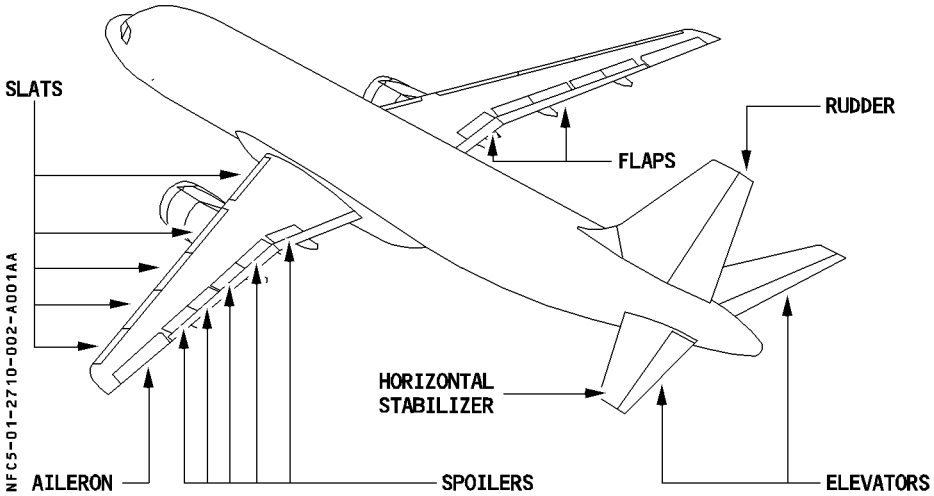
Flight control surfaces are all :
- Electrically-controlled, and
- Hydraulically-activated.

The stabilizer and rudder can also be mechanically-controlled.
Pilots use sidesticks to fly the aircraft in pitch and roll (and in yaw, indirectly, through turn coordination).
Computers interpret pilot input and move the flight control surfaces, as necessary, to follow their orders.

R However, when in normal law, regardless of the pilot's input, the computers will prevent
R excessive maneuvers and exceedance of the safe envelope in pitch and roll axis.
R However, as on conventional aircraft, the rudder has no such protection.



CONTROL SURFACES



The flight controls are electrically or mechanically controlled as follows :

Pitch axis
Elevator = Electrical
Stabilizer = Electrical for normal or alternate control. Mechanical for manual trim control

Roll axis
Ailerons = Electrical
Spoilers = Electrical

Yaw axis
Rudder = Mechanical, however control for yaw damping, turn coordination and trim is electrical.

Speed brakes
Speed brakes = Electrical

Note : All surfaces are hydraulically actuated.

COCKPIT CONTROLS

- Each pilot has a sidestick controller with which to exercise manual control of pitch and roll. These are on their respective lateral consoles.
  The two sidestick controllers are not coupled mechanically, and they send separate sets of signals to the flight control computers.
- Two pairs of pedals, which are rigidly interconnected, give the pilot mechanical control of the rudder.
- The pilots control speed brakes with a lever on the center pedestal.
- The pilots use mechanically interconnected handwheels on each side of the center pedestal to control the trimmable horizontal stabilizer.
- The pilots use a single switch on the center pedestal to set the rudder trim.
- There is no manual switch for trimming the ailerons.

COMPUTERS

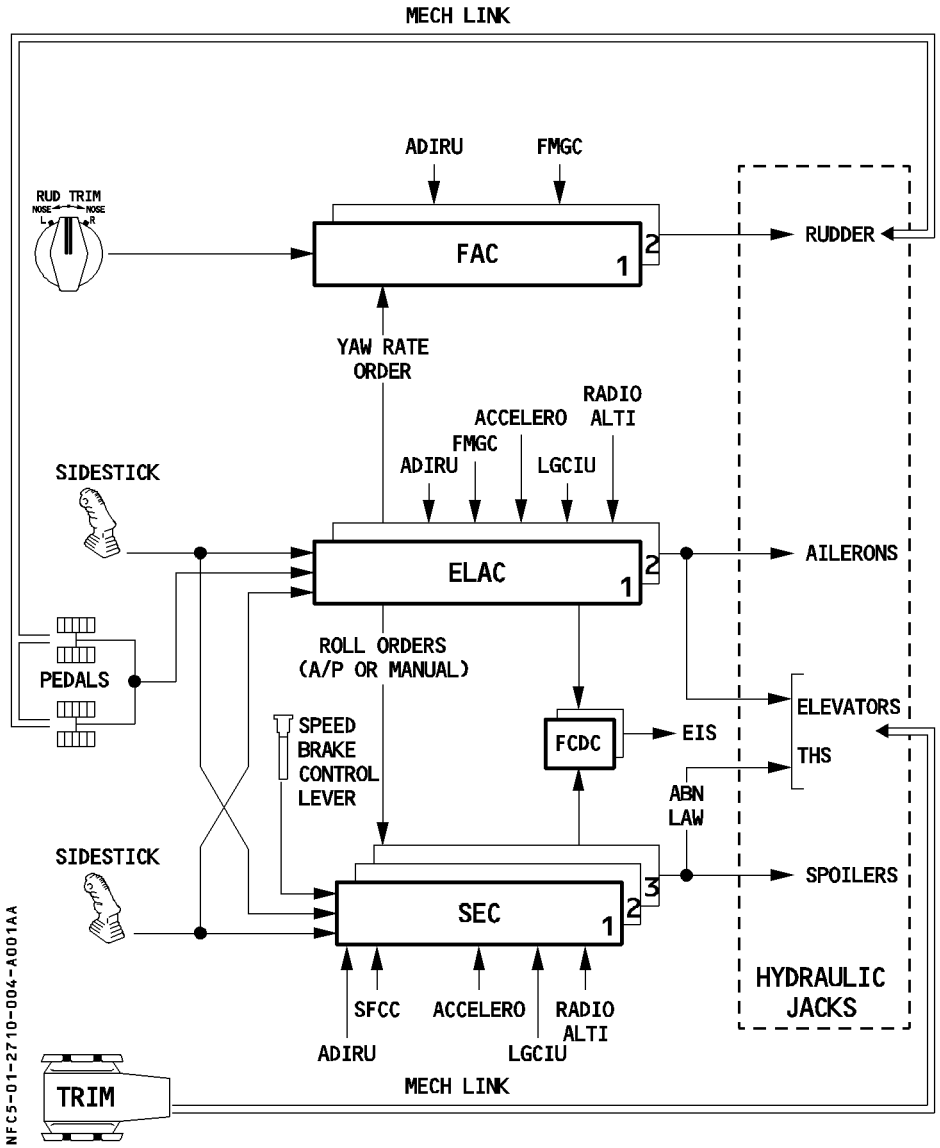
Seven flight control computers process pilot and autopilot inputs according to normal, alternate, or direct flight control laws.
The computers are :

2 ELACs
(Elevator Aileron Computer)
For : Normal elevator and stabilizer control.
Aileron control.

3 SECs
(Spoilers Elevator Computer)
For : Spoilers control.
Standby elevator and stabilizer control.

2 FACs
(Flight Augmentation Computer)
For : Electrical rudder control.

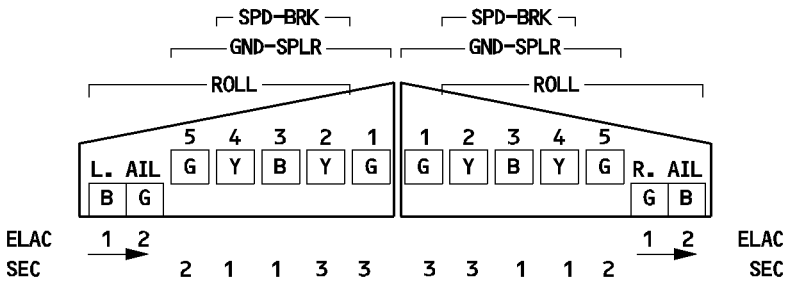
In addition 2 FCDC
Flight Control Data Concentrators (FCDC) acquire data from the ELACs and SECs and send it to the electronic instrument system (EIS) and the centralized fault display system (CFDS).

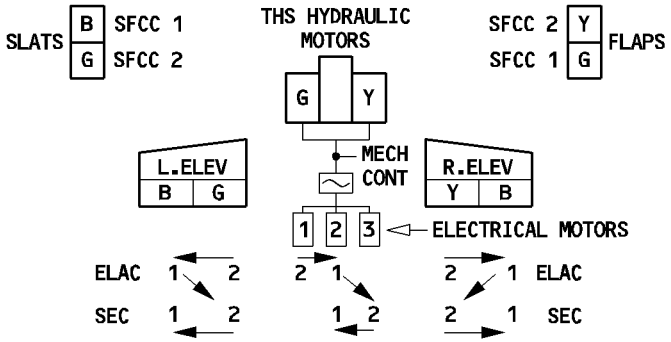

MECH LINK
ADIRU
FMGC
RUD TRIM
NOSE
NOSE
L
R
FAC
2
1
RUDDER
YAW RATE
ORDER
RADIO
ALTI
ACCELERO
FMGC
ADIRU
LGCIU
SIDESTICK
ELAC
2
1
AILERONS
PEDALS
ROLL ORDERS
(A/P OR MANUAL)
ELEVATORS
SPEED
BRAKE
CONTROL
LEVER
FCDC
EIS
THS
ABN
LAW
SIDESTICK
SEC
3
2
1
SPOILERS
HYDRAULIC
JACKS
SFCC
ACCELERO
RADIO
ALTI
ADIRU
LGCIU
TRIM
MECH LINK
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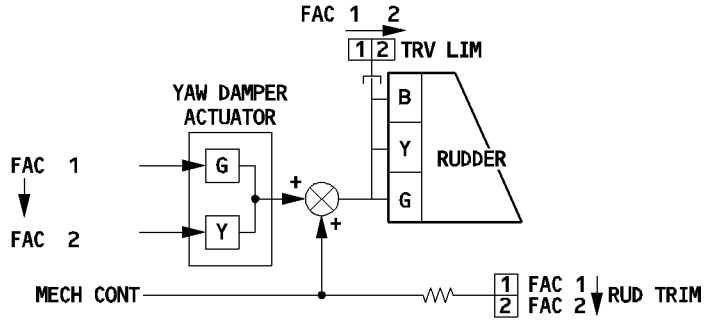
ARCHITECTURE

GENERAL ARCHITECTURE

FOR INFO





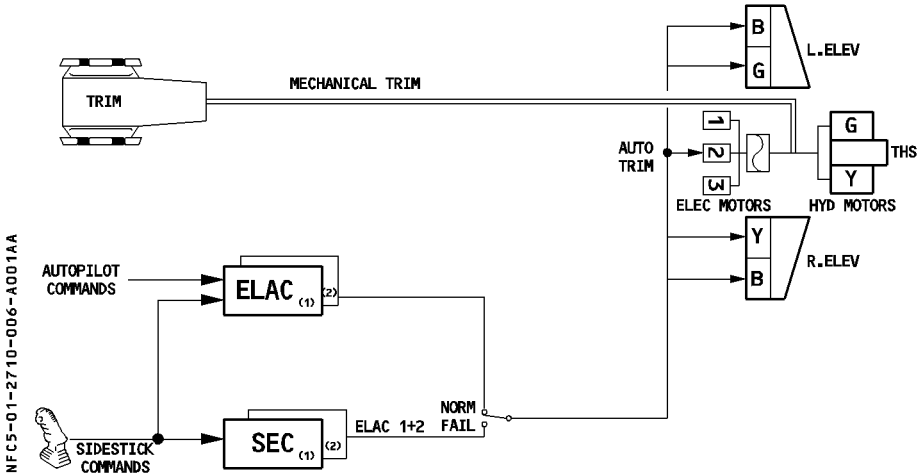


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→ Arrows indicate the control reconfiguration priorities

G B Y indicates the hydraulic power source (green, blue, or yellow) for each servo control.

PITCH CONTROL



R Two elevators and the Trimmable Horizontal Stabilizer (THS) control the aircraft in pitch. The maximum elevator deflection is 30° nose up, and 17° nose down. The maximum THS deflection is 13.5° nose up, and 4° nose down.

ELECTRICAL CONTROL

- In normal operations, ELAC2 controls the elevators and the horizontal stabilizer, and the green and yellow hydraulic jacks drive the left and right elevator surfaces respectively. The THS is driven by N° 1 of three electric motors.
- If a failure occurs in ELAC2, or in the associated hydraulic systems, or with the hydraulic jacks, the system shifts pitch control to ELAC1. ELAC1 then controls the elevators via the blue hydraulic jacks and controls the THS via the N° 2 electric motor.
- If neither ELAC1 nor ELAC2 is available, the system shifts pitch control either to SEC1 or to SEC2, (depending on the status of the associated circuits), and to THS motor N° 2 or N° 3.

Page 8, below, describes how the actuators are reconfigured in case of failure.

MECHANICAL CONTROL

Mechanical control of the THS is available from the pitch trim wheel at any time, if either the green or yellow hydraulic system is functioning.
Mechanical control from the pitch trim wheel has priority over electrical control.

ACTUATION

Elevators

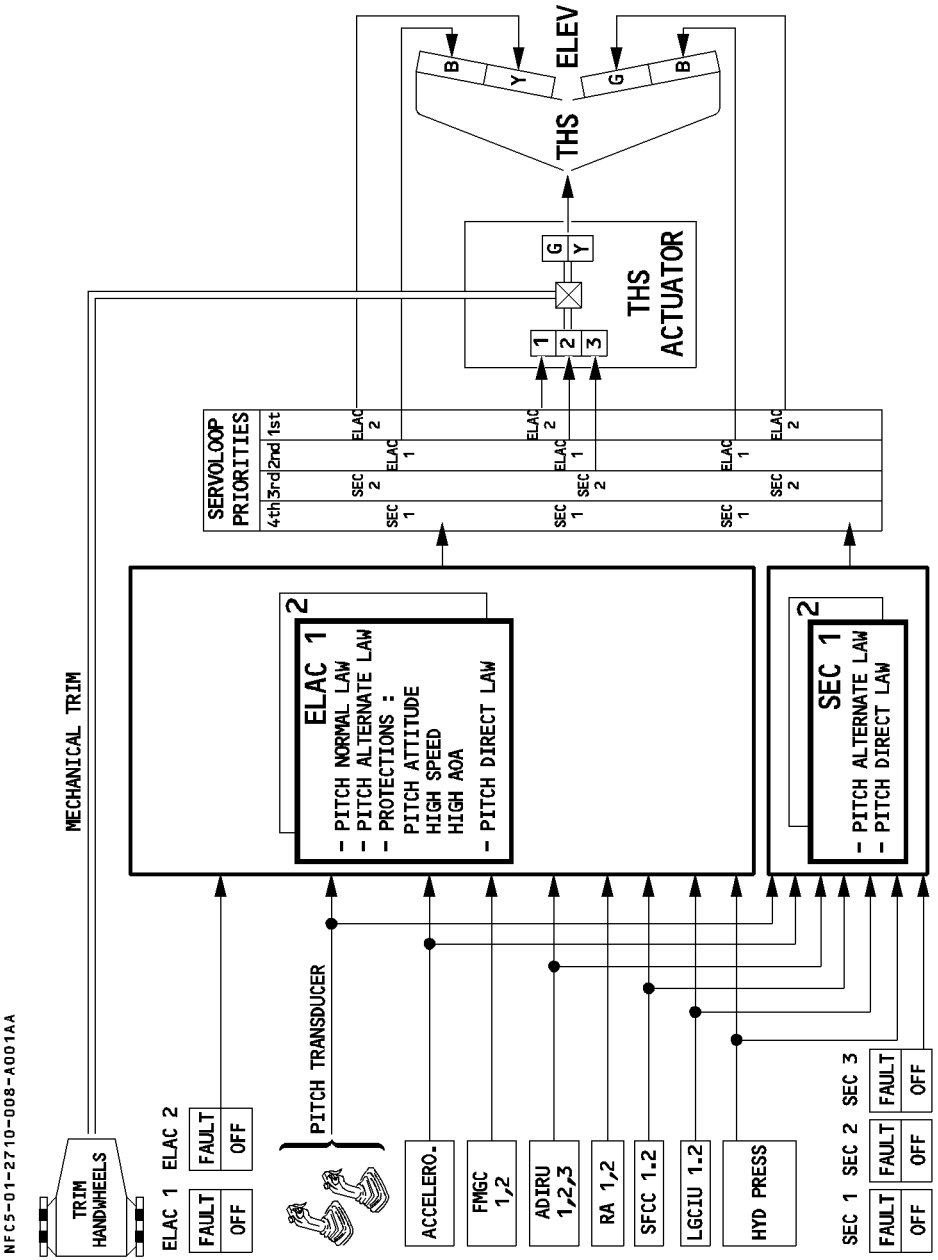
— Two electrically-controlled hydraulic servojacks drive each elevator.
Each servojack has three control modes :
. Active : The jack position is electrically-controlled.
. Damping : The jack follows surface movement.
. Centering : The jack is hydraulically retained in the neutral position.
— In normal operation :
· One jack is in active mode.
· The other jack is in damping mode.
· Some maneuvers cause the second jack to become active.
— If the active servojack fails, the damped one becomes active, and the failed jack is automatically switched to the damping mode.
R — If neither jack is being controlled electrically, both are automatically switched to
R centering mode.
R If neither jack is being controlled hydraulically, both are automatically switched to
R damping mode.
— If one elevator fails, the deflection of the remaining elevator is limited in order to avoid putting excessive asymmetric loads on the horizontal tailplane or rear fuselage.

Stabilizer

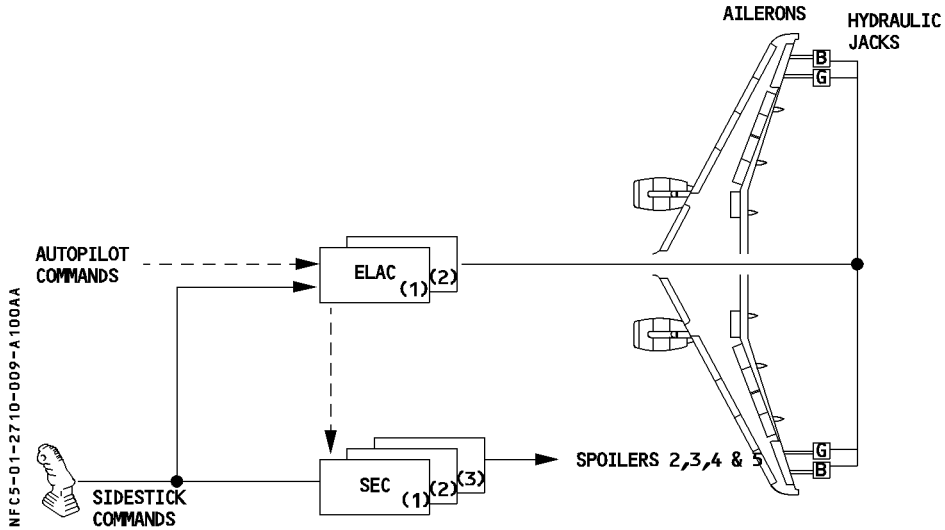
— A screwjack, driven by two hydraulic motors, drives the stabilizer.
— The two hydraulic motors are controlled by :
· One of three electric motors, or
· The mechanical trim wheel.

PITCH CONTROL – SCHEMATIC

FOR INFO



ROLL CONTROL



One aileron and four spoilers on each wing control the aircraft about the roll axis.
The maximum deflection of the ailerons is 25°.
The ailerons extend 5° down when the flaps are extended (aileron droop).
The maximum deflection of the spoilers is :
– 35° for spoilers 2, 4, and 5
– 7° for spoilers 3.

ELECTRIC CONTROL

– The ELAC 1 normally controls the ailerons.
  If ELAC1 fails, the system automatically transfers aileron control to ELAC2.
  If both ELACs fail, the ailerons revert to the damping mode.
– SEC3 controls the N° 2 spoilers, SEC1 the N° 3 and 4 spoilers, and SEC2 the N° 5 spoilers.

R If a SEC fails, the spoilers it controls are automatically retracted.

ACTUATION

Ailerons

Each aileron has two electrically controlled hydraulic servojacks.
One of these servojacks per aileron operates at a time.
Each servojack has two control modes :
– Active : Jack position is controlled electrically.
– Damping : Jack follows surface movement.

The system automatically selects damping mode, if both ELACs fail or in the event of blue and green hydraulic low pressure.

Spoilers

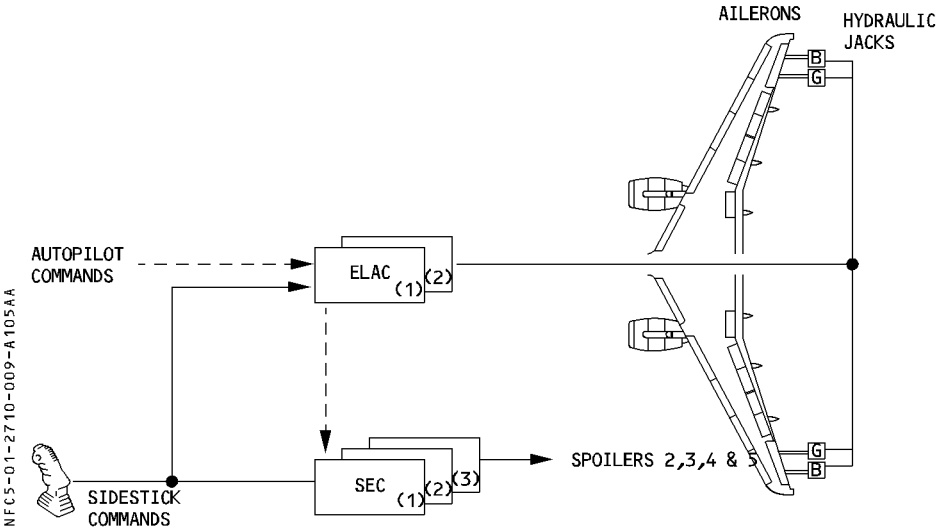
A servojack positions each spoiler. Each servojack receives hydraulic power from either the green, yellow, or blue hydraulic system, controlled by the SEC1, 2 or 3 (as shown on page 5).

The system automatically retracts the spoilers to their zero position, if it detects a fault or loses electrical control.

If the system loses hydraulic pressure, the spoiler retains the deflection it had at the time of the loss, or a lesser deflection if aerodynamic forces push it down.

R When a spoiler surface on one wing fails, the symmetric one on the other wing is inhibited.

ROLL CONTROL



One aileron and four spoilers on each wing control the aircraft about the roll axis.
The maximum deflection of the ailerons is 25°.
The ailerons extend 5° down when the flaps are extended (aileron droop).
The maximum deflection of the spoilers is 35°.

ELECTRIC CONTROL

- The ELAC 1 normally controls the ailerons.
  If ELAC1 fails, the system automatically transfers aileron control to ELAC2.
  If both ELACs fail, the ailerons revert to the damping mode.
- SEC3 controls the N° 2 spoilers, SEC1 the N° 3 and 4 spoilers, and SEC2 the N° 5 spoilers.
  If a SEC fails, the spoilers it controls are automatically retracted.

ACTUATION

Ailerons

Each aileron has two electrically controlled hydraulic servojacks.
One of these servojacks per aileron operates at a time.
Each servojack has two control modes :
Active : Jack position is controlled electrically
Damping : Jack follows surface movement.

The system automatically selects damping mode, if both ELACs fail or in the event of blue and green hydraulic low pressure.

Spoilers

A servojack positions each spoiler. Each servojack receives hydraulic power from either the green, yellow, or blue hydraulic system, controlled by the SEC1, 2 or 3 (as shown on page 5).

The system automatically retracts the spoilers to their zero position, if it detects a fault or loses electrical control.

If the system loses hydraulic pressure, the spoiler retains the deflection it had at the time of the loss, or a lesser deflection if aerodynamic forces push it down.

R When a spoiler surface on one wing fails, the symmetric one on the other wing is inhibited.

SPEEDBRAKES AND GROUND SPOILERS

SPEEDBRAKE CONTROL

The pilot controls the speedbrakes with the speed brake lever.
The speedbrakes are actually spoilers 2, 3 and 4.
Speedbrake extension is inhibited if :
– SEC1 and SEC3 both have faults.
– An elevator (L or R) has a fault (in this case only spoilers 3 and 4 are inhibited).
– Angle-of-attack protection is active.
– Flaps are in configuration FULL.
– Thrust levers above MCT position
– Alpha floor activation
If an inhibition occurs when the speedbrakes are extended, they retract automatically and stay retracted until the inhibition condition disappears and the pilots reset the lever. (The speedbrakes can be extended again 10 seconds or more after the lever is reset).
When a speedbrake surface on one wing fails, the symmetric one on the other wing is inhibited.

Note : 1. For maintenance purposes, the speedbrake lever will extend the N° 1 surfaces when the aircraft is stopped on the ground, whatever the slat/flap configuration.
2. When the aircraft is flying faster than 315 knots or Mach 0.75 with the autopilot engaged, the speedbrake retraction rate is reduced (Retraction from FULL to in takes about 25 seconds).

FOR INFO

The maximum speedbrake deflection in manual flight is :
40° for spoilers 3 and 4
20° for spoiler 2.
The maximum speedbrake deflection with the autopilot engaged is :
25° for spoilers 3 and 4
12.5° for spoilers 2.
The maximum speedbrake deflection with the autopilot engaged is achieved with half speedbrake lever deflection.
For these surfaces (which perform both roll and speedbrake functions) the roll function has priority. When the sum of a roll order and a simultaneous speedbrake order on one surface is greater than the maximum deflection available in flight, the same surface on the other wing is retracted until the difference between the two surfaces is equal to the roll order.

GROUND SPOILER CONTROL

Spoilers 1 to 5 act as ground spoilers.
When a ground spoiler surface on one wing fails, the symmetric ground spoiler surface on the other wing is inhibited.

Arming
The pilot arms the ground spoilers by pulling the speedbrake control lever up into the armed position.

R **Full extension – Rejected takeoff phase**
R – If the ground spoilers are armed and the speed exceeds 72 knots, the ground spoilers will automatically extend as soon as both thrust levers are reset to idle.
R – If the ground spoilers are not armed and the speed exceeds 72 knots, the ground spoilers will automatically extend as soon as reverse is selected on one engine (the other thrust lever remains at idle).

R **Full extension - Landing phase**
R – If the ground spoilers are armed and all thrust levers are at idle, the ground spoilers will automatically extend as soon as both main landing gears have touched down.
R – If the ground spoilers are not armed and both main landing gears have touched down, the ground spoilers will automatically extend as soon as reverse is selected on one engine (the other thrust lever remains at idle).

Note : · In autoland, the ground spoilers fully extend at half speed one second after both main landing gears touch down.
· The spoiler roll function is inhibited when spoilers are used for the ground spoiler function.

Partial extension
The ground spoilers partially extend (10°) when reverse is selected on at least one engine (other engine at idle), and one main landing gear strut is compressed. This partial extension, by decreasing the lift, eases the compression of the second main landing gear strut, and consequently leads to full ground spoiler extension.

SPEEDBRAKES AND GROUND SPOILERS

SPEEDBRAKE CONTROL

The pilot controls the speedbrakes with the speedbrake lever.
The speedbrakes are actually spoilers 2, 3 and 4.
Speedbrake extension is inhibited if :
– SEC1 and SEC3 both have faults.
– An elevator (L or R) has a fault (in this case only spoilers 3 and 4 are inhibited).
– Angle-of-attack protection is active.
– Flaps are in configuration 3 or FULL.
– Thrust levers above MCT position
– Alpha floor activation
If an inhibition occurs when the speed brakes are extended, they retract automatically and stay retracted until the inhibition condition disappears and the pilots reset the lever. (The speedbrakes can be extended again 10 seconds or more after the lever is reset).
When a speedbrake surface on one wing fails, the symmetric one on the other wing is inhibited.

Note : 1. For maintenance purposes, the speedbrake lever will extend the N° 1 surfaces when the aircraft is stopped on the ground, whatever the slat/flap configuration.
2. When the aircraft is flying faster than 315 knots or Mach 0.75 with the autopilot engaged, the speedbrake retraction rate is reduced (Retraction from FULL to in takes about 25 seconds).

FOR INFO

The maximum deflection for spoilers 2, 3, and 4 is 25°.
For these surfaces (which perform both roll and speed-brake functions) the roll function has priority. When the sum of a roll order and a simultaneous speedbrake order on one surface is greater than the maximum deflection available in flight, the same surface on the other wing is retracted until the difference between the two surfaces is equal to the roll order.

GROUND SPOILER CONTROL

Spoilers 1 to 5 act as ground spoilers.
When a ground spoiler surface on one wing fails, the symmetric ground spoiler surface on the other wing is inhibited.

Arming
The pilot arms the ground spoilers by pulling the speedbrake control lever up into the armed position.

R **Full extension – Rejected takeoff phase**
R – If the ground spoilers are armed and the speed exceeds 72 knots, the ground spoilers will automatically extend as soon as both thrust levers are set to idle.
R – If the ground spoilers are not armed and the speed exceeds 72 knots, the ground spoilers will automatically extend as soon as reverse is selected on one engine (the other thrust lever remains at idle).

R **Full extension - Landing phase**
R – If the ground spoilers are armed and all thrust levers are at idle, the ground spoilers will automatically extend as soon as both main landing gears have touched down.
R – If the ground spoilers are not armed and both main landing gears have touched down, the ground spoilers will automatically extend as soon as reverse is selected on one engine (the other thrust lever remains at idle).

Note : The spoiler roll function is inhibited when spoilers are used for the ground spoiler function.

Partial extension
The ground spoilers partially extend (10°) when reverse is selected on at least one engine (other engine at idle), and one main landing gear strut is compressed. This partial extension, by decreasing the lift, eases the compression of the second main landing gear strut, and consequently leads to full ground spoiler extension.

SPEEDBRAKES AND GROUND SPOILERS

SPEEDBRAKE CONTROL

The pilot controls the speedbrakes with the speedbrake lever.
The speedbrakes are actually spoilers 2, 3 and 4.
Speedbrake extension is inhibited if :
– SEC1 and SEC3 both have faults.
– An elevator (L or R) has a fault (in this case only spoilers 3 and 4 are inhibited).
– Angle-of-attack protection is active.
– Flaps are in configuration FULL.
– Thrust levers above MCT position
– Alpha floor activation
If an inhibition occurs when the speedbrakes are extended, they retract automatically and stay retracted until the inhibition condition disappears and the pilots reset the lever. (The speedbrakes can be extended again 10 seconds or more after the lever is reset).
When a speedbrake surface on one wing fails, the symmetric one on the other wing is inhibited.

Note : 1. For maintenance purposes, the speedbrake lever will extend the N° 1 surfaces when the aircraft is stopped on the ground, whatever the slat/flap configuration.
2. When the aircraft is flying faster than 315 knots or Mach 0.75 with the autopilot engaged, the speedbrake retraction rate is reduced (Retraction from FULL to in takes about 25 seconds).

FOR INFO

The maximum deflection for spoilers is :
· 25° for spoilers 3 and 4
· 12.5° for spoilers 2 in configuration 3, and 17.5° in other configurations

For these surfaces (which perform both roll and speed-brake functions) the roll function has priority. When the sum of a roll order and a simultaneous speedbrake order on one surface is greater than the maximum deflection available in flight, the same surface on the other wing is retracted until the difference between the two surfaces is equal to the roll order.

GROUND SPOILER CONTROL

Spoilers 1 to 5 act as ground spoilers.
When a ground spoiler surface on one wing fails, the symmetric ground spoiler surface on the other wing is inhibited.

Arming
The pilot arms the ground spoilers by pulling the speedbrake control lever up into the armed position.

R **Full extension – Rejected takeoff phase**
R – If the ground spoilers are armed and the speed exceeds 72 knots, the ground spoilers will automatically extend as soon as both thrust levers are set to idle.
R – If the ground spoilers are not armed and the speed exceeds 72 knots, the ground spoilers will automatically extend as soon as reverse is selected on one engine (the other thrust lever remains at idle).

R **Full extension - Landing phase**
R – If the ground spoilers are armed and all thrust levers are at idle, the ground spoilers will automatically extend as soon as both main landing gears have touched down.
R – If the ground spoilers are not armed and both main landing gears have touched down, the ground spoilers will automatically extend as soon as reverse is selected on one engine (the other thrust lever remains at idle).

Note : The spoiler roll function is inhibited when spoilers are used for the ground spoiler function.

Partial extension
The ground spoilers partially extend (10°) when reverse is selected on at least one engine (other engine at idle), and one main landing gear strut is compressed. This partial extension, by decreasing the lift, eases the compression of the second main landing gear strut, and consequently leads to full ground spoiler extension.

Retraction

The ground spoilers retract :

· After landing, or after a rejected takeoff, when the ground spoilers are disarmed.

Note : If ground spoilers are not armed, they extend at the reverse selection and retract when idle is selected.

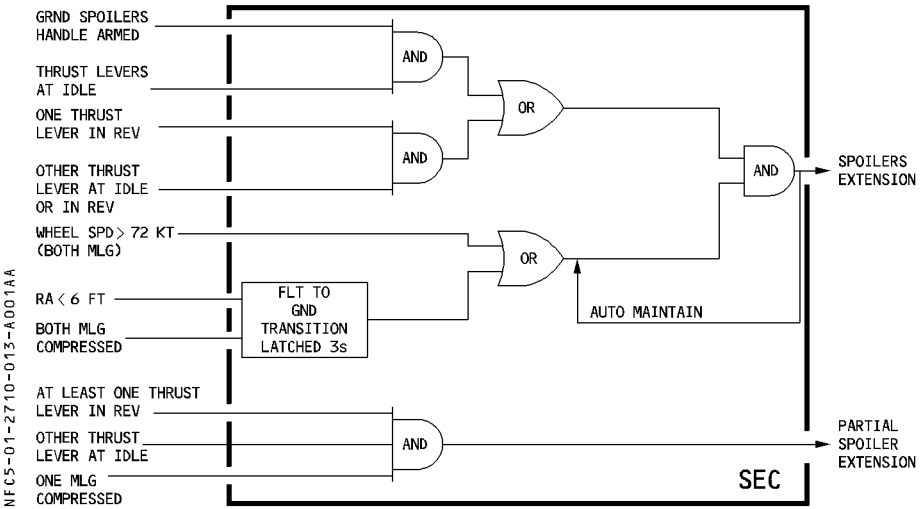
· During a touch and go, when at least one thrust lever is advanced above 20°.

Note : After an aircraft bounce, the ground spoilers remain extended with the thrust levers at idle.

FOR INFO

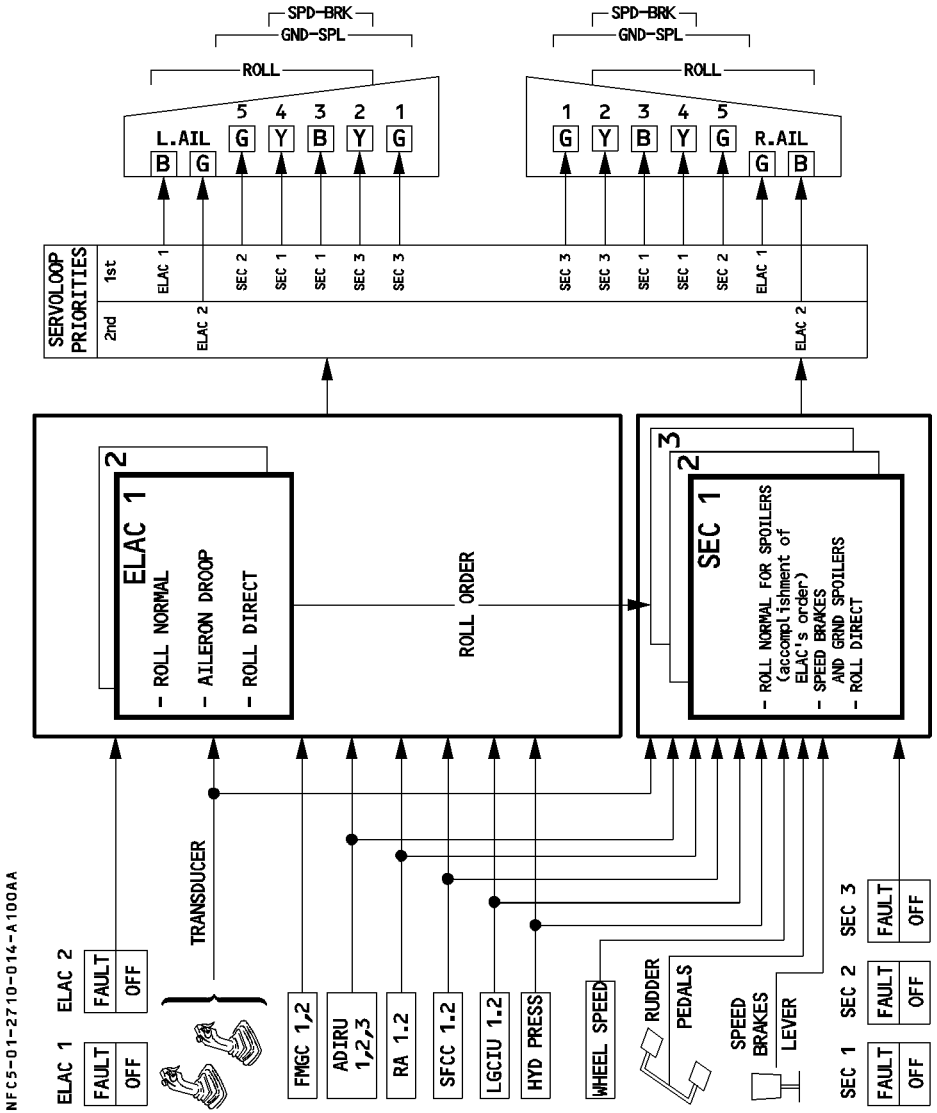
The landing gear touchdown condition is triggered for both main landing gear, either when their wheel speed is greater than 72 knots, or when their landing gear struts are, confirmed to be compressed by the radio altitude (RA < 6 feet).
The thrust levers are considered to be at idle when they are :
· Below 4°, when the RA is above 10 feet,
· Below 15°, when the RA is below 10 feet.

R

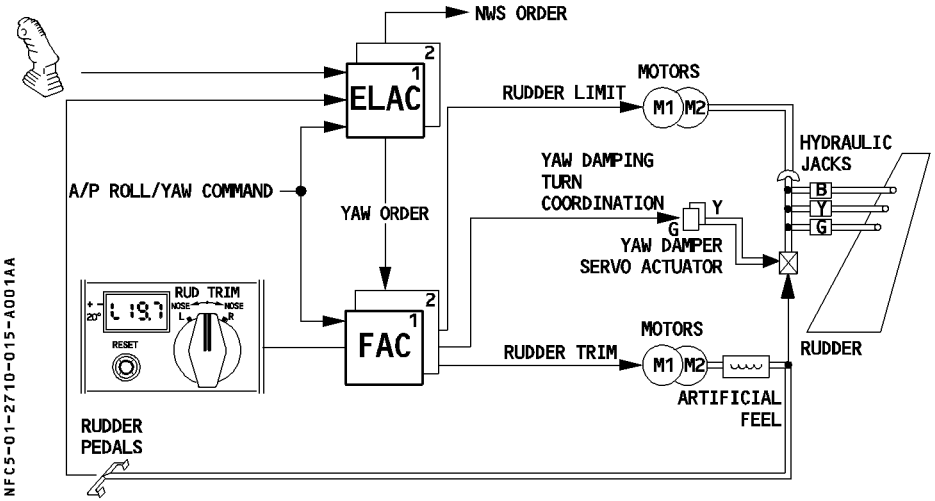


ROLL CONTROL – SCHEMATIC

FOR INFO



YAW CONTROL



One rudder surface controls yaw.

ELECTRICAL RUDDER CONTROL

The yaw damping and turn coordination functions are automatic.
The ELACs compute yaw orders for coordinating turns and damping yaw oscillations, and transmit them to the FACs.

MECHANICAL RUDDER CONTROL

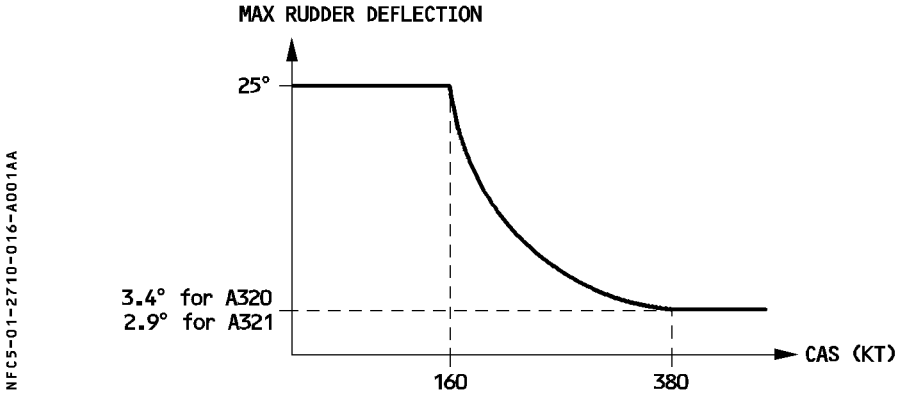
The pilots can use conventional rudder pedals to control the rudder.

RUDDER ACTUATION

Three independent hydraulic servojacks, operating in parallel, actuate the rudder. In automatic operation (yaw damping, turn coordination) a green servo actuator drives all three servojacks. A yellow servo actuator remains synchronized and takes over if there is a failure.
There is no feedback to the rudder pedals from the yaw damping and turn coordination functions.

RUDDER TRAVEL LIMIT

The deflection of the rudder and the pedals is limited as a function of speed.
Each channel of the limiter is controlled and monitored by its associated FAC. If both FACs fail, maximum deflection is available when the slats are extended.



RUDDER TRIM

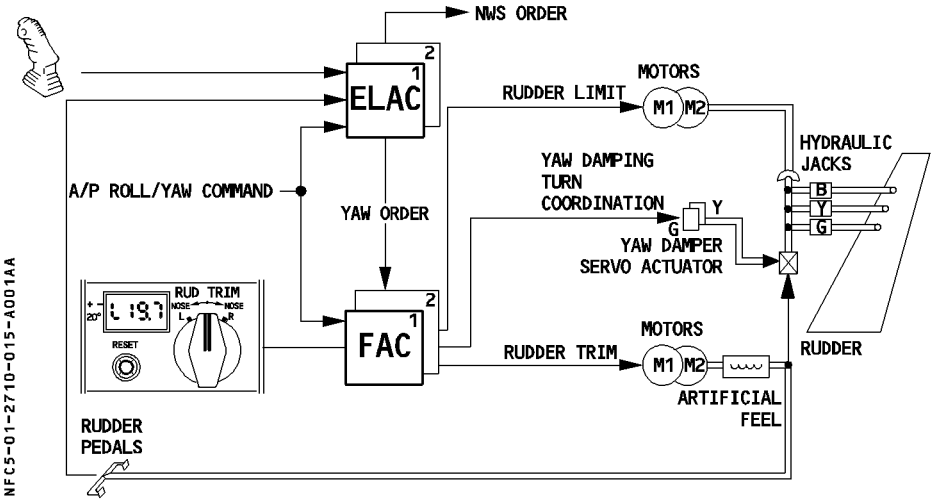
The two electric motors that position the artificial feel unit also trim the rudder. In normal operation, motor N° 1, controlled by FAC1, drives the trim, and FAC2 with motor N° 2 remains synchronized as back-up.
In manual flight, the pilot can apply rudder trim with the rotary RUD TRIM switch on the pedestal.

- Maximum deflection is ± 20°.
- Rudder trim speed is one degree per second.
- In addition to limitation by TLU, if rudder trim is applied, maximum rudder deflection may be reduced in the opposite direction.

The pilot can use a button on the RUD TRIM panel to reset the rudder trim to zero.

R *Note : With the autopilot engaged, the FMGC computes the rudder trim orders. The rudder trim rotary switch and the rudder trim reset pushbutton are not active.*

YAW CONTROL



One rudder surface controls yaw.

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The yaw damping and turn coordination functions are automatic.
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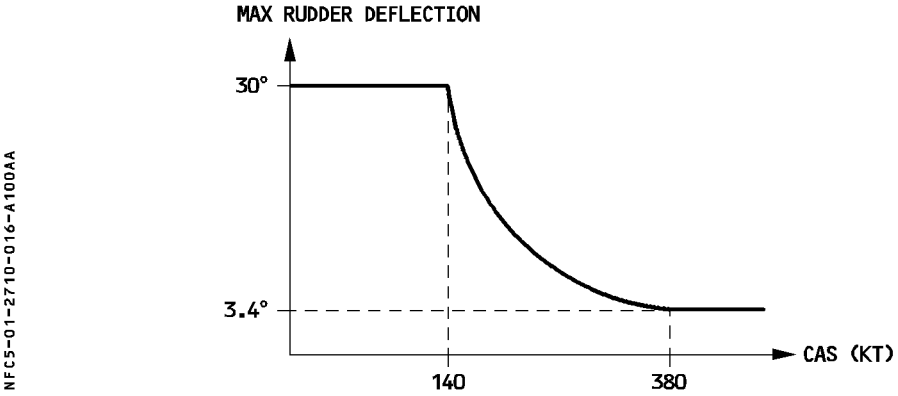
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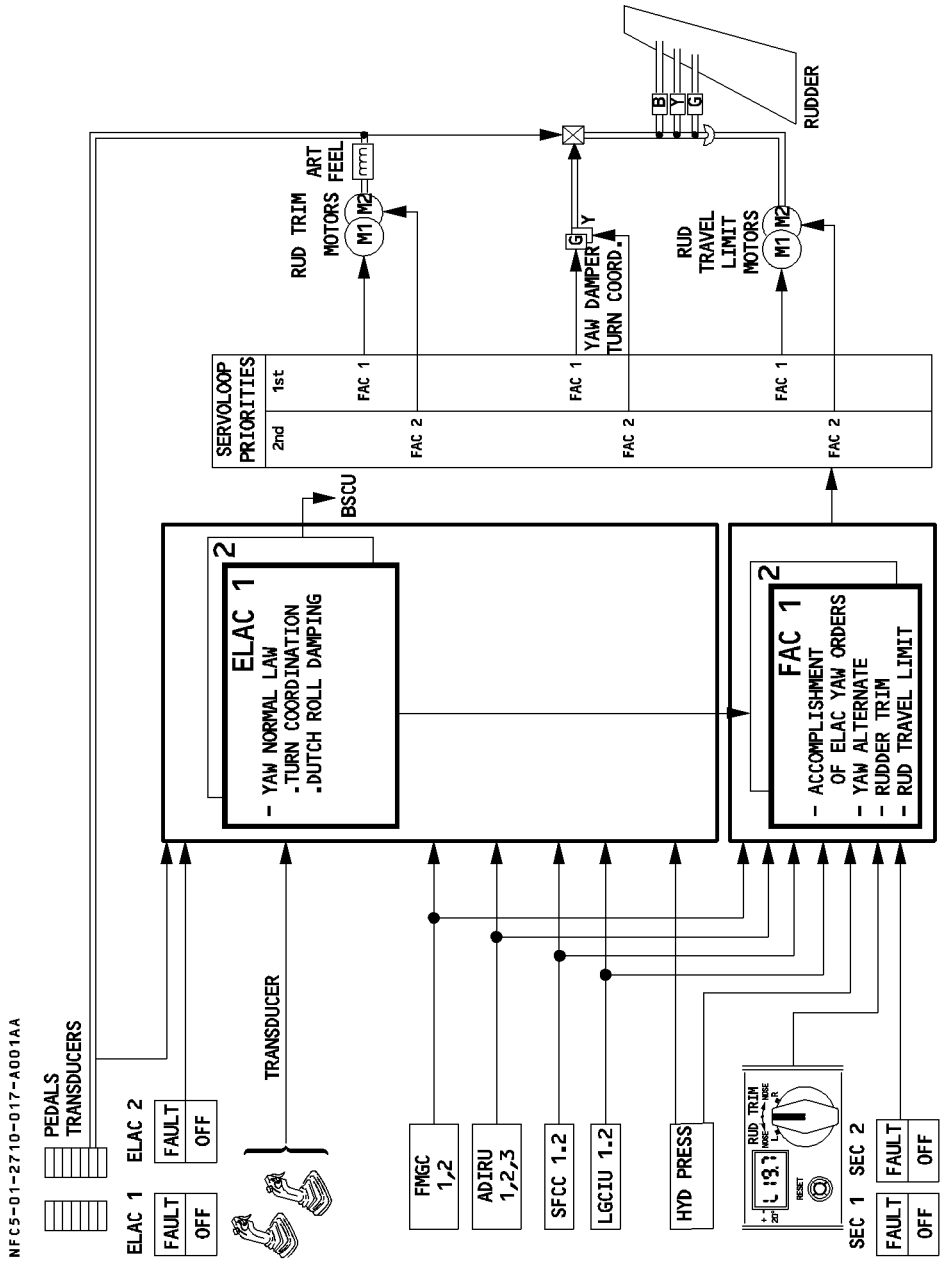
- Maximum deflection is ± 25°.
- Rudder trim speed is one degree per second.
- In addition to limitation by TLU, if rudder trim is applied, maximum rudder deflection may be reduced in the opposite direction.

The pilot can use a button on the RUD TRIM panel to reset the rudder trim to zero.

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YAW CONTROL – SCHEMATIC

FOR INFO



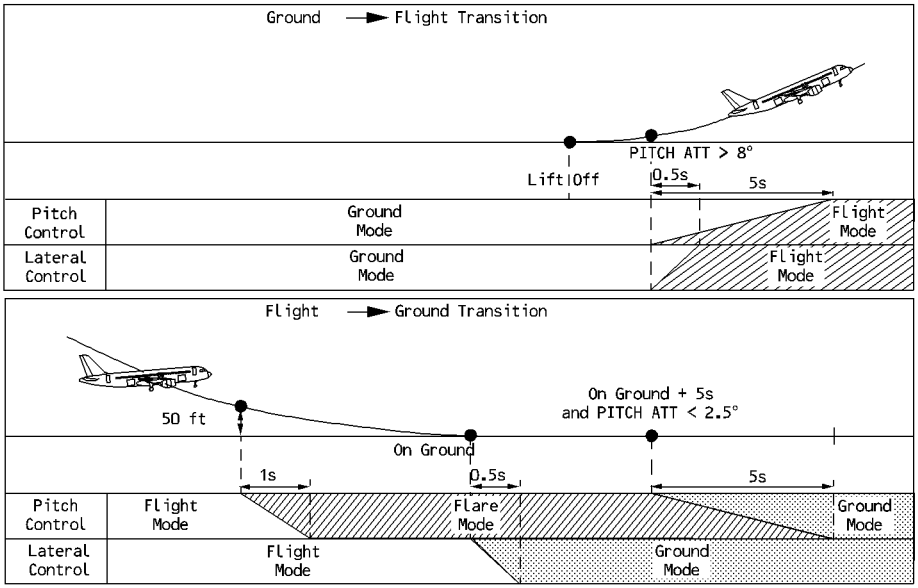
GENERAL

Flight control normal law covers :
- three-axis control
- flight envelope protection
- alleviation of maneuver loads

R

NORMAL LAW protection	Pitch Control		
	Ground Mode	Flight Mode	Flare Mode
Pitch Attitude		X	
Load Factor		X	
High Speed		X	
High Angle Of Attack		X	X

NORMAL LAW Protection	Lateral Control	
	Ground Mode	Flight Mode
Bank Angle		X



NFCS-01-2720-001-A001AA

PITCH CONTROL

GROUND MODE

R Ground mode is a direct relationship between sidestick deflection and elevator deflection, without auto trim.
It automatically sets the trimmable horizontal stabilizer (THS) at 0° (inside the green band). A setting that the pilot enters manually to adjust for CG has priority for takeoff.
When the aircraft reaches 75 knots during the takeoff roll, the system reduces the
R maximum up elevator deflection from 30° to 20°.

FLIGHT MODE

The normal-law flight mode is a load-factor-demand mode with automatic trim and protection throughout the flight envelope.
Following normal law, the sidestick controllers set the elevator and THS to maintain load factor proportional to stick deflection and independent of speed.
With the sidestick at neutral, wings level, the system maintains 1 g in pitch (corrected for pitch attitude), and there is no need for the pilot to trim by changing speed or configuration.
Pitch trim is automatic both in manual mode and when the autopilot is engaged. In normal turns (up to 33° of bank) the pilot does not have to make any pitch corrections once the turn is established.
The flight mode is active from takeoff to landing, and follows the logic shown schematically on page 1, above.
Automatic pitch trim freezes in the following situations :
- The pilot enters a manual trim order.
- The radio altitude is below 50 feet (100 feet with autopilot engaged).
- The load factor goes below 0.5 g.
R - The aircraft is under high-speed or high-Mach protection.

When angle-of-attack protection is active, the THS setting is limited between the setting at the aircraft's entry into this protection and 3.5° nose down. (Neither the pilot nor the system can apply additional nose-up trim).
Similarly, when the load factor is higher than 1.25 g or when the aircraft exceeds 33° of bank, the THS setting is limited to values between the actual setting and 3.5° nose down.

Control with autopilot engaged

- The ELACs and SECs limit what the autopilot can order.
- The pilot has to overcome a restraining force in order to move the sidestick when the
R autopilot is engaged. If he overcomes this force, he disconnects the autopilot.
- The pilot can also disconnect the autopilot by pushing on the rudder pedals (10° out of trim), or by moving the pitch trim wheel beyond a certain threshold.
- All protections of normal laws remain effective.

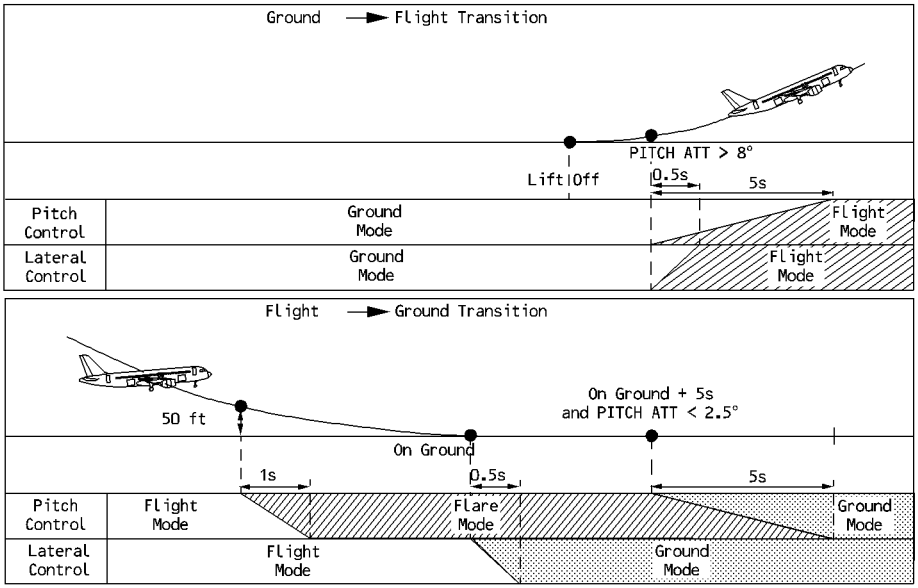
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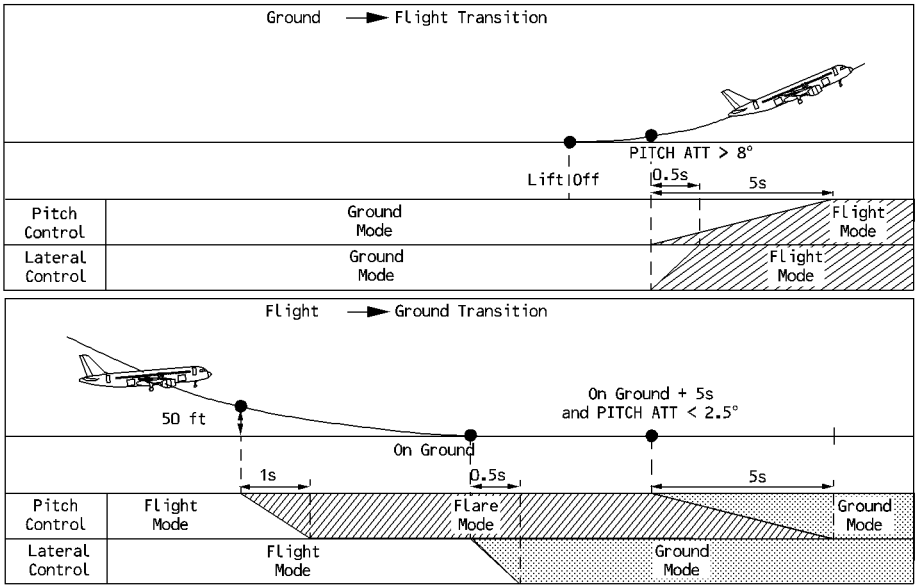
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NFCS-01-2720-001-A001AA

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With the sidestick in neutral and the wings level, the system maintains 1 g in pitch (corrected for pitch attitude), and there is no need for the pilot to trim by changing the speed or configuration.
Pitch trim is automatic, in both manual mode and when the autopilot is engaged. In normal turns (up to 33° of bank), the pilot does not have to make any pitch corrections once the turn is established.
The flight mode is active from takeoff to landing, and follows the logic illustrated on page 1.
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- The pilot enters a manual trim order.
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- The load factor goes below 0.5 g.

When angle-of-attack protection is active, the THS setting is limited between the setting at the aircraft's entry into this protection and 3.5° nose down. (Neither the pilot nor the system can apply additional nose-up trim).
Similarly, when the load factor is higher than 1.25 g, or when the aircraft exceeds 33° of bank, the THS setting is limited to values between the actual setting and 3.5° nose down.
When High Speed or High Mach Protection is active, the THS Setting is limited between the setting at the aircraft's entry into this protection and 11° nose-up.

Control with autopilot engaged

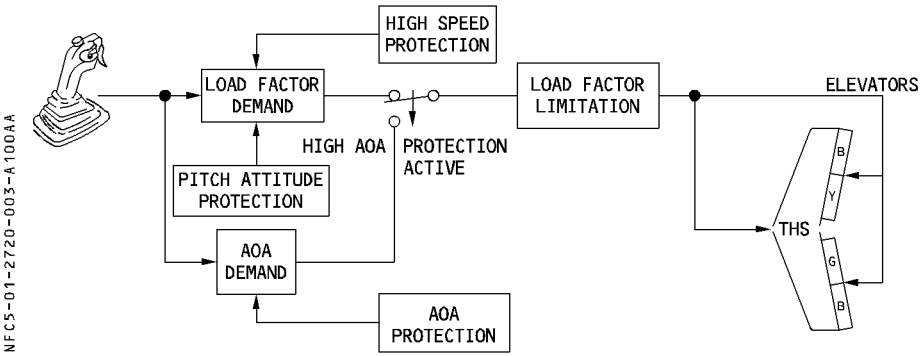
- The ELACs and SECs limit what the autopilot can order.
- The pilot has to overcome a restraining force, in order to move the sidestick when the
R autopilot is engaged. If he overcomes this force, he disconnects the autopilot.
- The pilot can also disconnect the autopilot by pushing on the rudder pedals (10° out of trim), or by moving the pitch trim wheel.
- All normal law protections, except pitch attitude protection, remain effective.

FLARE MODE

The flight mode changes to flare mode when the aircraft passes 50 feet RA as it descends to land.
The system memorizes the attitude at 50 feet, and that attitude becomes the initial reference for pitch attitude control.
As the aircraft descends through 30 feet, the system begins to reduce the pitch attitude, reducing it to 2° nose down over a period of 8 seconds. This means that it takes gentle nose-up action by the pilot to flare the aircraft.

PROTECTIONS

The normal law protects the aircraft throughout the flight envelope, as follows :
– load factor limitation
– pitch attitude protection
– high-angle-of-attack (AOA) protection
– high-speed protection.



LOAD FACTOR LIMITATION

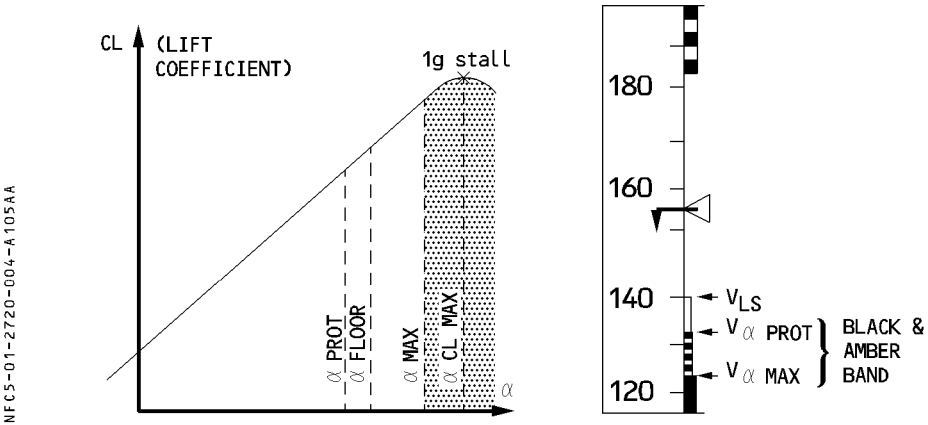
The load factor is automatically limited to :
+ 2.5 g to – 1 g for clean configuration.
+ 2 g to 0 for other configurations.

PITCH ATTITUDE PROTECTION

Pitch attitude is limited to :
– 30° nose up in conf 0 to 3 (progressively reduced to 25° at low speed).
– 25° nose up in conf FULL (progressively reduced to 20° at low speed).
– 15° nose down (indicated by green symbols "=" on the PFD's pitch scale).
The flight director bars disappear from the PFD when the pitch attitude exceeds 25° up or 13° down. They return to the display when the pitch angle returns to the region between 22° up and 10° down.

HIGH ANGLE OF ATTACK PROTECTION

Under normal law, when the angle of attack becomes greater than αprot, the system switches elevator control from normal mode to a protection mode, in which the angle of attack is proportional to sidestick deflection. That is, in the αprot range, from α prot to αmax, the sidestick commands α directly. However, the angle of attack will not exceed αmax, even if the pilot gently pulls the sidestick all the way back. If the pilot releases the sidestick, the angle of attack returns to αprot and stays there.
This protection against stall and windshear has priority over all other protections. The autopilot disconnects at α prot + 1°.



Vα prot, Vα floor, Vα max vary according to the weight and the configuration.
To deactivate the angle of attack protection, the pilot must push the sidestick :
– More than 8° forward, or
– More than 0.5° forward for at least 0.5 seconds, when α < α max.
In addition, below 200 feet, the angle of attack protection is also deactivated, when :
– Sidestick deflection is less than half nose-up, and
– Actual α is less than α prot – 2°.

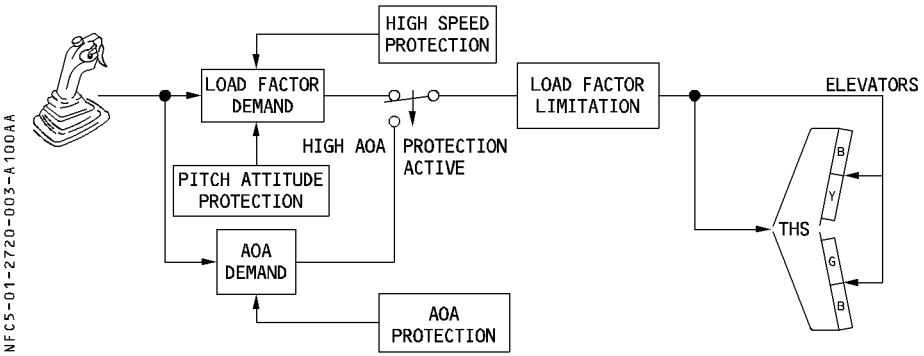
Note : 1. At takeoff, αprot is equal to αmax for 5 seconds.
2. αfloor is activated through the A/THR system, when :
– α is greater than α floor (9.5° in configuration 0; 15° in configuration 1, 2; 14° in configuration 3 ; 13° in configuration FULL), or
– Sidestick deflection is greater than 14° nose up, with either the pitch attitude or the angle of attack protection active.
The αfloor function is available from lift-off to 100 feet RA before landing.

FLARE MODE

The flight mode changes to flare mode when the aircraft passes 50 feet RA as it descends to land.
The system memorizes the attitude at 50 feet, and that attitude becomes the initial reference for pitch attitude control.
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LOAD FACTOR LIMITATION

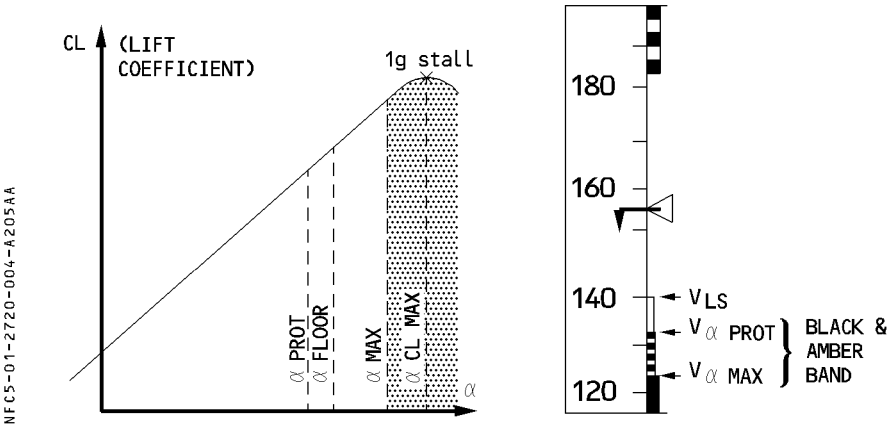
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This protection against stall and windshear has priority over all other protections. The autopilot disconnects at α prot + 1°.



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In addition, below 200 feet, the angle of attack protection is also deactivated, when :
– Sidestick deflection is less than half nose-up, and
– Actual α is less than α prot – 2°.

Note : 1. At takeoff, αprot is equal to αmax for 5 seconds.
2. αfloor is activated through the A/THR system, when :
– α is greater than αfloor (9.5° in configuration 0; 14° in configuration 1 and configuration 1 + F ; 13° in configuration 2 and 3 ; 12.5° in configuration FULL), or
– Sidestick deflection is greater than 14° nose up, with either the pitch attitude or the angle of attack protection active.
The αfloor function is available from lift-off to 100 feet RA before landing.

HIGH-SPEED PROTECTION

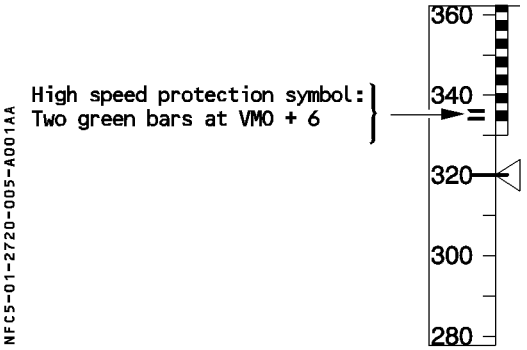
The aircraft automatically recovers following a high speed upset. Depending on the flight conditions (high acceleration, low pitch attitude), the High Speed Protection is activated at/or above VMO/MMO.

When it is activated, the pitch trim is frozen. Positive spiral static stability is introduced to 0° bank angle (instead of 33° in normal law), so that with the sidestick released, the aircraft
R always returns to a bank angle of 0°. The bank angle limit is reduced from 67° to 40°.

As the speed increases above VMO/MMO, the sidestick nose-down authority is progressively reduced, and a permanent nose-up order is applied to aid recovery to normal flight conditions.

The High Speed Protection is deactivated when the aircraft speed decreases below VMO/MMO, where the usual normal control laws are recovered.

The autopilot disconnects when high speed protection goes active.



Note : The ECAM displays an "O/SPEED" warning at VMO + 4 knots and MMO + 0.006.

LOW ENERGY WARNING ◁

The low energy warning is computed by the FAC, see 1.22.40.

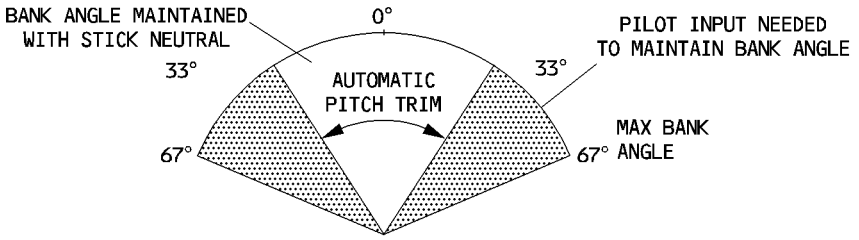
LATERAL CONTROL

NORMAL LAW

When the aircraft is on the ground (in "on ground" mode), the sidestick commands the aileron and roll spoiler surface deflection. The amount of control surface deflection that results from a given amount of sidestick deflection depends upon aircraft speed. The pedals
R control rudder deflection through a direct mechanical linkage. The aircraft smoothly
R transitions to "in flight" mode shortly after liftoff.
When the aircraft is in the "in flight" mode, normal law combines control of the ailerons, spoilers (except N° 1 spoilers), and rudder (for turn coordination) in the sidestick. While the system thereby gives the pilot control of the roll and heading, it also limits the roll rate and bank angle, coordinates the turns, and damps the dutch roll.
The roll rate requested by the pilot during flight is proportional to the sidestick deflection, with a maximum rate of 15° per second when the sidestick is at the stop.
When the aircraft is in "flare" mode, the lateral control is the same as in "in flight" mode.
R After touchdown, the aircraft smoothly transitions from "in flight" mode to "ground" mode.

BANK ANGLE PROTECTION

Inside the normal flight envelope, the system maintains positive spiral static stability for bank angles above 33°. If the pilot releases the sidestick at a bank angle greater than 33°, the bank angle automatically reduces to 33°. Up to 33°, the system holds the roll attitude constant when the sidestick is at neutral. If the pilot holds full lateral sidestick deflection, the bank angle goes to 67° (indicated by a pair of green bar lines "=" on the PFD) and no further.
R If Angle-of-Attack protection is active, and the pilot maintains full lateral deflection on the
R sidestick, the bank angle will not go beyond 45 degrees. If High Speed Protection is active,
R and the pilot maintains full lateral deflection on the sidestick, the bank angle will not go
R beyond 40 degrees. If high speed protection is operative, the system maintains positive spiral static stability from a bank angle of 0°, so that with the sidestick released, the aircraft always returns to a bank angle of 0°.
When bank angle protection is active, auto trim is inoperative.
If the bank angle exceeds 45°, the autopilot disconnects and the FD bars disappear. The FD bars return when the bank angle decreases to less than 40°.



MFCS-01-2720-006-A001A4

HIGH-SPEED PROTECTION

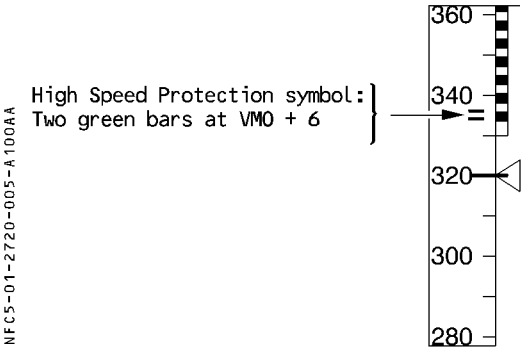
The aircraft automatically recovers, following a high speed upset. Depending on the flight conditions (high acceleration, low pitch attitude), High Speed Protection is activated at/or above VMO/MMO.

When it is activated, the THS setting is limited between the setting at the aircraft's entry into this protection and 11° nose-up. Positive spiral static stability is introduced to 0° bank angle (instead of 33° in normal law), so that with the sidestick released, the aircraft always
R returns to a bank angle of 0°. The bank angle limit is reduced from 67° to 40°.

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High Speed Protection is deactivated, when the aircraft speed decreases below VMO/MMO, where the usual normal control laws are recovered.

The autopilot disconnects, when High Speed Protection becomes active.



Note : The ECAM displays an "O/SPEED" warning at VMO + 4 knots and MMO + 0.006.

LOW ENERGY WARNING ◁

The low energy warning is computed by the FAC (Refer to 1.22.40).

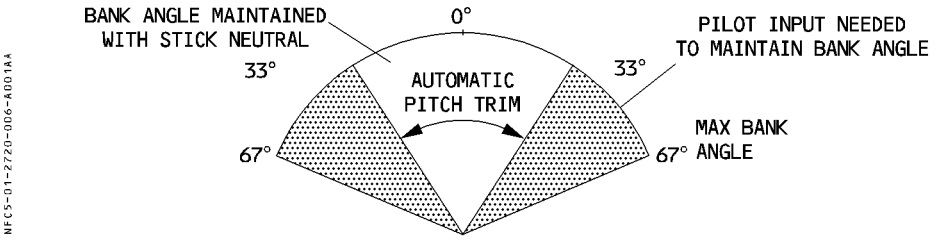
LATERAL CONTROL

NORMAL LAW

When the aircraft is on the ground (in "on ground" mode), the sidestick commands the aileron and roll spoiler surface deflection. The amount of control surface deflection that results from a given amount of sidestick deflection depends upon aircraft speed. The pedals
R control rudder deflection through a direct mechanical linkage. The aircraft smoothly
R transitions to "in flight" mode shortly after liftoff.
When the aircraft is in the "in flight" mode, normal law combines control of the ailerons, spoilers (except N° 1 spoilers), and rudder (for turn coordination) in the sidestick. While the system thereby gives the pilot control of the roll and heading, it also limits the roll rate and bank angle, coordinates the turns, and damps the dutch roll.
The roll rate requested by the pilot during flight is proportional to the sidestick deflection, with a maximum rate of 15° per second when the sidestick is at the stop.
When the aircraft is in "flare" mode, the lateral control is the same as in "in flight" mode.
R After touchdown, the aircraft smoothly transitions from "in flight" mode to "ground" mode.

BANK ANGLE PROTECTION

Inside the normal flight envelope, the system maintains positive spiral static stability for bank angles above 33°. If the pilot releases the sidestick at a bank angle greater than 33°, the bank angle automatically reduces to 33°. Up to 33°, the system holds the roll attitude constant when the sidestick is at neutral. If the pilot holds full lateral sidestick deflection, the bank angle goes to 67° (indicated by a pair of green bar lines "=" on the PFD) and no further.
R If Angle-of-Attack protection is active, and the pilot maintains full lateral deflection on the
R sidestick, the bank angle will not go beyond 45 degrees. If High Speed Protection is active,
R and the pilot maintains full lateral deflection on the sidestick, the bank angle will not go
R beyond 40 degrees. If high speed protection is operative, the system maintains positive spiral static stability from a bank angle of 0°, so that with the sidestick released, the aircraft always returns to a bank angle of 0°.
When bank angle protection is active, auto trim is inoperative.
If the bank angle exceeds 45°, the autopilot disconnects and the FD bars disappear. The FD bars return when the bank angle decreases to less than 40°.



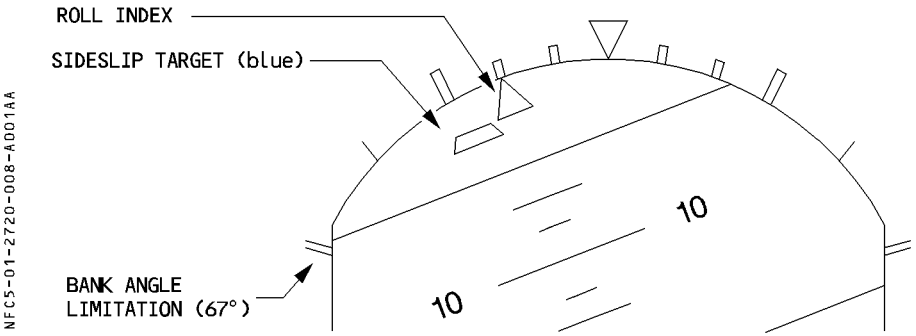
NFCS-01-2720-006-A001A4

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SIDESLIP TARGET

If one engine fails, the FAC modifies the sideslip indication slightly to show the pilot how much rudder to use to get the best climb performance (ailerons to neutral and spoilers retracted).

In the case of an engine failure at takeoff, or at go-around, the sideslip index on the PFD changes from yellow to blue (Refer to 1.31.40 that provides the conditions for the blue display of the sideslip target).



R In flight, the lateral normal law commands some rudder surface deflection to minimize the
R sideslip. The pilot's response is normal and instinctive : zero the slip indication by applying the right amount of rudder to get the best climb performance.

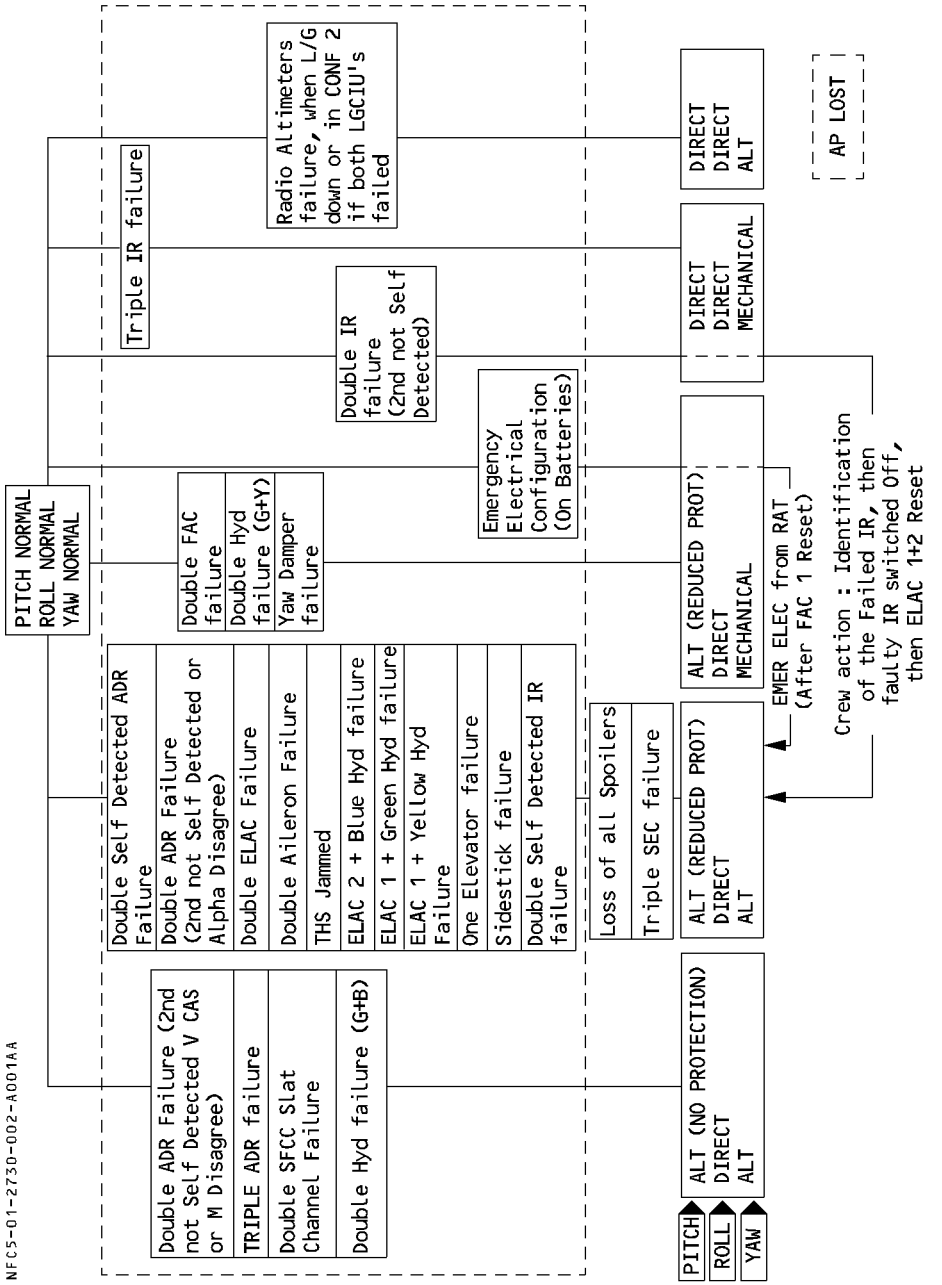
GENERAL

Depending on the failures occuring to the flight control system, or on its peripherals, there are 3 levels of reconfiguration :

- Alternate law
  They are two levels of alternate law : with and without reduced protections.
- Direct law
- Mechanical

R

FLIGHT CONTROLS LAW RECONFIGURATION



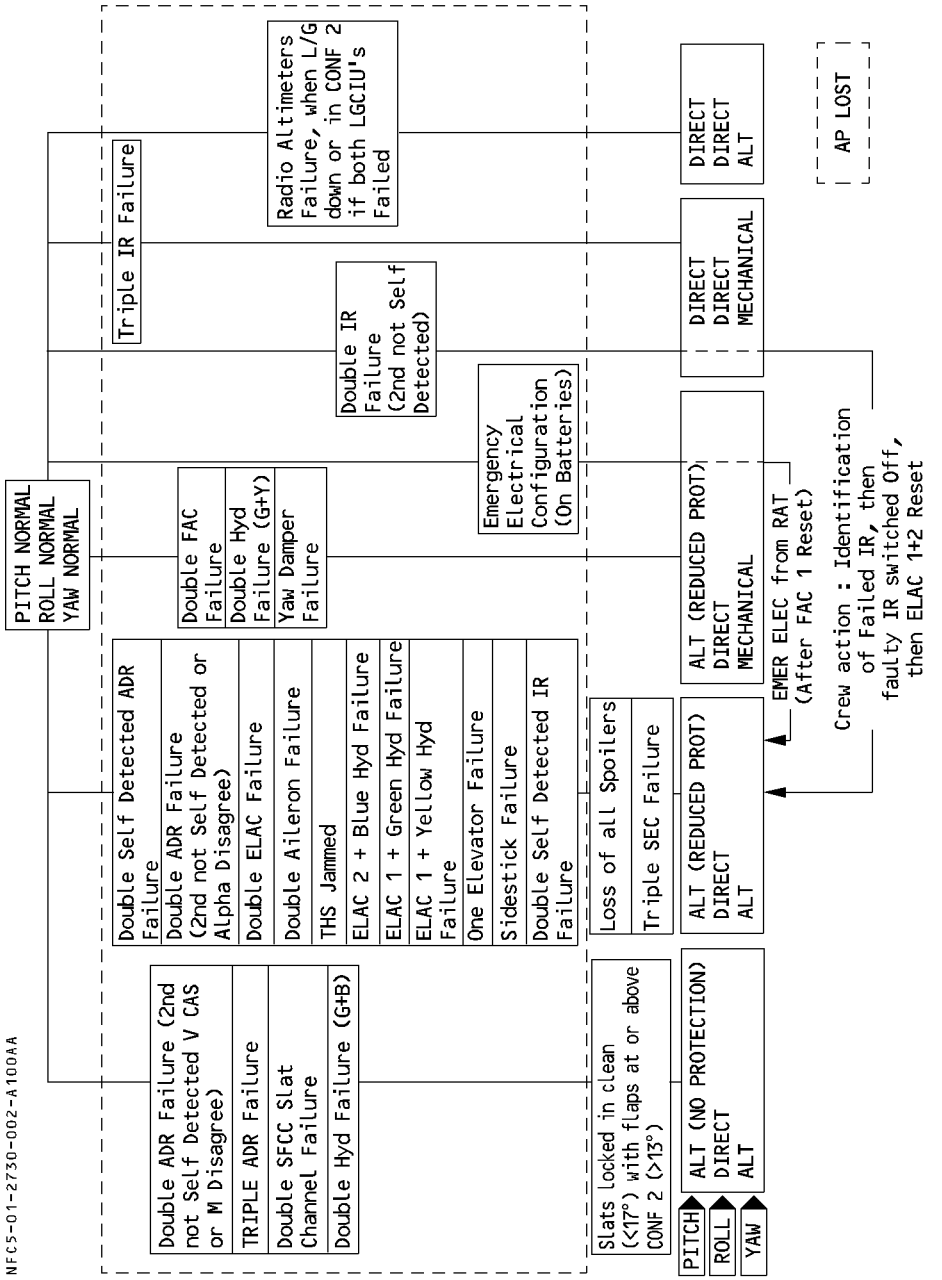
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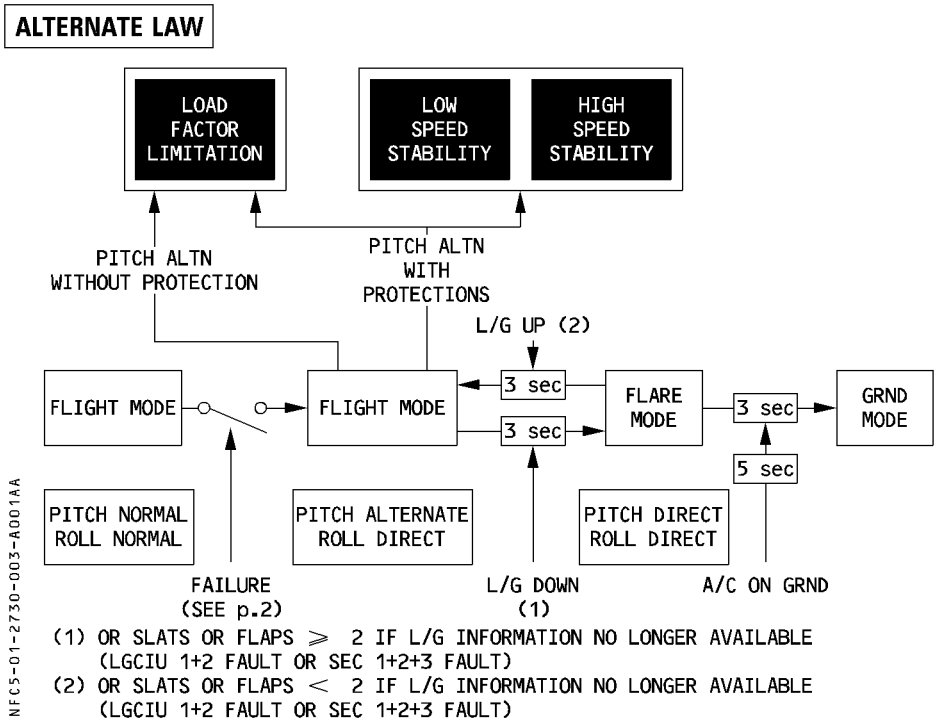
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  They are two levels of alternate law : with and without reduced protections.
- Direct law
- Mechanical

R

FLIGHT CONTROLS LAW RECONFIGURATION



R



PITCH CONTROL

GROUND MODE

Under alternate law the ground mode becomes active on the ground five seconds after touchdown.
It is identical to the ground mode of the normal law.

FLIGHT MODE

In flight, the alternate law pitch mode follows a load-factor demand law much as the normal law pitch mode does, but it has less built-in protection (reduced protections).

FLARE MORE

In pitch alternate law the flight mode changes to the flare mode when the pilot selects landing gear down. The flare mode is a direct stick-to-elevator relationship.
(See DIRECT LAW).

LATERAL CONTROL

When the aircraft flying in pitch alternate law, lateral control follows the roll direct law associated with yaw alternate or mechanical.

ROLL DIRECT LAW

See page 6.

YAW ALTERNATE LAW

Only the yaw damping function is available. Damper authority is limited to ± 5° of rudder deflection.

REDUCED PROTECTIONS

LOAD FACTOR LIMITATION

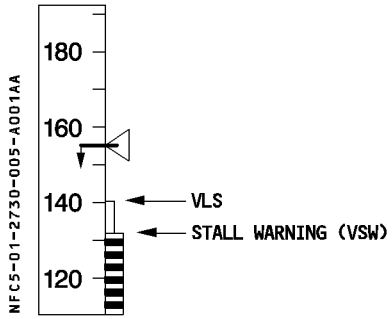
The load factor limitation is similar to that under normal law.

PITCH ATTITUDE PROTECTION

There is no pitch attitude protection. Amber Xs replace the green double bars "=" on the PFD.

R LOW SPEED STABILITY

An artificial low speed stability replaces the normal angle-of-attack protection. It is available for all slat/flap configurations, and the low speed stability is active from about 5 knots up to about 10 knots above stall warning speed, depending on the aircraft's gross weight and slats/flaps configuration.
A gentle progressive nose down signal is introduced, which tends to keep the speed from falling below these values.
The system also injects bank-angle compensation, so that operation effectively maintains a constant angle of attack.
In addition, audio stall warnings (crickets + "STALL" synthetic voice message) is activated at an appropriate margin from the stall condition.
The PFD speed scale is modified to show a black/red barber pole below the stall warning.
The α floor protection is inoperative.



R HIGH SPEED STABILITY

Above VMO or MMO, a nose up demand is introduced to avoid an excessive increase in speed. The pilot can override this demand.
In addition, the aural overspeed warning (VMO + 4 or MMO + 0.006) remains available.

BANK ANGLE PROTECTION

Not provided.

Note : The AP will disconnect, if speed exceeds VMO/MMO, or if the bank angle exceeds 45°.

ALTERNATE LAW WITHOUT REDUCED PROTECTION

This is identical to alternate law except that it does not include the low-speed stability or the high-speed stability. It includes only the load factor limitation.

DIRECT LAW

PITCH CONTROL

The pitch direct law is a direct stick-to-elevator relationship (elevator deflection is proportional to stick deflection).
In all configurations the maximum elevator deflection varies as a function of CG.
It is a compromise between adequate controllability with the CG forward, and not-too-sensitive control with the CG aft.
There is no automatic trim : the pilot must trim manually.
The PFD displays in amber the message "USE MAN PITCH TRIM".
No protections are operative.
The α floor function is inoperative.
Overspeed and stall warnings are available as for alternate law.

LATERAL CONTROL

When flying in "direct law", the roll direct law associated with mechanical yaw control governs lateral control.

ROLL DIRECT LAW

The roll direct law is a direct stick-to-surface-position relationship. System gains are set automatically to correspond to slat/flap configuration.
With the aircraft in the clean configuration, the maximum roll rate is about 30° per second.
With slats extended, it is about 25° per second.
To limit roll rate, the roll direct law uses only ailerons and spoilers N° 4 and 5.
If spoiler N° 4 has failed, spoiler N°3 replaces it.
If the ailerons have failed, all roll spoilers become active.

YAW MECHANICAL CONTROL

The pilot controls yaw with the rudder pedals.
The yaw damping and turn coordination functions are lost.

ABNORMAL ATTITUDE LAWS

The system applies an abnormal-attitude law in pitch and roll if the aircraft exceeds any of these limits in flight.
– Pitch attitude > 50° nose up or 30° nose down
– Bank angle > 125°
– Angle of attack > 30° or < – 10° (– 15° for A319 and A321)
– Speed > 440 knots or < 60 knots
– Mach > 0.91 or < 0.1
The law in pitch is the alternate law with no protection except load-factor protection and without auto trim. In roll it is a full-authority direct law with a yaw mechanical.
When the aircraft has recovered from its abnormal attitude, the flight control laws in effect are :
– in pitch : alternate law without protection with autotrim.
– in roll : full authority direct law with yaw alternate law.
There is no reversion to the direct law when the pilot extends the landing gear.

MECHANICAL BACK-UP

PITCH

Mechanical back-up permits the pilot to control the aircraft during a temporary complete loss of electrical power.
He does this in pitch by applying trim manually to the THS.
The PFDs display “MAN PITCH TRIM ONLY” in red.

LATERAL

The pilot uses the rudder pedals as the mechanical back-up to control the aircraft laterally.

ABNORMAL ATTITUDE LAWS

The system applies an abnormal-attitude law in pitch and roll, if the aircraft exceeds any of these limits in flight.
– Pitch attitude > 50° nose up or 30° nose down
– Bank angle > 125°
– Angle of attack > 30° or < – 10° for the A320 (– 15° for the A318, A319 and A321).
– Speed > 440 knots or < 70 to 90 knots (depending on the aircraft pitch attitude)
– Mach > 0.91
The law in pitch is the alternate law with no protection, except load-factor protection, and without auto trim. In roll, it is a full-authority direct law with a yaw mechanical.
When the aircraft has recovered from its abnormal attitude, the flight control laws in effect are :
– In pitch : Alternate law without protection, with autotrim.
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MECHANICAL BACKUP

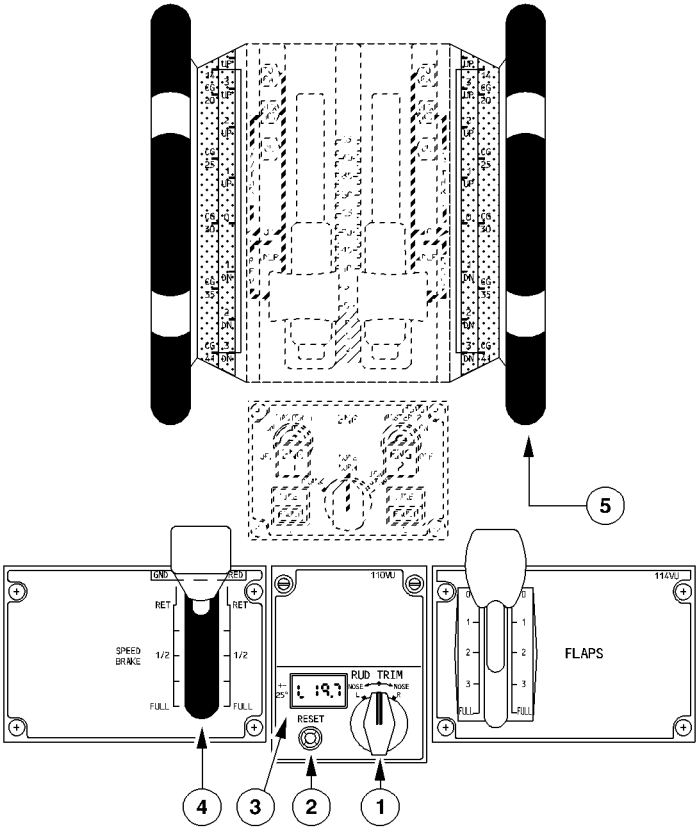
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LATERAL

The pilot uses the rudder pedals as the mechanical backup to laterally control the aircraft.

PEDESTAL



NFC5-01-2740-001-A001AA

(1) RUD TRIM Rotary Switch

Controls the rudder trim actuator, which moves the neutral point of the artificial feel by the equivalent of one degree of rudder travel per second.

Note : The rudder trim rotary switch has no effect, when the autopilot is engaged.

(2) RESET Pushbutton

R By pushing the RESET pushbutton, the zero trim position is ordered at 1.5° / second.

Note : The RESET pushbutton is not active, when the autopilot is engaged.

(3) Position Indicator

Displays the rudder trim direction (L or R) and value (0 to 20°).

(4) SPEEDBRAKE lever

The lever controls :
- The position of the speedbrake surfaces.
  To set speedbrake surfaces to a required position, the lever has to be pushed down and set to the required position. A "hardpoint" is provided at "½" SPEEDBRAKE position.
- The manual preselection of the ground spoilers.
  To arm the ground spoilers, the lever must be pulled up when in the RET position. When the lever is armed (or reverse thrust is selected), all spoiler's surfaces will automatically extend at landing, or in case of a rejected takeoff.

(5) PITCH TRIM wheel

Both pitch trim wheels provide mechanical control of the THS and have priority over electrical control. A pilot action on the pitch trim wheel disconnects the autopilot.

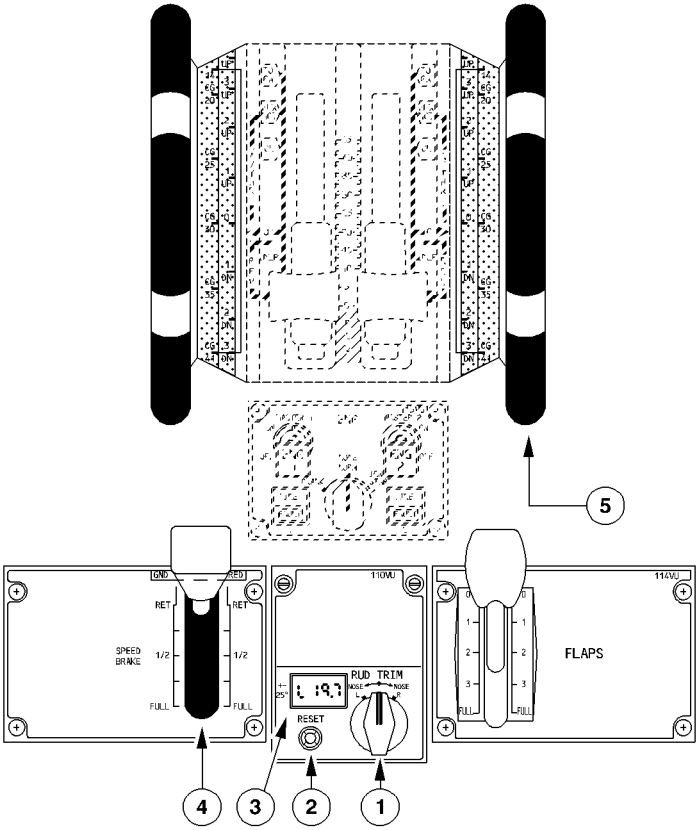
Note : Crew action on the pitch trim wheel does not disconnect the ELACs (micro-switches, actuated by the override mechanism, ensure that the computers remain synchronized with the manually-selected position).

R The THS is manually-controlled on ground for the THS setting, before takeoff and in flight, when in direct law.
- Before takeoff, the pilot sets the THS to the angular value, determined as a function of the aircraft CG, using the CG scale on the wheel. The relationship between the aircraft CG and the THS setting shown on the trim wheel is only applicable for takeoff. The limits of the THS normal setting range for takeoff are indicated by a green band on the pitch trim wheel.
- In flight, when in direct law, the pilot uses the THS conventionally to fly in trim. In flight, the aircraft pitch trim setting depends on aircraft CG, weight, altitude and speed. Consequently, the relation between the aircraft CG, and the THS setting displayed on the pitch trim wheel, does not apply in flight.

R Following nosewheel touchdown, as the pitch attitude becomes less than 2.5° for more than 5 seconds, pitch trim is automatically reset to zero.

Note : This function is inoperative, when the green or yellow hydraulic system is not pressurized.

PEDESTAL



NFC5-01-2740-001-A001AA

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Note : The RESET pushbutton is not active, when the autopilot is engaged.

(3) Position Indicator

Displays the rudder trim direction (L or R) and value (0 to 25°).

(4) SPEEDBRAKE Lever

The lever controls :
- The position of the speedbrake surfaces.
  To set speedbrake surfaces to a required position, the lever has to be pushed down and set to the required position. A "hardpoint" is provided at "½" SPEEDBRAKE position.
- The manual preselection of the ground spoilers.
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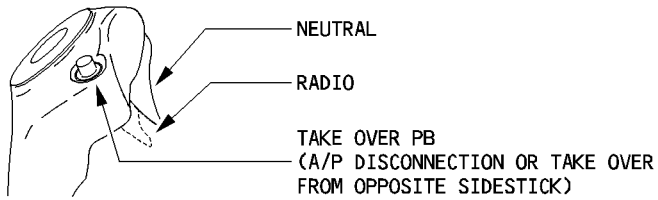
Note : This function is inoperative, when the green or yellow hydraulic system is not pressurized.

LATERAL CONSOLES

SIDESTICKS

Each pilot has on his lateral console a sidestick he can use to control pitch and roll manually. Each sidestick is springloaded to neutral.
When the autopilot is engaged, a solenoid-operated detent locks both sidesticks in the neutral position. If the pilot applies a force above a given threshold (5 daN in pitch, 3.5 daN in roll) the stick becomes free and the autopilot disengages.
The hand grip has two switches :
- Autopilot disconnect and sidestick takeover pushbutton.
- Push-to-talk button.

NFCS-01-2740-003-A200AA



Sidestick priority logic

- When only one pilot operates the sidestick, it sends his control signals to the computers.
- When the pilots move both side stick simultaneously in the same or opposite direction and neither takes priority, the system adds the signals of both pilots algebraically. The total is limited to the signal that would result from the maximum deflection of a single sidestick.

R *Note : In the event of simultaneous input on both sidesticks (2° deflection off the neutral*
R *position in any direction) the two green SIDE STICK PRIORITY lights on the*
R *glareshield come on and "DUAL INPUT" voice message is activated.*

A pilot can deactivate the other stick and take full control by pressing and keeping pressed his priority takeover pushbutton. For latching the priority condition, it is recommended to press the takeover push button for more than 40 seconds. This allows the pilot to release his takeover push button without losing priority. However, a pilot can at any time reactivate a deactivated stick by momentarily pressing the takeover push button on either stick. If both pilots press their takeover pushbuttons, the pilot that presses last gets priority.

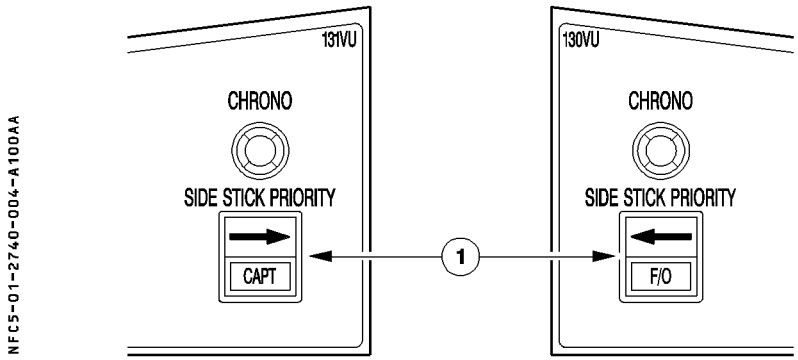
Note : If an autopilot is engaged, the first action on a takeover pushbutton disengages it.

In a priority situation

– A red light comes on in front of the pilot whose stick is deactivated.
– A green light comes on in front of the pilot who has taken control, if the other stick is not in the neutral position (to indicate a potential and unwanted control demand).

Note : If the aircraft is on the ground and commencing its takeoff run and one stick is deactivated, this triggers the takeoff "CONFIG" warning.

GLARESHIELD

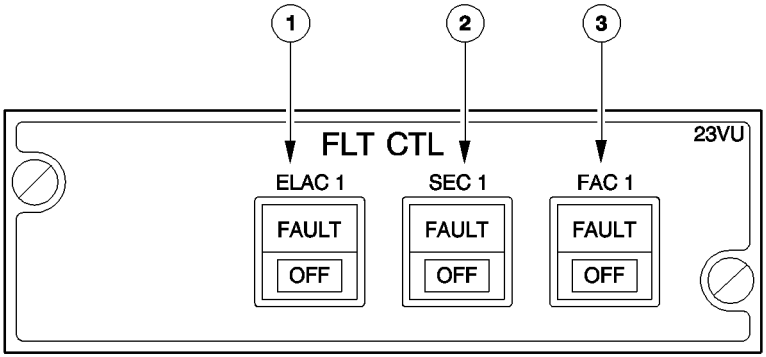


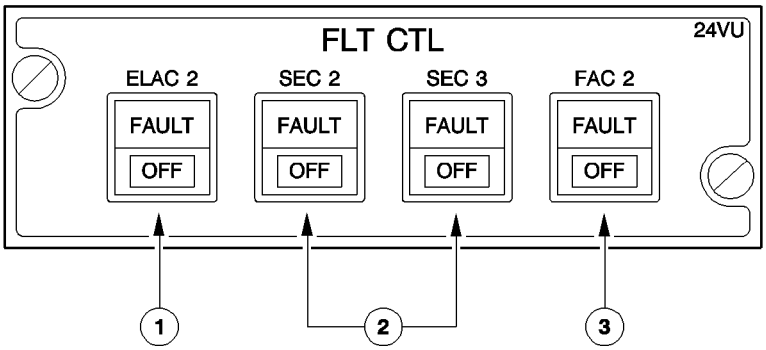
(1) SIDE STICK PRIORITY lt

Red arrow light :
– comes on in front of the pilot losing authority.
– goes out if he has recovered his authority
  · if the other pilot releases his TAKEOVER pushbutton prior the priority condition is latched.
  or
  · If he has used his takeover push button to cancel a latched priority situation.
  Sidestick priority audio : A "PRIORITY LEFT" or "PRIORITY RIGHT" audio voice message is given each time priority is taken.

Green CAPT and F/O lights :
– Both lights flash when the pilots move both sidesticks simultaneously and neither takes priority.
– When a pilot has taken priority by pressing the takeover pushbutton and the other pilot's sidestick is not at neutral, the light in front of the pilot with priority lights up. It goes out when the other pilot returns his stick to the neutral position.

OVERHEAD PANEL





NFC5-01-2740-005-A001AA

(1) ELAC 1(2) pushbutton

Controls the Elevator and Aileron Control (ELAC) Computer 1(2).

ON : ELAC 1(2) performs the following functions :
- Normal pitch and roll
- Alternate pitch
- Direct pitch and roll
- Abnormal attitude
- Aileron droop
- Acquisition of autopilot orders.

OFF : The corresponding computer is not active. Switching it OFF, then ON, resets the computer.

FAULT : Comes on amber, along with an ECAM caution :
- When a failure is detected
- During ELAC power-up test (eight seconds).

Note : The ELAC power-up test occurs when electrical power is turned on, or after the occurrence of an electrical transient lasting longer than 25 milliseconds.

The FAULT light goes off, when the pilot selects OFF, or at the end of the ELAC power-up test, if its results are satisfactory.

(2) SEC 1(2)(3) pushbutton

Controls the spoiler and elevator (SEC) computers 1(2)(3).

ON : SEC 1(2)(3) performs the following functions :
- Normal roll (by controlling the spoilers)

R
- Speedbrakes and ground spoilers
- Alternate pitch (SEC 1 and SEC 2 only)
- Direct pitch (SEC 1 and SEC 2 only)
- Direct roll
- Abnormal attitude.

OFF : The corresponding computer is not active. Switching it OFF, then on, resets the computer.

FAULT : Comes on amber, along with an ECAM caution, when a failure is detected. The FAULT light goes off, when the pilot selects OFF.

③ FAC 1(2) pb sw

Controls the flight augmentation computer (FAC) 1(2).

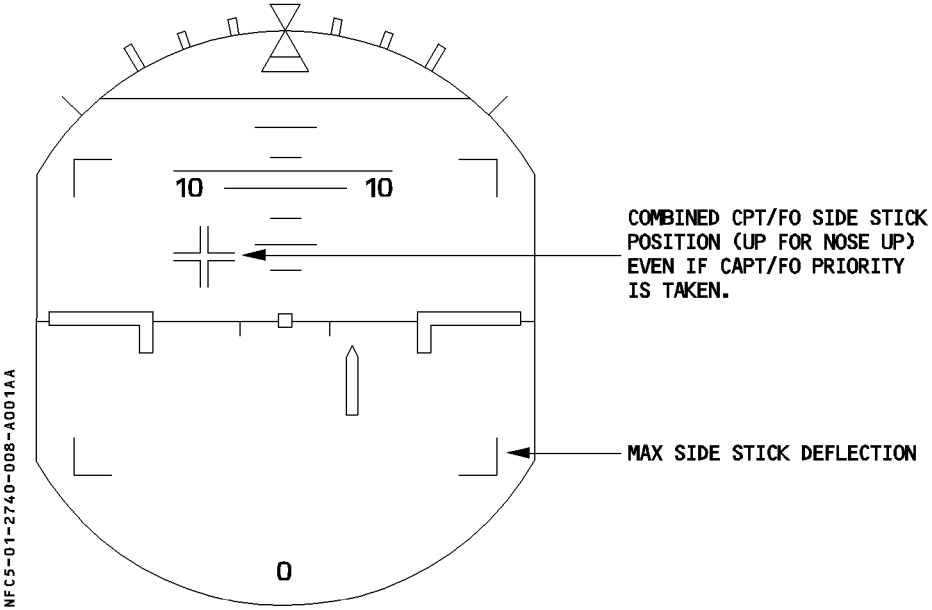
ON : Both FACs perform the following functions :
- Normal roll (coordinating turns and damping dutch roll)
- Rudder trim
- Rudder travel limit
- Alternate yaw

OFF : The corresponding computer is not active. Switching it OFF and then ON resets the computer.

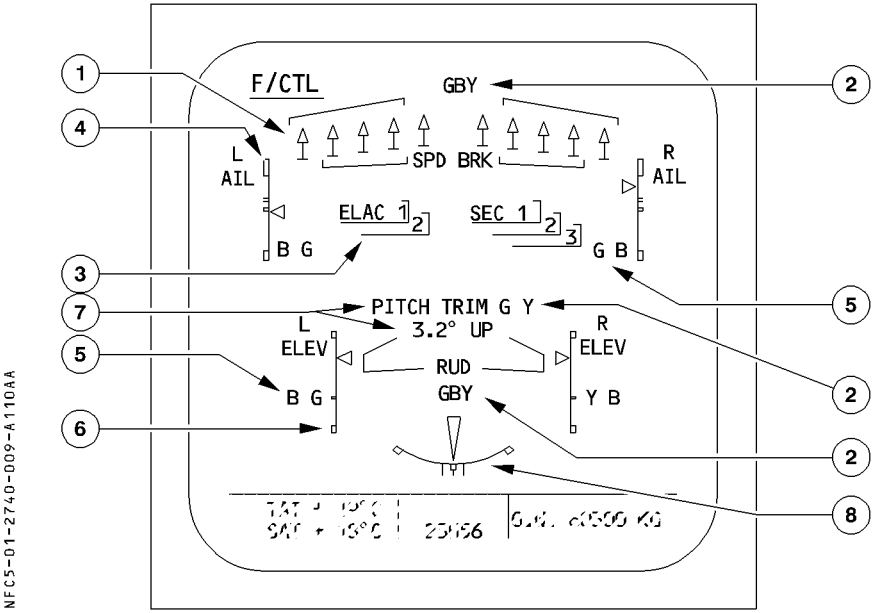
FAULT : Lights up in amber, along with a caution on ECAM, when a failure is detected. The FAULT light goes out when the pilot selects OFF.

SIDE STICK INDICATIONS ON PFD

On the ground, after the first engine start, sidestick position indications appear white on both PFDs.
The indications disappear when the aircraft goes from the ground into flight.



ECAM F/CTL PAGE



NFCS-01-2740-009-A110AA

(1) Spoilers/Speedbrakes' Indication

NFCS-01-2740-009-B110AA

- : SPOILER DEFLECTED BY MORE THAN 2.5°(GREEN)
- – : SPOILER RETRACTED (GREEN)
- 1 : SPOILER FAULT DEFLECTED (AMBER)
- 1 : SPOILER FAULT RETRACTED (AMBER)

(2) Hydraulic System Pressure Indication

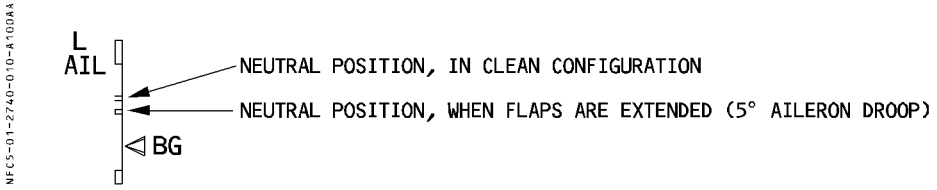
It is normally green. It becomes amber, if the hydraulic system's pressure decreases.

(3) ELAC/SEC Indication

– ELAC and SEC labels are always displayed in white
– The computer number is normally in green, and boxed in grey.
The number and box become amber, if the computer fails, or is switched OFF.

(4) Aileron position Indication

White scale and green index. It changes to amber, when neither (green nor blue) servojack is available.



(5) Aileron and Elevator Actuator Indication

"G" and "B" are normally displayed in green.
They become amber, in the case of a green or blue hydraulic system low pressure. The partial box also becomes amber, if the associated computer or actuator fails.

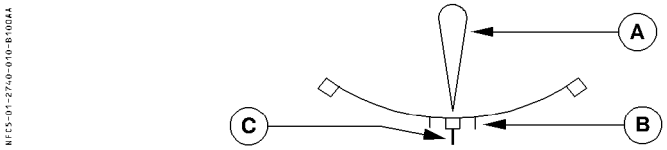
(6) Elevator position Indication

White scale and green index. The index becomes amber, when both associated actuators are not available.

(7) Pitch Trim position Indication

The pitch trim numbers are in green. They become amber, if green and yellow hydraulic system pressure decreases.
The "PITCH TRIM" legend is in white. It becomes amber, if the pitch trim jams.

(8) Yaw Control Indications



(A) Rudder position Indication

R It is normally in green. The rudder symbol becomes amber, if the blue, green, and yellow hydraulic pressures are low.

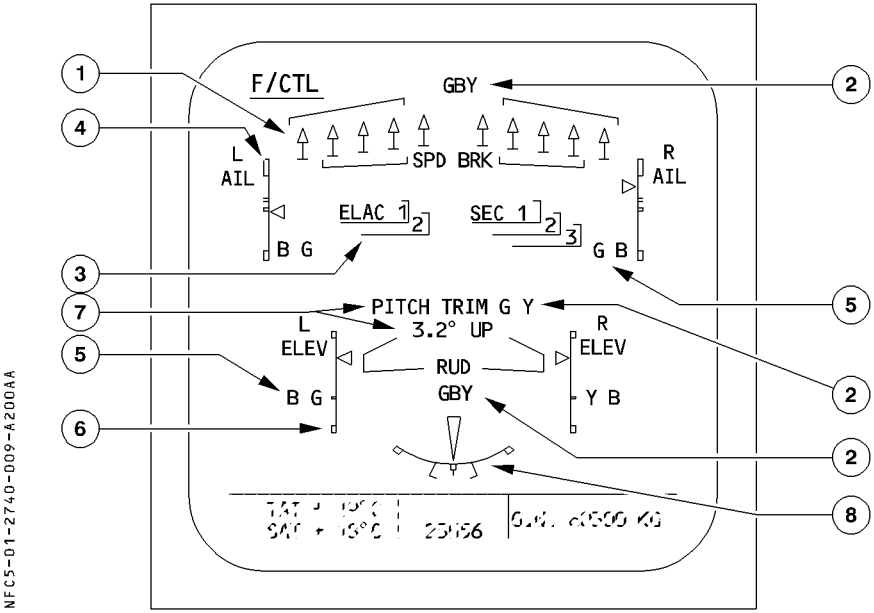
(B) Rudder Travel Limiter

Indicates the high-speed position.

(C) Rudder Trim position

It is normally in blue. It becomes amber, if the rudder trim reset fails.

ECAM F/CTL PAGE



NFCS-01-2740-009-A200AA

(1) Spoilers/Speedbrakes' Indication

NFCS-01-2740-009-B200AA

- : SPOILER DEFLECTED BY MORE THAN 2.5°(GREEN)
- – : SPOILER RETRACTED (GREEN)
- 1 : SPOILER FAULT DEFLECTED (AMBER)
- 1 : SPOILER FAULT RETRACTED (AMBER)

(2) Hydraulic System Pressure Indication

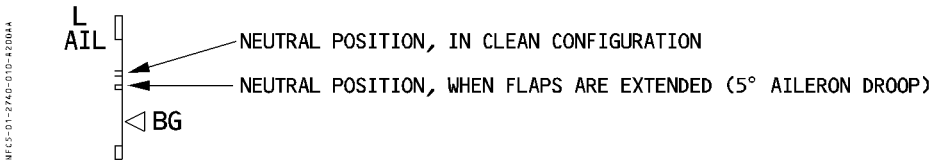
It is normally green. It becomes amber, if the hydraulic system's pressure decreases.

(3) ELAC/SEC Indication

– ELAC and SEC labels are always displayed in white
– The computer number is normally in green, and boxed in grey.
The number and box become amber, if the computer fails, or is switched OFF.

(4) Aileron position indication

It is indicated with a white scale and green index. It changes to amber, when neither (green nor blue) servojack is available.



(5) Aileron and elevator actuator indication

"G" and "B" are normally displayed in green.
They become amber, in the case of a green or blue hydraulic system low pressure. The partial box also becomes amber, if the associated computer or actuator fails.

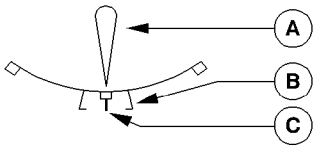
(6) Elevator position indication

It is indicated with a white scale and green index. The index becomes amber, when both associated actuators are not available.

(7) Pitch trim position indication

The pitch trim numbers are in green. They become amber, if green and yellow hydraulic system pressure decreases.
The "PITCH TRIM" legend is in white. It becomes amber, if the pitch trim jams.

(8) Yaw control indications

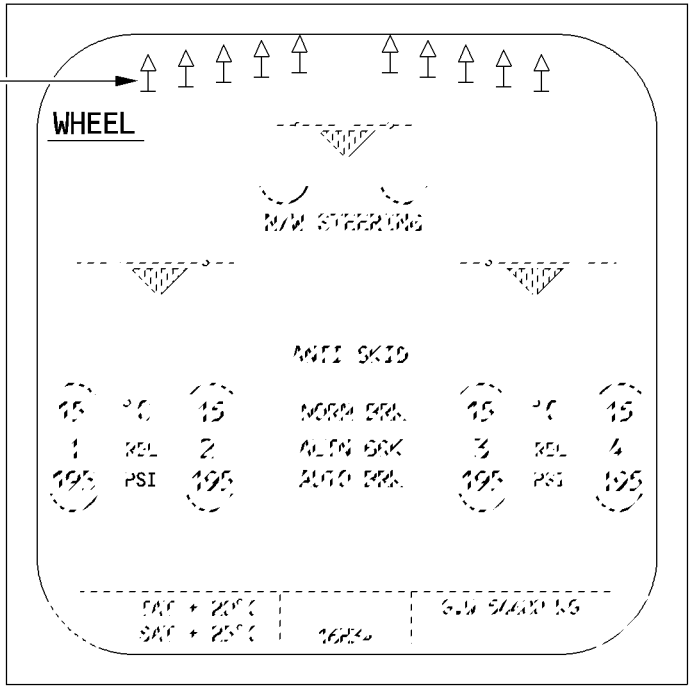


R (A) Rudder position indication
It is normally in green. The rudder symbol becomes amber, if the blue, green, and yellow hydraulic pressures are low.

(B) Rudder travel limiter
It is normally in green. It becomes amber when travel limiter 1 and 2 are faulty.

(C) Rudder trim position
It is normally in blue. It becomes amber, if the rudder trim reset fails.

ECAM WHEEL PAGE

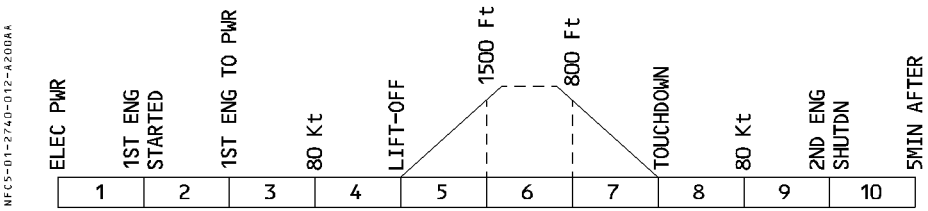


NFC5-01-2740-011-A110AA

(1) Spoilers/Speedbrakes' Indication

These indications are identical to those displayed on the FLT CTL page.

WARNINGS AND CAUTIONS



E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
CONFIG . SLATS/FLAPS NOT IN T.O CONFIG, or . SPD BRK NOT RETRACTED, or . PITCH TRIM NOT IN TO RANGE, or . RUD TRIM NOT IN T.O RANGE A/C not in TO configuration when thrust levers are set at TO, or Flex TO, or when pressing TO CONFIG. pb.	CRC	MASTER WARN	NIL F/CTL	NIL	5, 6, 7, 8
CONFIG R (L) SIDESTICK FAULT (BY TAKE OVER) L or R sidestick is inoperative (takeover pb pressed more than 30 sec) when thrust levers are set at TO, or Flex TO, or when pressing TO CONFIG pb.			NIL	Red * SIDESTICK PRIORITY lt	
L +R ELEV FAULT Loss of both elevators.			F/CTL	PFD message	NIL
L (R) SIDESTICK FAULT Transducers, on pitch or roll axis, are failed on one sidestick.	SINGLE CHIME	MASTER CAUT		NIL	
ELAC 1 (2) FAULT Failure of ELAC				FAULT lt on ELAC pb	3, 4, 5, 7, 8
ELAC 1 (2) FAULT One sidestick transducer fault.				NIL	
SEC 1 (2) (3) FAULT Failure of one SEC.				FAULT lt on SEC pb	3, 4, 5
FCDC 1 + 2 FAULT Failure of both FCDCs.				NIL	4, 5, 7
DIRECT LAW Direct laws are active.				PFD message	4, 5, 7, 8
ALTN LAW Alternate laws are active.			NIL	NIL	
DUAL INPUT Both sidesticks are moved simultaneously.	Synthetic voice repeated every 5 seconds	NIL		SIDESTICK Priority light	NIL

* The red SIDESTICK PRIORITY light comes on, as soon as the sidestick becomes inoperative.

R

E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
GND SPLR FAULT Loss of ground spoiler function in SEC 1 + 3 or 1 + 2 or 2 + 3 or 1 + 2 + 3.	SINGLE CHIME	MASTER CAUTION	F/CTL	NIL	3, 4, 5
SPD BRK DISAGREE Position disagree between surfaces and lever position.					
SPD BRK FAULT Spd brake lever transducers to SEC 1 and 3 failed.					
SPD BRK STILL OUT Speedbrake out, with at least one engine not at idle.			NIL		1, 2, 3, 4, 5, 8, 9, 10
STABILIZER JAM Loss of the electrical control of the stabilizer (with or without jamming of the stabilizer)			F/CTL		4, 5
L (R) ELEV FAULT Loss of both servojacks on one elevator, or activation of elevator flutter protection in ELAC.					
L (R) AIL FAULT Loss of both servojacks on one aileron.					
SPLR FAULT Loss of one or more spoilers.					3, 4, 5, 7
ELAC 1 PITCH FAULT Failure of pitch channel in ELAC 1.	NIL	NIL			3, 4, 5, 7, 8
ELAC 2 PITCH FAULT Failure of pitch channel in ELAC 2, or loss of one or both ELAC 2 rudder pedal transducers.					
GND SPLR 1 + 2 (3 + 4) Gnd splr channel failed in SEC 3 (1).					3, 4, 5
ELEV SERVO FAULT Loss of one servojack on one elevator.					
SPD BRK 2 (3 + 4) FAULT Spdbrake lever transducers to SEC 3 (1) failed.					3, 4, 5, 7, 8
AIL SERVO FAULT Loss of one servojack on one aileron or loss of one or both ELAC 1 rudder pedal transducers.					
FCDC 1 (2) FAULT			NIL		3, 4, 5, 6, 7, 8, 9
SIDESTICK PRIORITY Failure in a sidestick priority logic circuit.					

MEMO DISPLAY

– "SPEED BRK" memo display logic :
  · When the speedbrakes are extended in Flight Phases 2, 3, 4, and 5, the SPEED BRK memo flashes in amber.
  · When the speedbrakes are extended in Flight Phases 6 and 7, the SPEED BRK memo is displayed in green. It flashes in amber, after 50 seconds, if at least one engine is above idle.
– "GND SPLRS ARMED" appears in green, if the ground spoilers are armed.

DESCRIPTION

GENERAL

Each wing has the following lift augmentation devices :
- two flap surfaces
- five slat surfaces.

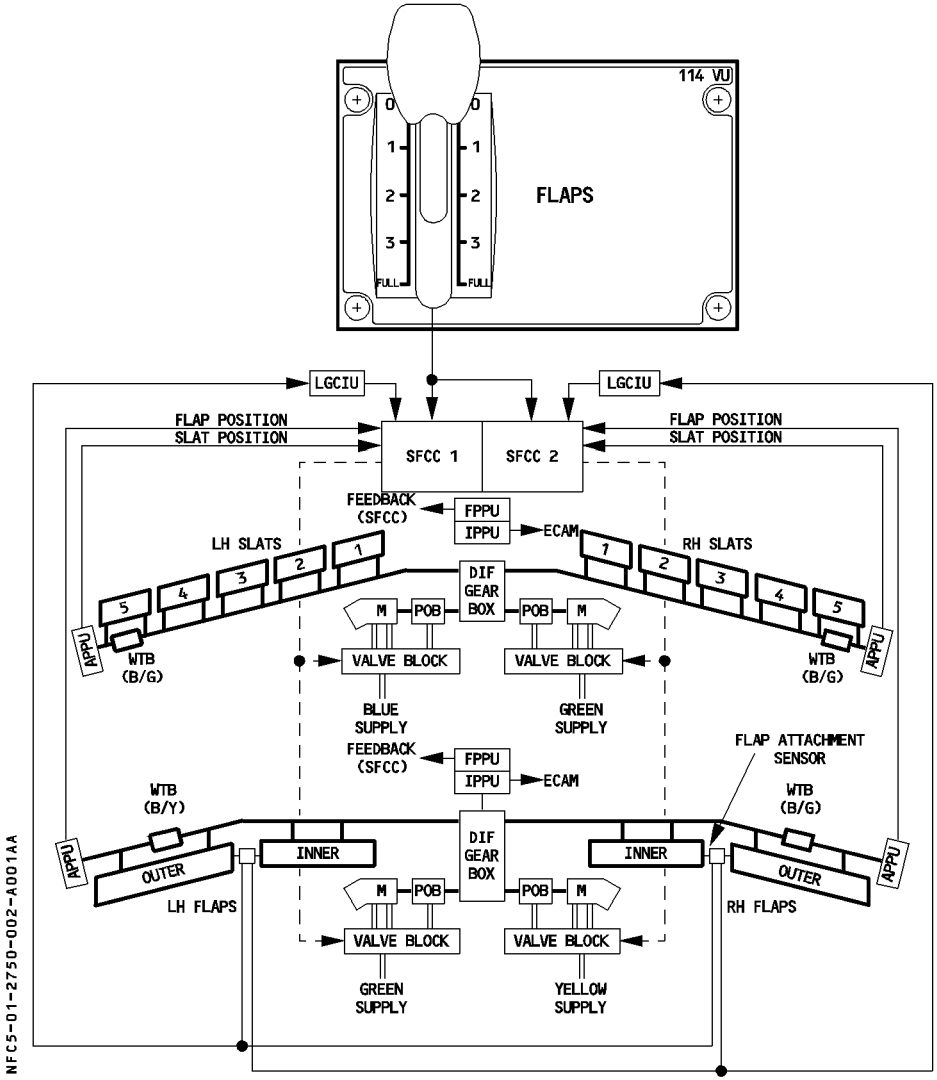
These surfaces are electrically controlled and hydraulically operated.
The pilot extends slats and flaps by moving the FLAPS lever on the center pedestal.
It has five positions.

MAIN COMPONENTS

The slat and flap systems are similar, comprising :
- Two slat flap control computers (SFCCs), each containing one slat channel and one flap channel.
- A power control unit (PCU) consisting of two independent hydraulic motors coupled by a differential gearbox.
  The motors use green and blue hydraulic power for the slats and yellow and green power for the flaps.
  Pressure-off brakes (POBs) lock the transmission when the slat or flap surfaces have reached the selected position or if hydraulic power fails.
- Five slat surfaces and two flap surfaces per wing.
- An assymetry position pick-off unit (APPU) that measures the assymetry between the left and right wings.
- A flap disconnect detection system, which detects attachment failure and inhibits flap operation in order to prevent further damage. A sensor detects the failure by measuring excessive differential movement between the inner and the outer flaps.
- Wingtip brakes (WTBs), activated in case of assymetry, mechanism overspeed, symmetrical runaway, or uncommanded movement of the surfaces. They cannot be released in flight.
  They use blue and green hydraulic power for the slats and for the right wing flaps, and blue and yellow hydraulic power for the left wing flaps.
- Feedback position pick-off units (FPPUs) that feed back position information to the SFCCs.
- An indication position pick-off unit (IPPU) that sends position data to the ECAM.

Note : If the flap wingtip brakes are on, the pilot can still operate the slats, and if the slat wingtip brakes are on, he can still operate the flaps.
If one SFCC is inoperative, slats and flaps both operate at half speed.
If one hydraulic system is inoperative, the corresponding surfaces (slats or flaps) operate at half speed.

ARCHITECTURE



DESCRIPTION

GENERAL

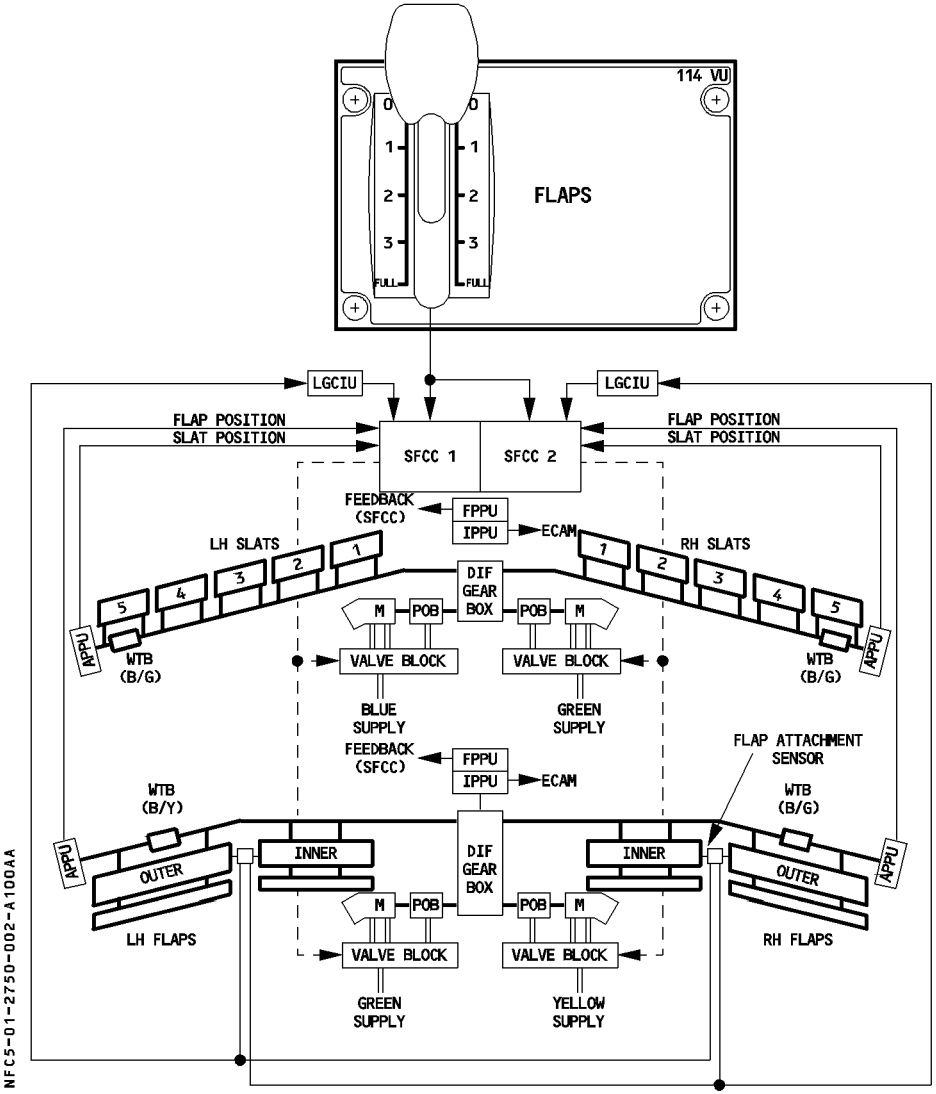
Each wing has the following lift augmentation devices :
– Two double-slotted flap surfaces.
– Five slat surfaces.
These surfaces are electrically controlled and hydraulically operated.
The pilot extends slats and flaps by moving the FLAPS lever on the center pedestal.
It has five positions.

MAIN COMPONENTS

The slat and flap systems are similar, comprising :
– Two slat flap control computers (SFCCs), each containing one slat channel and one flap channel.
– A power control unit (PCU) consisting of two independent hydraulic motors coupled by a differential gearbox.
The motors use green and blue hydraulic power for the slats and yellow and green power for the flaps.
Pressure-off brakes (POBs) lock the transmission when the slat or flap surfaces have reached the selected position or if hydraulic power fails.
– Five slat surfaces and two double-slotted flap surfaces per wing.
– An assymetry position pick-off unit (APPU) that measures the assymetry between the left and right wings.
– A flap disconnect detection system, which detects attachment failure and inhibits flap operation in order to prevent further damage. A sensor detects the failure by measuring excessive differential movement between the inner and the outer flaps.
– Wingtip brakes (WTBs), activated in case of assymetry, mechanism overspeed, symmetrical runaway, or uncommanded movement of the surfaces. They cannot be released in flight.
They use blue and green hydraulic power for the slats and for the right wing flaps, and blue and yellow hydraulic power for the left wing flaps.
– Feedback position pick-off units (FPPUs) that feed back position information to the SFCCs.
– An indication position pick-off unit (IPPU) that sends position data to the ECAM.

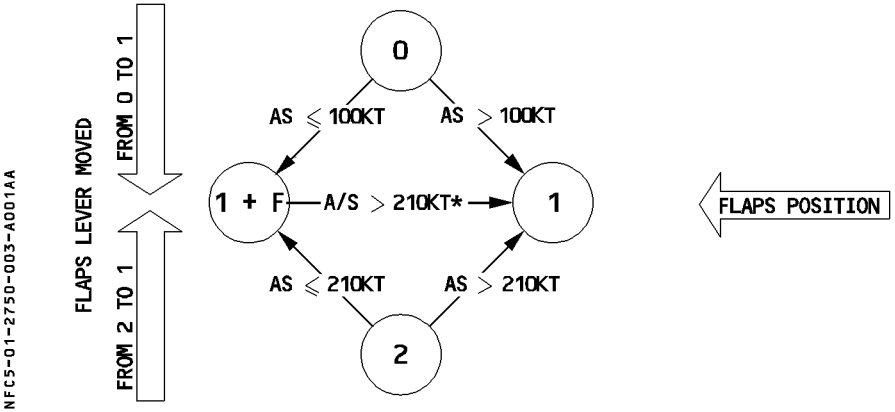
Note : If the flap wingtip brakes are on, the pilot can still operate the slats, and if the slat wingtip brakes are on, he can still operate the flaps.
If one SFCC is inoperative, slats and flaps both operate at half speed.
If one hydraulic system is inoperative, the corresponding surfaces (slats or flaps) operate at half speed.

ARCHITECTURE



CONFIGURATIONS

The FLAPS lever has five positions : 0, 1, 2, 3 and FULL.
Two configurations correspond to position 1 : Configuration 1 and Configuration 1 + F.
The pilot selects these as follows :



* When Configuration 1 + F is selected, the flaps retract to 0° automatically at 210 knots (before the airspeed reaches VFE).

R

ALPHA/SPEED LOCK FUNCTION (SLATS)

This function inhibits slat retraction at high angles-of-attack and low speeds.

The SFCCs use corrected angle-of-attack (alpha) or airspeed information from the ADIRUs to inhibit slat retraction.

R If alpha exceeds 8.5 degrees or the airspeed goes below 148 knots, retraction from position 1 to position 0 is inhibited.

R The inhibition is removed when alpha goes below 7.6 degrees and, when the speed exceeds 154 knots.

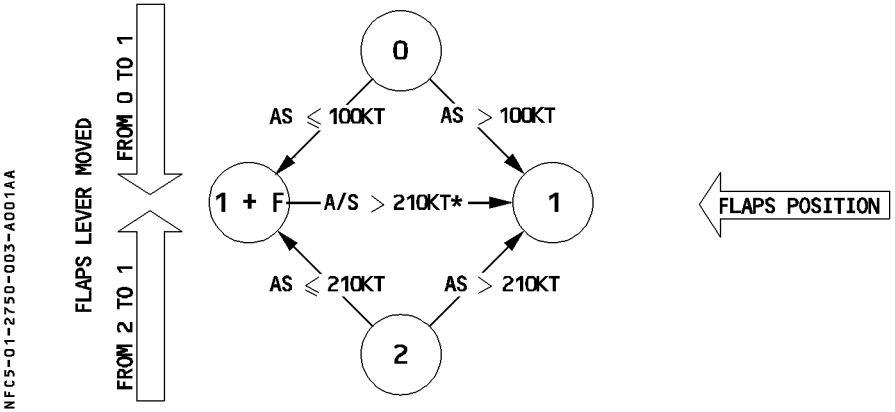
This function is not active if :

R — Alpha exceeds 8.5 degrees or the airspeed goes below 148 knots, after the flight crew has moved the lever to 0

— The aircraft is on the ground, and its speed is less than 60 knots.

CONFIGURATIONS

The FLAPS lever has five positions : 0, 1, 2, 3 and FULL.
Two configurations correspond to position 1 : Configuration 1 and Configuration 1 + F.
The pilot selects these as follows :



* When Configuration 1 + F is selected, the flaps retract to 0° automatically at 210 knots (before the airspeed reaches VFE).

R

ALPHA/SPEED LOCK FUNCTION (SLATS)

This function inhibits slat retraction at high angles of attack and low speeds.

The SFCCs use corrected angle-of-attack (alpha) or airspeed information from the ADIRUs to inhibit slat retraction.

If alpha exceeds 8.0 degrees or the airspeed goes below 165 knots, retraction from position 1 to position 0 is inhibited.

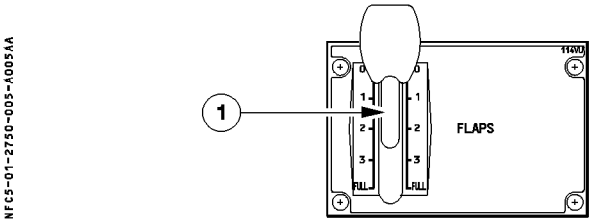
R The inhibition is removed when alpha goes below 7.1 degrees and, when the speed exceeds 171 knots.

This function is not active if :

- Alpha exceeds 8.0 degrees or the airspeed goes below 165 knots, after the flight crew has moved the lever to 0
- The aircraft is on the ground, and its speed is less than 60 knots.

CONTROLS AND INDICATORS

PEDESTAL



(1) FLAPS lever

The FLAPS lever selects simultaneous operation of the slats and flaps.
The five lever positions correspond to the following surface positions :

Position	SLATS	FLAPS	Indications on ECAM			
0	0	0			CRUISE	HOLD
1	18	0	1			
		10	1 + F	TAKEOFF		
2	22	15	2			APPR
3	22	20	3		LDG	
FULL	27	35	FULL			

Before selecting any position, the pilot must pull the lever out of the detent. Balks at positions 1 and 3 prevent the pilot from calling for excessive flap/slat travel with a single action.

Note : The pilot cannot select an intermediate lever position.

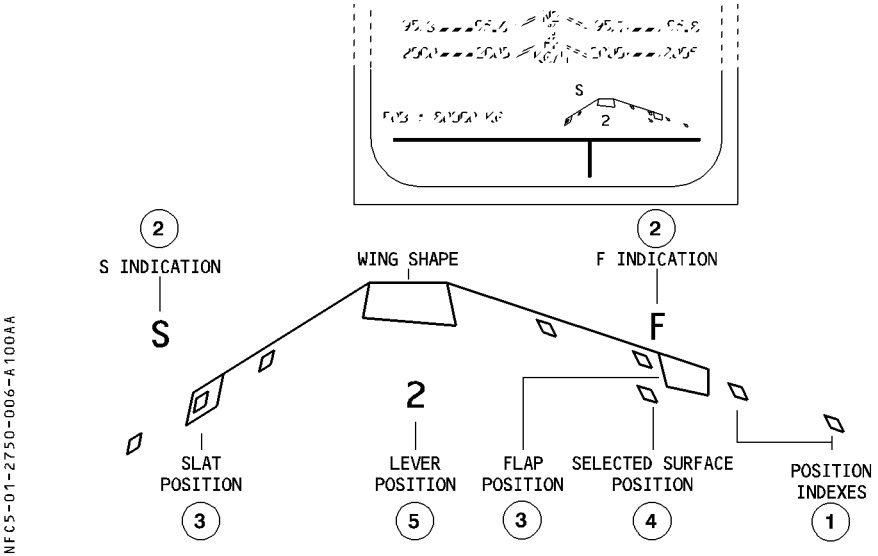
Takeoff in configuration 1 :
1 + F (18°/10°) is selected. If the pilot does not select configuration 0 after takeoff, the flaps retract automatically at 210 knots.

Takeoff or go-around in configuration 2 or 3 :
If the pilot selects configuration 1, he gets 1 + F (18°/10°) if airspeed is under 210 knots. If the pilot does not select configuration 0 after takeoff, the flaps retract automatically at 210 knots.

Configuration 0 to configuration 1 in flight :
Configuration 1 (18°/0°) is selected.

Note : After flap retraction, configuration 1 + F is no longer available until the airspeed is 100 knots or less, unless configuration 2, 3, or FULL has been selected previously.

ECAM UPPER DISPLAY



(1) Position indexes :

These white points indicate that the slats and flaps are in a selectable position. They do not appear, when the aircraft is in clean configuration.

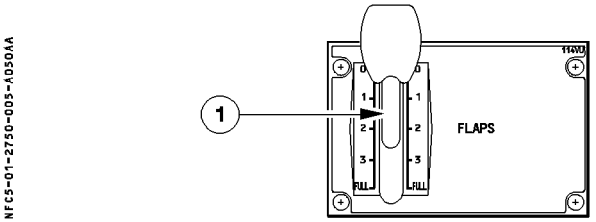
(2) F and S

"F" and "S" normally appear in white. They become amber, if :
- Both relevant hydraulic systems fail, unless the aircraft is on ground with both engines stopped.
- The wingtip brakes are on.
- There is a slats or flaps fault.

"S (F) LOCKED" legend, appears in amber, in association with an ECAM caution, when the wingtip brakes are applied, or when the system detects a non-alignment between two flaps.
The "A-LOCK" legend pulses in cyan, when the slat alpha/speedlock function is active.

CONTROLS AND INDICATORS

PEDESTAL



(1) FLAPS lever

The FLAPS lever selects simultaneous operation of the slats and flaps.
The five lever positions correspond to the following surface positions :

Position	SLATS	FLAPS	Indications on ECAM			
0	0	0			CRUISE	HOLD
1	18	0	1			
		10	1 + F	TAKEOFF		
2	22	15	2			APPR
3	22	20	3		LDG	
FULL	27	40	FULL			

Before selecting any position, the pilot must pull the lever out of the detent. Balks at positions 1 and 3 prevent the pilot from calling for excessive flap/slat travel with a single action.

Note : The pilot cannot select an intermediate lever position.

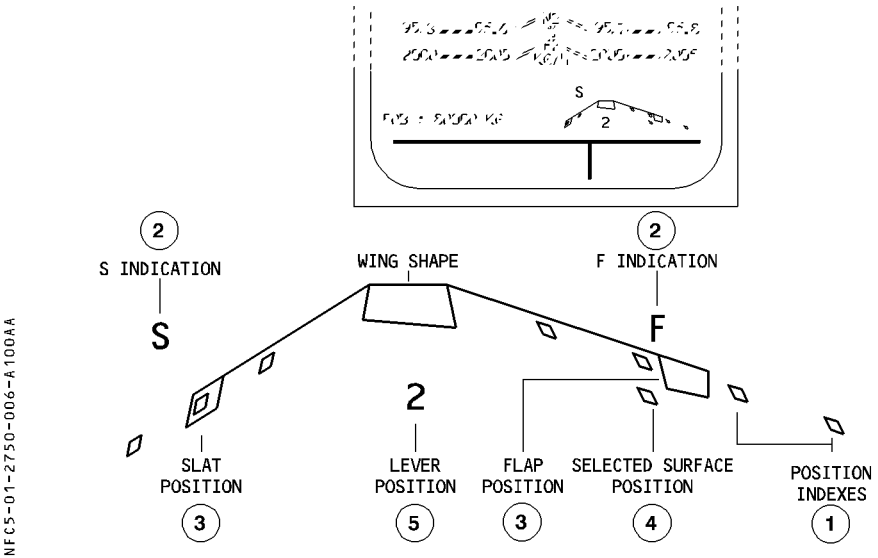
Takeoff in configuration 1 :
1 + F (18°/10°) is selected. If the pilot does not select configuration 0 after takeoff, the flaps retract automatically at 210 knots.

Takeoff or go-around in configuration 2 or 3 :
If the pilot selects configuration 1, he gets 1 + F (18°/10°) if airspeed is under 210 knots. If the pilot does not select configuration 0 after takeoff, the flaps retract automatically at 210 knots.

configuration 0 to configuration 1 in flight :
configuration 1 (18°/0°) is selected.

Note : After flap retraction, configuration 1 + F is no longer available until the airspeed is 100 knots or less, unless configuration 2, 3, or FULL has been selected previously.

ECAM UPPER DISPLAY



(1) Position indexes :

These white points indicate that the slats and flaps are in a selectable position. They do not appear, when the aircraft is in clean configuration.

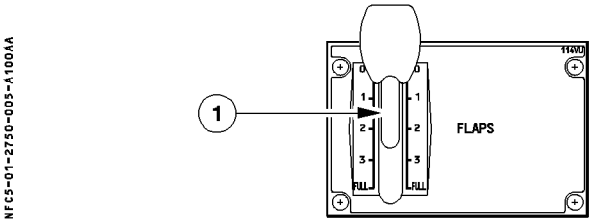
(2) F and S

"F" and "S" normally appear in white. They become amber, if :
- Both relevant hydraulic systems fail, unless the aircraft is on ground with both engines stopped.
- The wingtip brakes are on.
- There is a slats or flaps fault.

"S (F) LOCKED" legend, appears in amber, in association with an ECAM caution, when the wingtip brakes are applied, or when the system detects a non-alignment between two flaps.
The "A-LOCK" legend pulses in cyan, when the slat alpha/speedlock function is active.

CONTROLS AND INDICATORS

PEDESTAL



(1) FLAPS lever

The FLAPS lever selects simultaneous operation of the slats and flaps.
The five lever positions correspond to the following surface positions :

Position	SLATS	FLAPS	Indications on ECAM			
0	0	0			CRUISE	HOLD
1	18	0	1			
		10	1 + F	TAKEOFF		
2	22	14	2			APPR
3	22	21	3		LDG	
FULL	27	25	FULL			

Before selecting any position, the pilot must pull the lever out of the detent. Balks at positions 1 and 3 prevent the pilot from calling for excessive flap/slat travel with a single action.

Note : The pilot cannot select an intermediate lever position.

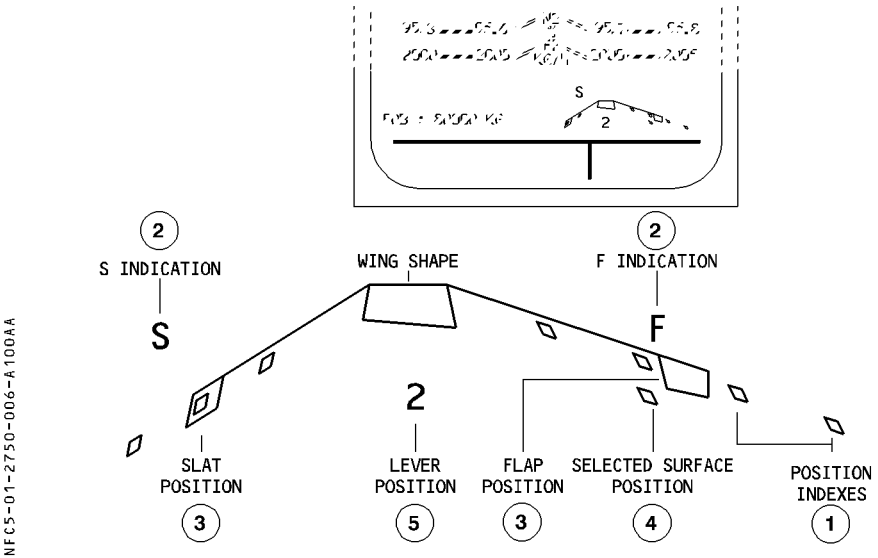
Takeoff in configuration 1 :
1 + F (18°/10°) is selected. If the pilot does not select configuration 0 after takeoff, the flaps retract automatically at 210 knots.

Takeoff or go-around in configuration 2 or 3 :
If the pilot selects configuration 1, he gets 1 + F (18°/10°) if airspeed is under 210 knots. If the pilot does not select configuration 0 after takeoff, the flaps retract automatically at 210 knots.

configuration 0 to configuration 1 in flight :
configuration 1 (18°/0°) is selected.

Note : After flap retraction, configuration 1 + F is no longer available until the airspeed is 100 knots or less, unless configuration. 2, 3, or FULL has been selected previously.

ECAM UPPER DISPLAY



(1) Position indexes :

These white points indicate that the slats and flaps are in a selectable position. They do not appear, when the aircraft is in clean configuration.

(2) F and S

"F" and "S" normally appear in white. They become amber, if :
- Both relevant hydraulic systems fail, unless the aircraft is on ground with both engines stopped.
- The wingtip brakes are on.
- There is a slats or flaps fault.

"S (F) LOCKED" legend, appears in amber, in association with an ECAM caution, when the wingtip brakes are applied, or when the system detects a non-alignment between two flaps.
The "A-LOCK" legend pulses in cyan, when the slat alpha/speedlock function is active.

(3) Flaps/Slats' actual position

These green boxes indicate the actual flaps/slats position.
They become amber, if :
- Both relevant hydraulic systems fail, unless the aicraft is on ground with both engines stopped.
- The wingtip brakes are on.
- There is a slats or flaps fault.

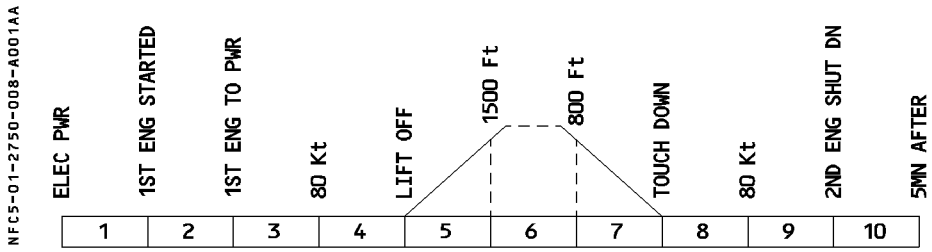
(4) Selected position

It is in blue, when the surfaces are in transit.
It disappears, when the selected position is reached.

(5) Lever position

The "0", "1 + F", "1", "2", "3", or "FULL" legend appears.
- It is green, when the slats and flaps are in the selected position. "0" is not displayed, when the aircraft attains clean configuration.
- It becomes cyan, when the slats and flaps are in transit.

WARNINGS AND CAUTIONS



R

E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
CONFIG SLATS (FLAPS) NOT IN TO CONFIG slats or flaps are not in takeoff configuration when thrust levers are set at TO or FLEX TO or when pressing TO CONFIG pb.	CRC	MASTER WARN	NIL	NIL	5, 6 * 7, 8
SLATS (FLAPS) FAULT failure of both slat or flap channels	SINGLE CHIME	MASTER CAUT			4, 5, 8
SLATS (FLAPS) LOCKED slats or flaps wing tip brakes applied or non alignment detected between 2 flaps					
SLATS SYS 1 (2) FAULT failure of slat channel in one SFCC	NIL	NIL			3, 4, 5, 7, 8
FLAP SYS 1 (2) FAULT failure of flap channel in one SFCC					
SLAT (FLAP) TIP BRK FAULT failure of one wing tip brake on slats or flaps or failure of one wing tip brake solenoid on slats or flaps					
FLAPS ATTACH SENSOR failure of flap attachment failure detection sensor					

R * The warning is automatically recalled by pressing the TO CONFIG pushbutton.

(3) Flaps/Slats' actual position

These green boxes indicate the actual flaps/slats position.
They become amber, if :
- Both relevant hydraulic systems fail, unless the aicraft is on ground with both engines stopped.
- The wingtip brakes are on.
- There is a slats or flaps fault.

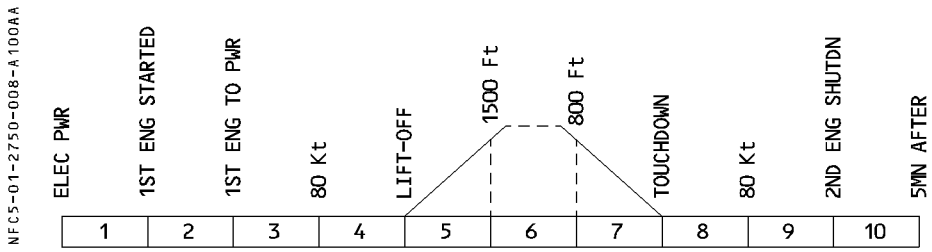
(4) Selected position

It is in blue, when the surfaces are in transit.
It disappears, when the selected position is reached.

(5) Lever position

The "0", "1 + F", "1", "2", "3", or "FULL" legend appears.
- It is green, when the slats and flaps are in the selected position. "0" is not displayed, when the aircraft attains clean configuration.
- It becomes cyan, when the slats and flaps are in transit.

WARNINGS AND CAUTIONS



R

E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
CONFIG SLATS (FLAPS) NOT IN TO CONFIG Slats or flaps are not in takeoff configuration, when thrust levers are set at TO, or FLEX TO, or when pressing the TO CONFIG pb.	CRC	MASTER WARN	NIL	NIL	5, 6 * 7, 8
FLAP LVR NOT ZERO Flap lever is not in the zero position, and the aircraft is above 22 000 feet.					1 to 5, 7 to 10
SLATS (FLAPS) FAULT Failure of both slat or flap channels.	SINGLE CHIME	MASTER CAUT			4, 5, 8
SLATS (FLAPS) LOCKED Slats or flaps' wing tip brakes applied, or non alignment detected between 2 flaps.					
SLATS SYS 1 (2) FAULT Failure of slat channel in one SFCC.	NIL	NIL			3, 4, 5, 7, 8
FLAP SYS 1 (2) FAULT Failure of flap channel in one SFCC.					
SLAT (FLAP) TIP BRK FAULT Failure of one wing tip brake on slats or flaps, or failure of one wing tip brake solenoid on slats, or flaps.					
FLAPS ATTACH SENSOR Failure of flap attachment's failure detection sensor.					

* The warning is automatically recalled by pressing the TO CONFIG pushbutton.

BUS EQUIPMENT LIST

			NORM		EMER ELEC		
			AC	DC	AC ESS	DC ESS	HOT
COMPUTERS	MAIN FLT CTL	ELAC 1				X	HOT 1 (1)
		ELAC 2		DC2			HOT 2 (1)
		SEC 1				X	HOT 1 (1)
		SEC 2		DC2			
		SEC 3		DC2			
		FAC 1			X	SHED	
		FAC 2	AC2	DC2			
		FCDC 1				SHED	
		FCDC 2		DC2			
	FLAPS SLATS	SFCC 1 slats				X	
		SFCC 1 flaps				X	
		SFCC 2 slats		DC2			
		SFCC 2 flaps		DC2			
PITCH TRIM		MOTOR 1		DC2			HOT 2 (1)
		MOTOR 2				X	
		MOTOR 3		DC2			
RUDDER TRIM		MOTOR 1				X	
		MOTOR 2		DC2			
		INDIC		DC2			
RUDDER TRAVEL LIMIT		MOTOR 1				X	
		MOTOR 2		DC2			

(1) standby supply

28.00 CONTENTS

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– ECAM FUEL PAGE 8
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– WARNINGS AND CAUTIONS 12
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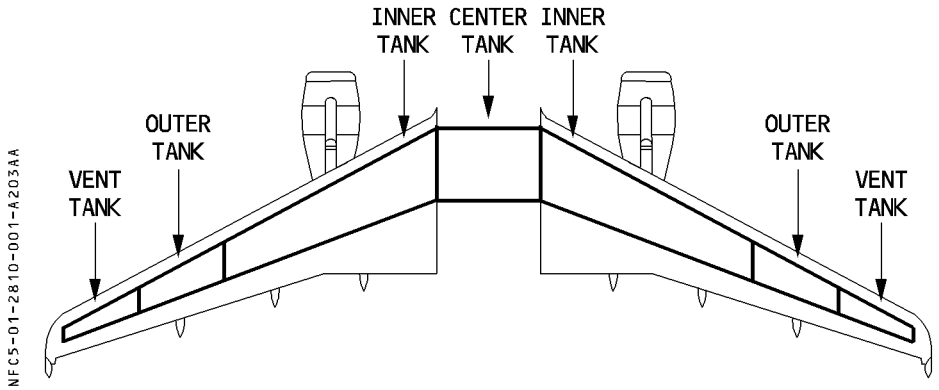
28.30 ELECTRICAL SUPPLY
– BUS EQUIPMENT LIST

GENERAL

The fuel system :
- stores fuel in the tanks
- supplies fuel in the correct quantities to the fuel tanks during refueling
- supplies fuel to the engines and the auxiliary power unit (APU)
- circulates fuel to cool the integrated drive generator (IDG)
- keeps fuel in the outer wing for wing bending and flutter relief.

TANKS

The fuel is stored in the wings and the center section. The wings have inner and outer tanks.
There is a vent surge tank outboard of the outer tank in each wing.
When the aircraft has been refueled to maximum capacity, the fuel can expand by 2 % (20° temperature rise) without spilling.
There is an overpressure protector in each vent outer and inner tank and between the center tank and the left inner tank.



USABLE FUEL					
		OUTER TANKS	INNER TANKS	CENTER TANK	TOTAL
VOLUME	(liters)	880 x 2	6924 x 2	8250	23858
	(US gallons)	232 x 2	1829 x 2	2180	6302
WEIGHT *	(KG)	691 x 2	5435 x 2	6476	18728
	(LB)	1520 x 2	11982 x 2	14281	41285

* Fuel density : 0.785 kg/l or 6.551 lb/US Gal.

ENGINE FEED

GENERAL

The main fuel pump system supplies fuel from the center tank or the inner wing tanks to the engines. The system has six main fuel pumps.

MAIN COMPONENTS

TANK PUMPS

R In normal operation each engine is supplied by one pump in the center tank or two pumps in its own side wing tank.

All wing tank pumps remain on throughout the flight. They are fitted with pressure relief
R sequence valves which ensure that, when all pumps are running, the center tank pumps will deliver fuel preferentially.

TRANSFER VALVES

Two electrical transfer valves are mounted in each wing to permit fuel transfer from outer to inner tank.

CROSS FEED VALVE

A cross feed valve controlled by a double motor allows both engines to be fed from one side or one engine to be fed from both sides.

ENGINE LP VALVES

The fuel flow to an engine can be stopped by its low pressure (LP) fuel valve, the closure of the LP fuel valve is by :
– the engine master switch, or
– the ENG FIRE PUSH pushbutton.

SUCTION VALVES

Closed by pumps pressure in normal operation, they allow engines to be fed by gravity if the inner tank pumps fail.

R *Note : Center tank pumps are not fitted with suction valves. Therefore, gravity feeding is not possible from the center tank.*

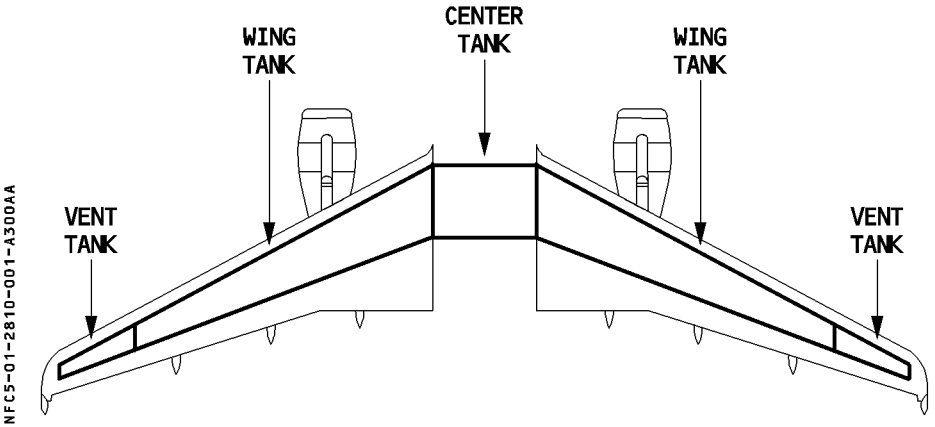
GENERAL

The fuel system :
- stores fuel in the tanks
- supplies fuel in the correct quantities to the fuel tanks during refueling
- supplies fuel to the engines and the auxiliary power unit (APU)
- controls the transfer of fuel from the center tank to the wing tanks
- circulates fuel to cool the integrated drive generator (IDG).

TANKS

Tanks in the wings and the center section store fuel.
There is a vent surge tank outboard of each wing tank.
When the aircraft has been refueled to maximum capacity, the fuel can expand by 2 % (20° temperature rise) without spilling.

R There is an overpressure protector in each vent and wing tank, and between the center tank and the left wing tank.



USABLE FUEL				
		WING TANKS	CENTER TANK	TOTAL
VOLUME	(liters)	2 x 7750	8200	23700
	(US gallons)	2 x 2047	2166	6260
WEIGHT *	(KG)	2 x 6084	6437	18605
	(LB)	2 x 13410	14190	41010

* Fuel density : 0.785 kg/l or 6.551 lb/US Gal.

ENGINE FEED

GENERAL

The main fuel pump system supplies fuel from the wing tanks to the engines. The system has four main fuel pumps.

MAIN COMPONENTS

TANK PUMPS

In normal operation each engine is supplied from two pumps in its own side wing tank.

CROSS FEED VALVE

A cross feed valve controlled by a double motor allows both engines to be fed from one side or one engine to be fed from both sides.

ENGINE LP VALVES

The fuel flow to an engine can be stopped by its low pressure (LP) fuel valve. The closure of the LP fuel valve is controlled by :
– the engine master switch, or
– the ENG FIRE PUSH pushbutton.

SUCTION VALVES

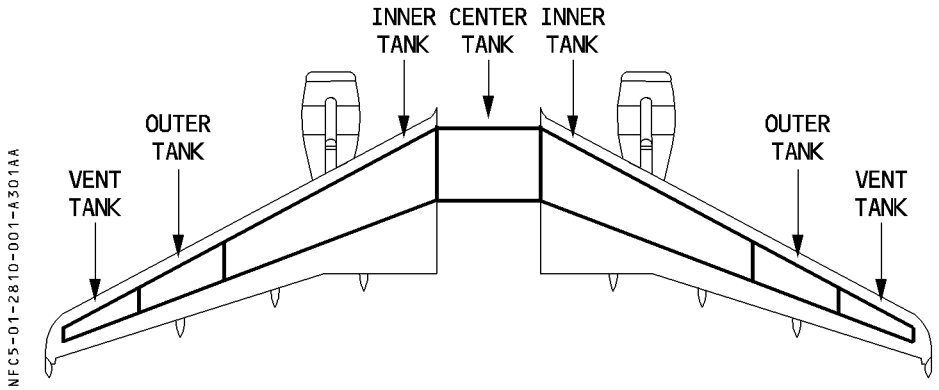
Closed by pumps pressure in normal operation, they allow engines to be fed by gravity if the wing tank pumps fail.

GENERAL

The fuel system :
- stores fuel in the tanks
- supplies fuel in the correct quantities to the fuel tanks during refueling
- supplies fuel to the engines and the auxiliary power unit (APU)
- circulates fuel to cool the integrated drive generator (IDG)
- keeps fuel in the outer wing for wing bending and flutter relief.

TANKS

The fuel is stored in the wings and the center section. The wings have inner and outer tanks.
There is a vent surge tank outboard of the outer tank in each wing.
When the aircraft has been refueled to maximum capacity, the fuel can expand by 2 % (20° temperature rise) without spilling.
There is an overpressure protector in each vent outer and inner tank and between the center tank and the left inner tank.



USABLE FUEL					
		OUTER TANKS	INNER TANKS	CENTER TANK	TOTAL
VOLUME	(liters)	880 x 2	7099 x 2	8250	24209
	(US gallons)	232 x 2	1875 x 2	2180	6395
WEIGHT *	(KG)	691 x 2	5573 x 2	6476	19004
	(LB)	1520 x 2	12286 x 2	14281	41893

* Fuel density : 0.785 kg/l or 6.551 lb/US Gal.

ENGINE FEED

GENERAL

The main fuel pump system supplies fuel from the center tank or the inner wing tanks to the engines. The system has six main fuel pumps.

MAIN COMPONENTS

TANK PUMPS

R In normal operation each engine is supplied by one pump in the center tank or two pumps in its own side wing tank.

R All wing tank pumps remain on throughout the flight. They are fitted with pressure relief sequence valves which ensure that, when all pumps are running, the center tank pumps will deliver fuel preferentially.

TRANSFER VALVES

Two electrical transfer valves are mounted in each wing to permit fuel transfer from outer to inner tank.

CROSS FEED VALVE

A cross feed valve controlled by a double motor allows both engines to be fed from one side or one engine to be fed from both sides.

ENGINE LP VALVES

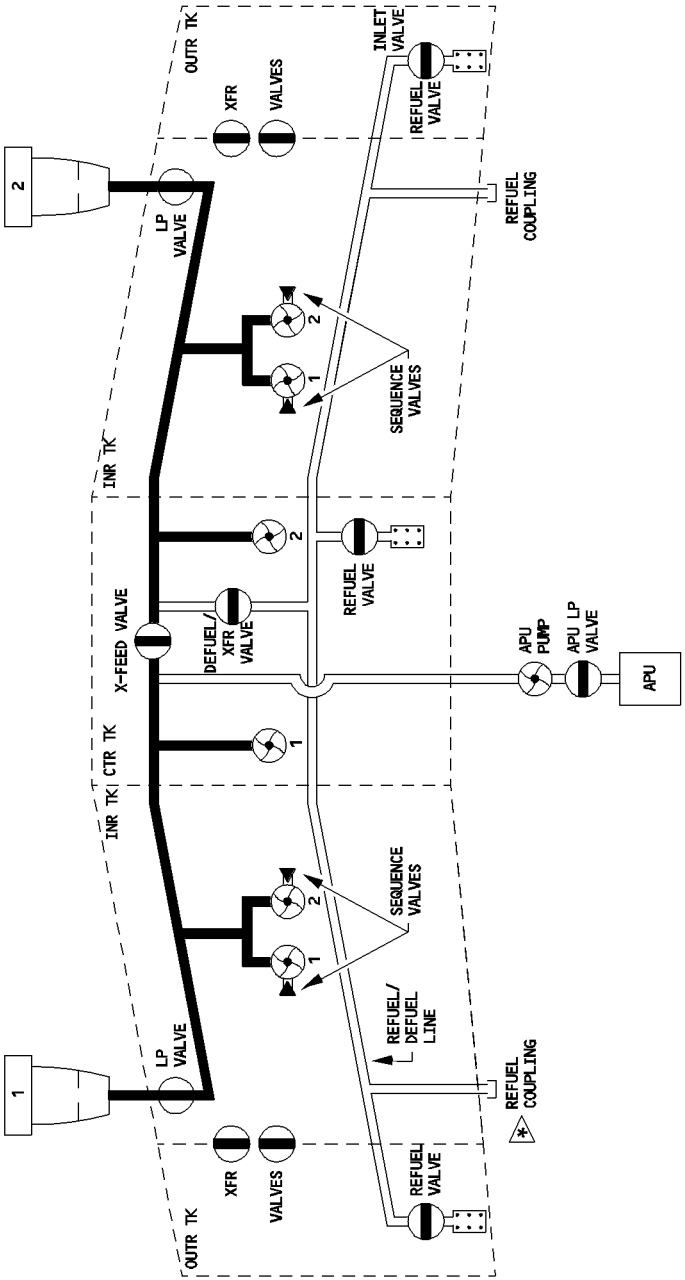
The fuel flow to an engine can be stopped by its low pressure (LP) fuel valve, the closure of the LP fuel valve is by :
- the engine master switch, or
- the ENG FIRE PUSH pushbutton.

SUCTION VALVES

Closed by pumps pressure in normal operation, they allow engines to be fed by gravity if the inner tank pumps fail.

R *Note : Center tank pumps are not fitted with suction valves. Therefore, gravity feeding is not possible from the center tank.*

ENGINE FEED

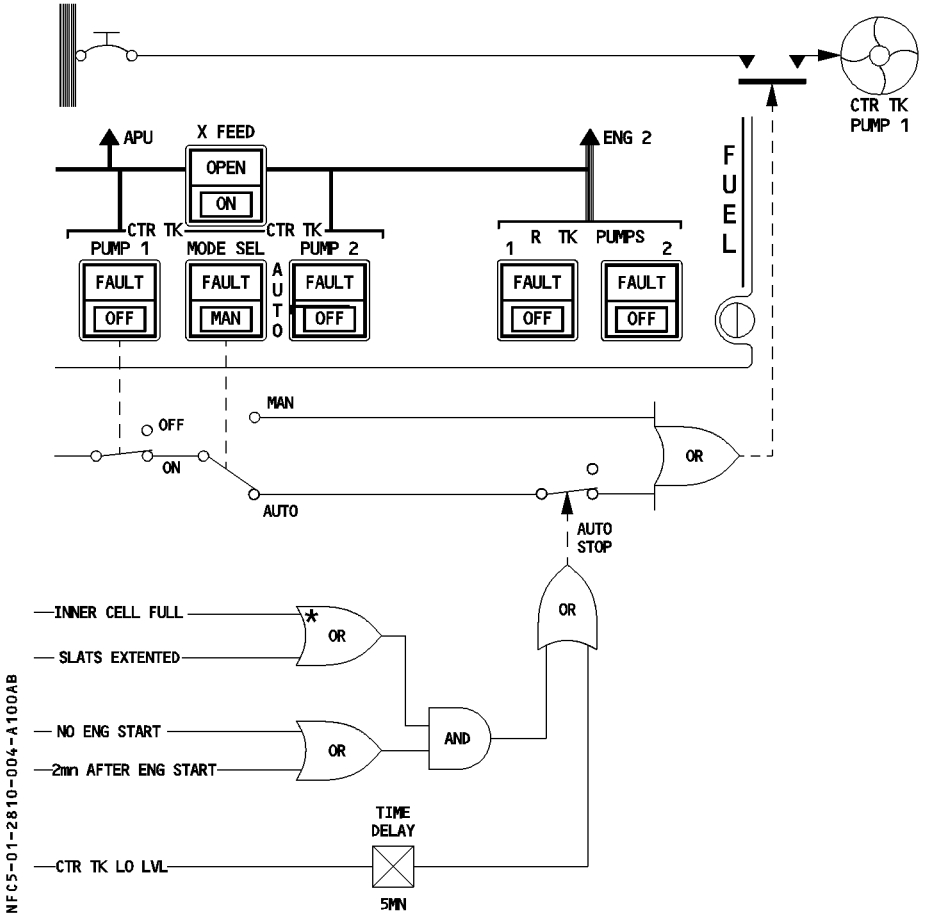


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FUEL FEED SEQUENCE

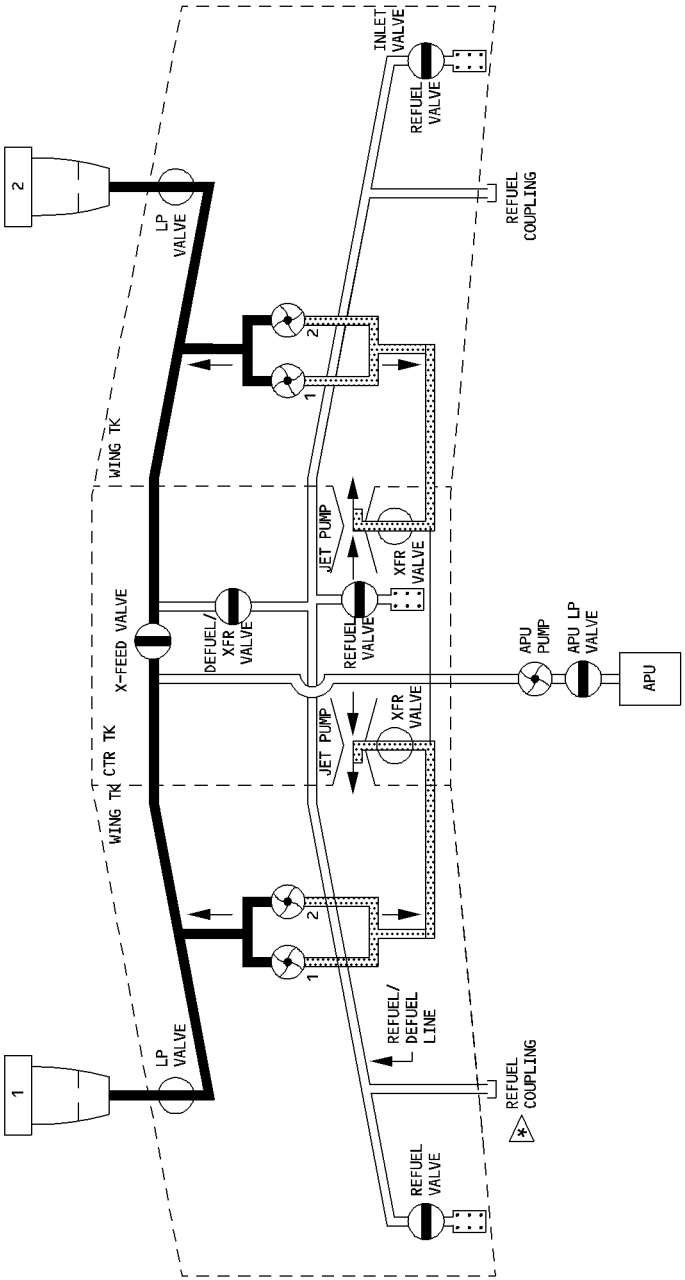
The tanks empty in the following sequence :
1. center tank
2. inner tanks (down to 750 kg in each inner tank)
3. outer tanks (fuel transfered into the inner tanks)

CENTER TANK PUMPS CONTROL LOGIC



* Each center tank pump stops until approximately 500 kg (1100 lb) of its associated inner tank fuel has been used (when the fuel level reaches the underfull sensors).

ENGINE FEED



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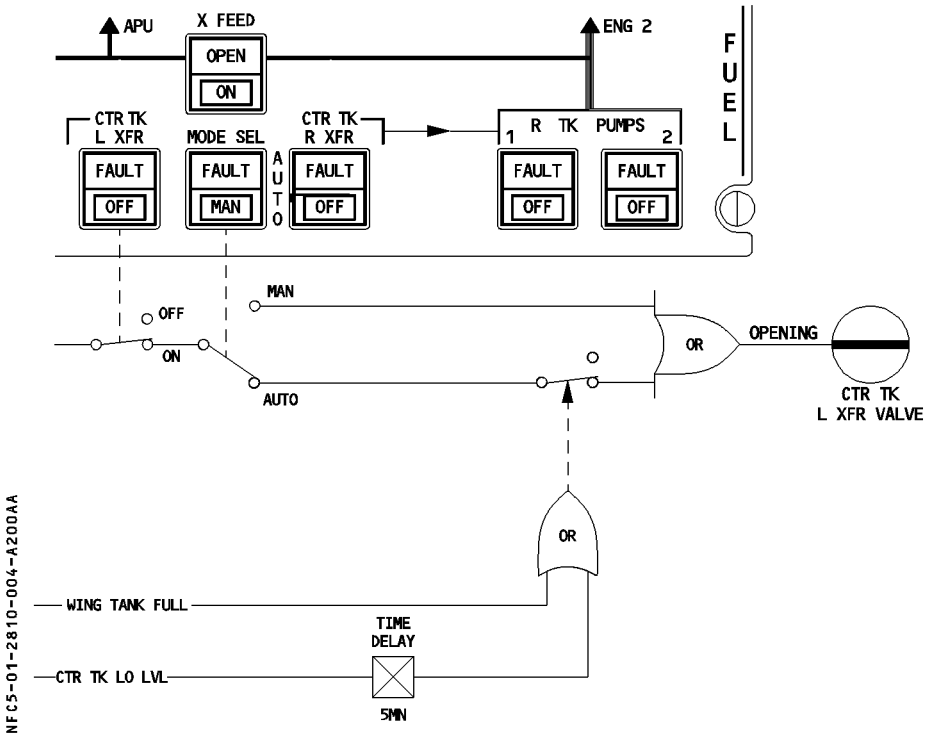
FUEL FEED SEQUENCE

The wing tanks feed fuel to the engines. The tanks empty in the following sequence :
1. center tank (fuel transferred into wing tanks)
2. wing tanks

CENTER TANK FUEL TRANSFER

The transfer system controls the flow of fuel from the center tank to the wing tanks. The Fuel Level Sensing Control Unit (FLSCU) has automatic control of the transfer valve. When the transfer valve is open, fuel from the wing tank pumps flows through the jet pump and creates a suction in it. This suction moves the fuel from the center tank to the related wing tank.

Center tank transfer valve control logic



R The FLSCU automatically closes the associated center tank transfer valve when the wing tank is full. The FLSCU then reopens the center tank transfer valve when the engine has used 250 kg (550 lb) of wing tank fuel (when the fuel level reaches the underfull sensors).

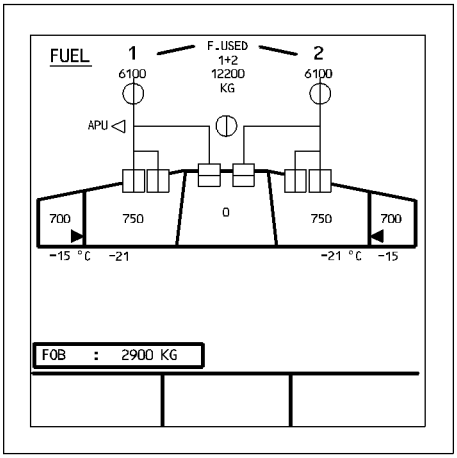
With MODE SEL in the MAN position, the center tank pumps will run. In manual mode, the CTR TK PUMP pushbuttons must be selected off, when the center tank is empty.

FUEL TRANSFER FROM OUTER TO INNER TANKS

The transfer valves automatically open, when the inner tank fuel reaches the low level (about 750 kg/1650 lb), thus enabling the fuel to drain from the outer to inner tanks. When open, the valves are latched open. They will automatically close at the next refueling operation.

Note : 1. Two level sensors are installed in each inner tank. Each sensor controls two transfer valves, one in each wing, ensuring simultaneous transfer to both wings.
2. The 750 kg/1650 lb value is based on a level aircraft attitude, with no acceleration. During steep descent or acceleration/deceleration, the transfer valves may open with more than 750 kg/1650 lb of fuel in each inner tank, and the low level warning may be triggered.

ECAM INDICATION



TRANSFER FROM OUTER
TO INNER TANKS
+
INNER TANK FEEDING

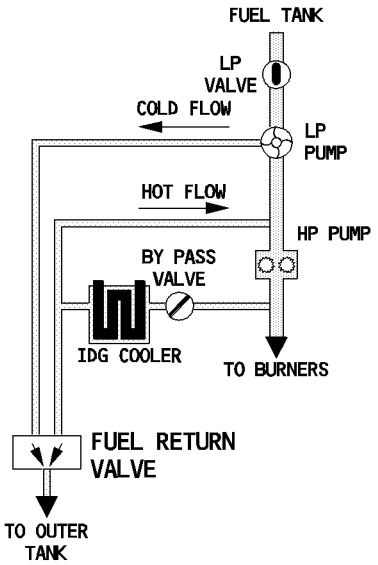
NFCS-01-2810-005-A220AA

APU FEED

A special fuel pump supplies fuel for APU startup when fuel feed pressure is low (due to loss of tank pumps or loss of normal AC electrical supply). This pump normally runs off the AC ESS SHED, but runs off the AC STAT INV BUS if the AC ESS SHED fails.

FUEL RECIRCULATION SYSTEM

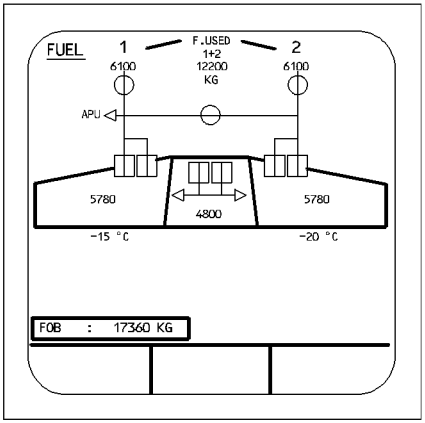
See also 1.70.40 "IDG COOLING SYSTEM".
Some of the fuel supplied to each engine goes from the high-pressure fuel line in that engine, through the integrated drive generator (IDG) heat exchanger (where it absorbs heat), to the fuel return valve, and to the outer fuel tank.
This operation ensures the IDG cooling when the oil temperature is high or when at low engine power.
The FADEC controls the fuel return valve.
If the outer tank is already full, the fuel overflows to the inner tank through a spill pipe.
If center tankis feeding, the wing tank will tend to overfill and the system automatically selects the CTR TK PUMP off when the inner tank is full. The wing tank pumps will feed until the engine have used approximately 500 kg (1100 lb) of fuel when the fuel level reaches the underfull sensors. The logic circuits then restart the center tank pumps.



NFC5-01-2810-006-A105AA

With the MODE SEL in MAN position, the center tank transfer valves will open.
Wing tank overflow must be prevented by selecting the CTR TK XFR pushbuttons off when the wing tanks are full. They must also be selected off when the center tank is empty.

ECAM INDICATION



TRANSFER FROM CENTER TANK

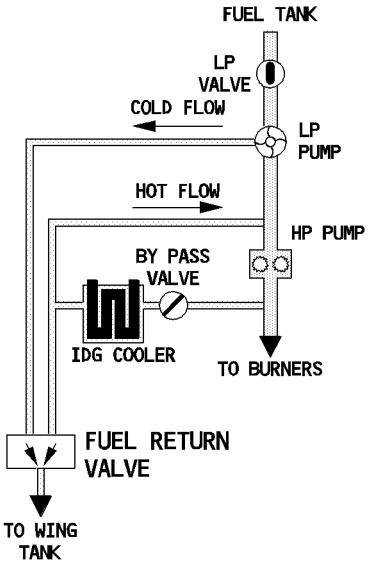
NFC5-01-2810-005-A315AA

APU FEED

A special fuel pump supplies fuel for APU startup when fuel feed pressure is low (due to loss of tank pumps or loss of normal AC electrical supply). This pump normally runs off the AC ESS SHED, but runs off the AC STAT INV BUS if the AC ESS SHED fails.

FUEL RECIRCULATION SYSTEM

See also 1.70.40 "IDG COOLING SYSTEM".
Some of the fuel supplied to each engine goes from the high-pressure fuel line in that engine, through the integrated drive generator (IDG) heat exchanger (where it absorbs heat), to the fuel return valve, and back to the wing tank.
This operation ensures the IDG cooling when the oil temperature is high or when at low engine power.
The FADEC controls the fuel return valve.

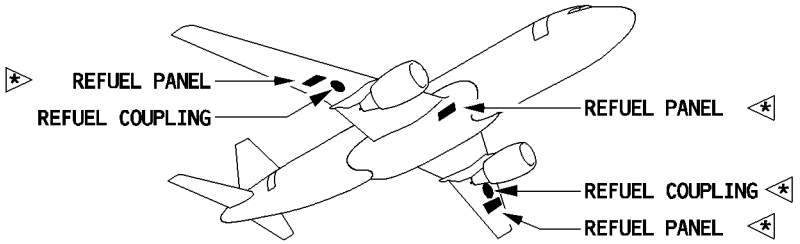


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REFUELING – DEFUELING

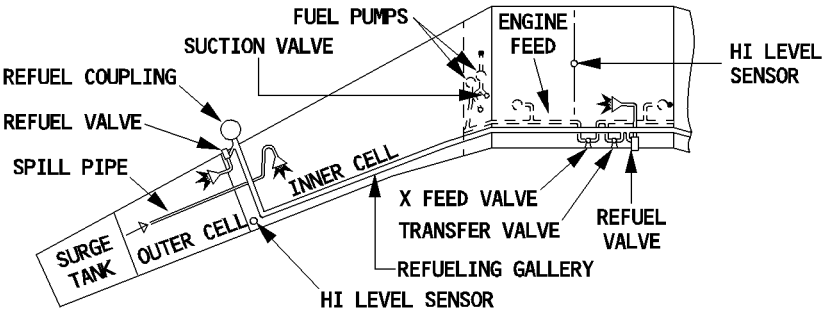
– One (two) refueling point(s) is (are) installed under the wings allowing the refueling from either the right or left (◁) side of the aircraft.
– A refuel panel is located on the fuselage side beneath the right wing or under the right or left wing adjacent to the refuel coupling.

NFC5-01-2810-007-A106AA



A gallery connects the refuel coupling to the refuel valve of each tank.
Refueling is normally automatic, the required fuel load being set on the preselector.
Manual control is also available.
Automatic refueling starts by the outer cells. If the selected fuel load exceeds the wing tank capacity, the center tank is refuelled simultaneously.
When an outer cell is full the fuel overflows into the inner cell through a spill pipe.
Refuel valves close automatically when the tanks contain the preselected load or when sensors detect a high fuel level.
The aircraft can be refueled when only battery power is available.
The wing tanks can be refueled by gravity through refueling points on top of the wings.
A transfer valve between the engine feed system and the refueling gallery permits :
– tank pumps to transfer fuel from one tank to another.
– defueling through the refuel coupling.
Approximate refueling time at nominal pressure is :
– 17 minutes for wing tanks.
– 20 minutes for all tanks.

NFC5-01-2810-007-B106AA



FUEL QUANTITY INDICATION AND LEVEL SENSING

FUEL QUANTITY INDICATION (FQI) SYSTEM

The FQI is a computerized system that :
- transmits the actual total fuel mass, as well as the quantity and temperature of fuel in the tanks, to the ECAM.
- controls automatic refueling.

Two channels perform fuel computations : channel 2 activates automatically if channel 1 fails.

The FQI system comprises :
- an FQI computer.
- a set of capacitance probes in each tank to measure fuel level and temperature.
- one densitometer (cadensicon) sensor in each wing inner tank permitting the calculation of the fuel quantity.
- one Capacitance Index Compensator (CIC) in each inner tank giving the dielectric constant of the fuel in case of cadensicon failure.
- a quantity indicator for each tank installed on the refuel/defuel panel.
- a preselector on the refuel/defuel panel that shows the preselected and actual total fuel quantity.

FUEL LEVEL SENSING CONTROL UNIT (FLSCU)

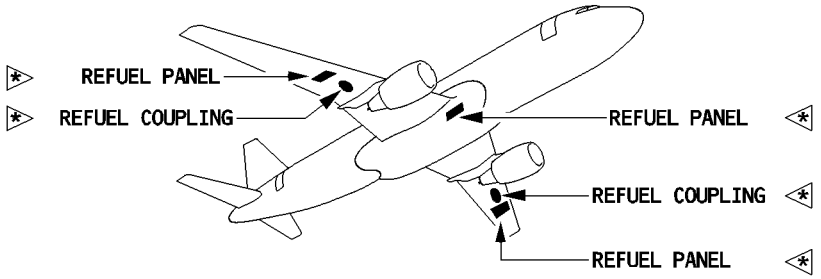
The fuel level system generates fuel-level and fuel-temperature signals in order to operate the appropriate switching functions for refueling and defueling and control the IDG cooling recirculation system and the center-tank-to-wing-tank fuel transfer system.

The FLSCU comprises :
- fuel level sensors in the tanks to sense high, low, and overflow levels.
- a fuel temperature sensor to control the IDG cooling recirculation.

When fuel quantity in one wing tank goes below 750 kg (1650 lb), the low-level sensor triggers the LO LVL warning on ECAM.

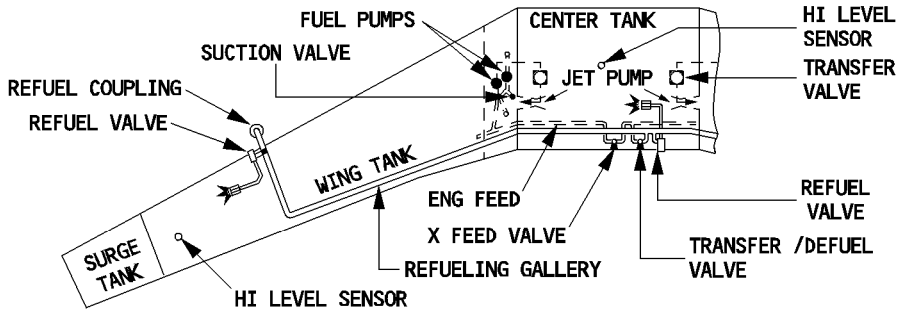
REFUELING – DEFUELING

R One (two) refueling point(s) is (are) installed under the wings allowing the refueling from
R either the right or left (◁) side of the aircraft.
R – A refuel panel is located either on the fuselage side beneath the right wing or under the
R right wing adjacent to the refuel coupling.
R



NFC5-01-2810-007-A200AB

A gallery connects the refuel coupling to the refuel valve of each tank.
Refueling is normally automatic, the required fuel load being set on the preselector.
Manual control is also available.
Automatic refueling starts with the wing tanks. If the preselected fuel load exceeds the capacity of the wing tanks, the center tank receives fuel simultaneously.
Refuel valves close automatically when the tanks contain the preselected load or when sensors detect a high fuel level.
The aircraft can be refueled when only battery power is available.
The wing tanks can be refueled by gravity through refueling points on top of the wings.
A transfer valve between the engine feed system and the refueling gallery permits :
– tank pumps to transfer fuel from one tank to another.
– defueling through the refuel coupling.
Approximate refueling time at nominal pressure is :
– 17 minutes for wing tanks.
– 20 minutes for all tanks.



NFC5-01-2810-007-B200AA

FUEL QUANTITY INDICATION AND LEVEL SENSING

FUEL QUANTITY INDICATION (FQI) SYSTEM

The FQI is a computerized system that :
- transmits the actual total fuel mass, as well as the quantity and temperature of fuel in the tanks, to the ECAM.
- controls automatic refueling.

Two channels perform fuel computations : channel 2 activates automatically if channel 1 fails.

The FQI system has :
- an FQI computer.
- R a set of capacitance probes in each tank to measure fuel level.
- R sensors in each wing tank to measure fuel temperature.
- R devices for measuring fuel characteristics such as density
- R a multi tank indicator allowing the quantity for each tank to be displayed on the refuel/defuel panel.

FUEL LEVEL SENSING CONTROL UNIT (FLSCU)

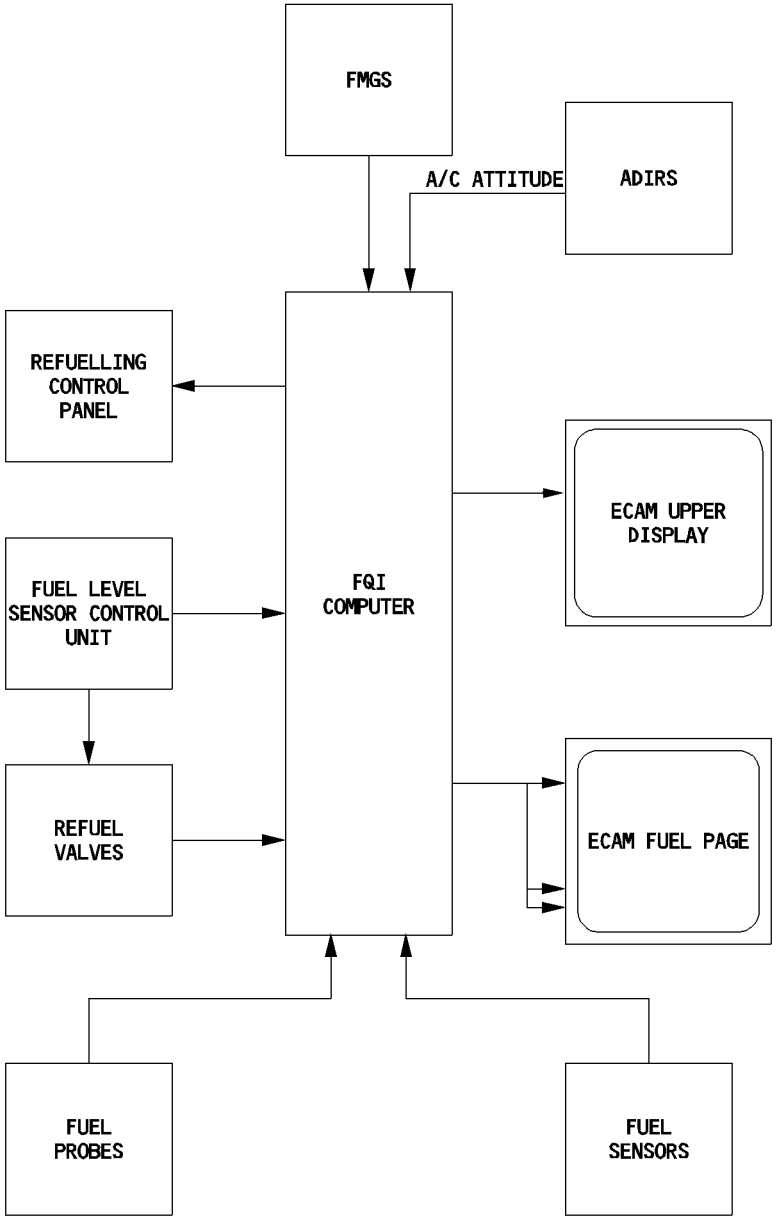
The fuel level system generates fuel-level and fuel-temperature signals in order to operate the appropriate switching functions for refueling and defueling and control the IDG cooling recirculation system and the center-tank-to-wing-tank fuel transfer system and ACT (◁) to center tank fuel transfer system.

The FLSCU comprises :
- fuel level sensors in the tanks to sense high, low, and overflow levels.
- a fuel temperature sensor to control the IDG cooling recirculation.

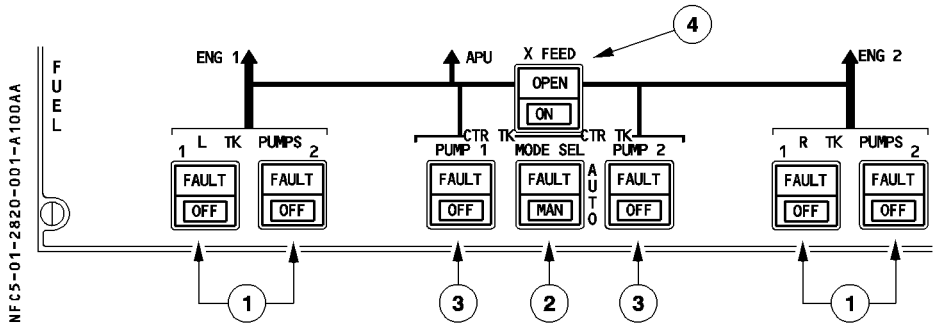
When fuel quantity in one wing tank goes below 750 kg (1650 lb), the low-level sensor triggers the LO LVL warning on ECAM.

FUEL SYSTEM ARCHITECTURE

R



OVERHEAD PANEL



(1) L (R) TK PUMPS 1(2) pb sw

On : Pump is on but fuel feeds only when center tank pumps delivery pressure drops below threshold.
OFF : Pump is OFF and OFF button lights up white.
FAULT light : Amber light comes on, and ECAM caution comes on, when the delivery pressure drops. It does not come on when OFF is selected.

(2) MODE SEL pb sw

AUTO : Control of center tank pumps is automatic.
- They run at engine start for 2 minutes.
- Before or after engine start sequence, the pumps run if the slats are retracted.
- They stop automatically 5 minutes after center tank low level is reached.

MAN : Flight crew controls the center tank pumps manually with center tank pumps pushbutton switches.
FAULT light : Amber light comes on, and ECAM caution comes on when center tank has more than 250 kg (550 lb) of fuel and the left or right wing tank has less than 5000 kg (11000 lb).

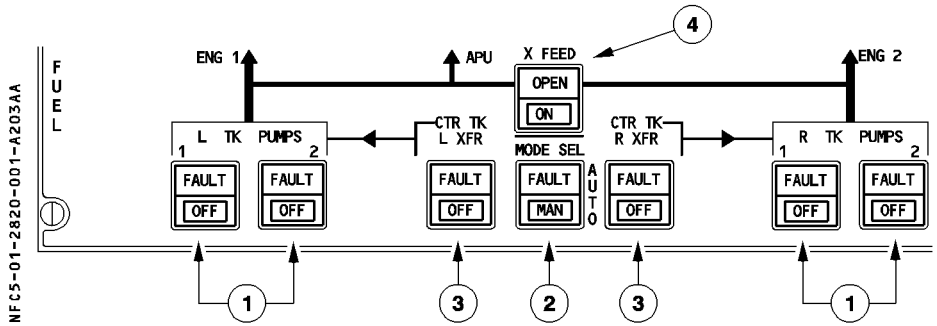
(3) CTR TK PUMP 1(2) pb sw

On : · Pump runs if MAN mode is selected on MODE SEL pushbutton switch.
· Pump is automatically controlled when AUTO mode is selected.
OFF : Pump is OFF and OFF button lights up white.
FAULT light : Amber light comes on, associated with ECAM caution, when the pump is in operation and the delivery pressure drops.

④ X FEED pb sw

Off : Valve closes and button does not light up.
ON : Valve opens and ON button lights up white.
OPEN light : This green light comes on when the valve is fully open.

OVERHEAD PANEL



(1) L (R) TK PUMPS pb sw

On : Pump is on.
OFF : Pump is OFF and OFF button lights up white.
FAULT light : Amber light comes on, and ECAM caution comes on, when the delivery pressure drops. It does not come on when OFF is selected.

(2) MODE SEL pb sw

AUTO : Control of center tank transfer valves is automatic.
- They open if the associated wing tank is not full.
- They close automatically five minutes after the center tank reaches its low level.

MAN : Flight crew controls the center tank transfer valves manually with CTR TK XFR pushbutton switches.
FAULT light : Amber light comes on, and ECAM caution comes on, when :
- The center tank has more than 250 kg (550 lb) of fuel and the left or right wing tank has less than 5000 kg (11000 lb) and
- the MODE SEL pushbutton switch is at AUTO.

(3) CTR TK L(R) XFR pb sw

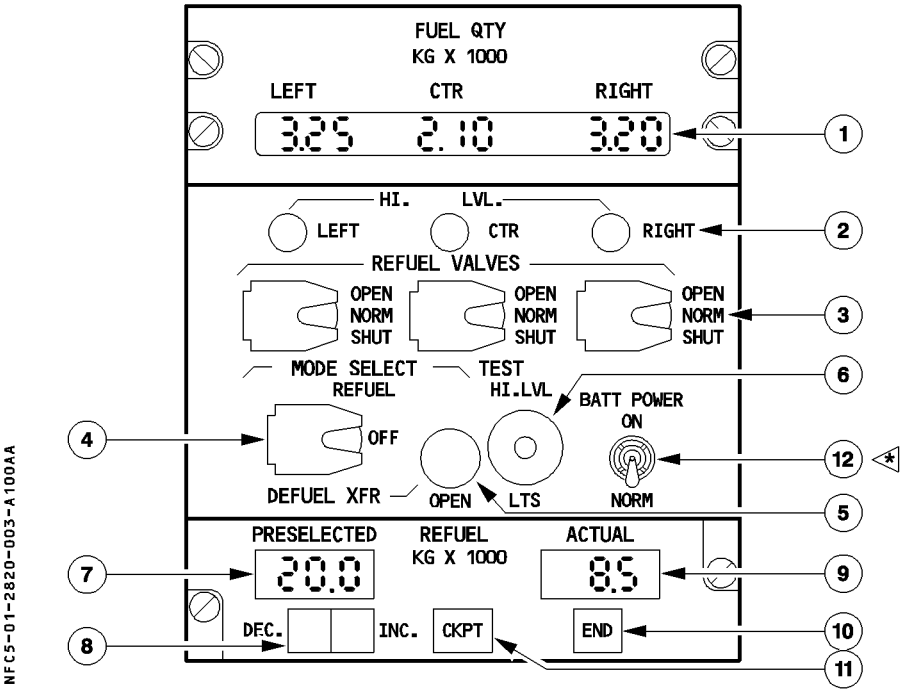
On : The transfer valve opens if MAN mode is selected with the MODE SEL pushbutton switch.
- The transfer valve is controlled automatically when the flight crew selects AUTO mode.

OFF : The transfer valve is closed.
FAULT light : Amber light comes on, as does the ECAM caution, if the associated wing tank overflows.

④ X FEED pb sw

Off : Valve closes and button does not light up.
ON : Valve opens and ON button lights up white.
OPEN light : This green light comes on when the valve is fully open.

REFUELING CONTROL PANEL



(1) FUEL QUANTITY indicator

The number shows the quantity of fuel in each tank.

(2) HI LVL lt

This blue light comes on when the system detects a high fuel level.
The corresponding refuel valve closes automatically.

(3) REFUEL VALVES sel (guarded in NORM)

NORM : Automatic refueling logic controls the refuel valves.
OPEN : Valves open when the MODE SELECT switch is set to REFUEL or DEFUEL position. When the MODE SELECT switch is in the REFUEL position, each refuel/defuel valve closes when the system detects a high level in the associated tank.
SHUT : Valves close.

(4) MODE SELECT sw (guarded at OFF)

OFF : Refuel system is de-energized. Refuel valves are closed.
REFUEL : Refuel valves operate in automatic or in manual mode depending on the position of REFUEL/DEFUEL VALVES switches.
DEFUEL : Refuel/Defuel transfer valve opens.
Refuel valve opens if the associated REFUEL VALVE selector is at OPEN.

(5) OPEN lt

This amber light comes on when the transfer valve is open.

(6) TEST sw

When this switch is pressed, the HI LVL lights come on if high level sensors and associated circuits are serviceable.

Note : If tanks are full (HI LVL lights on) during this test, the HI LVL lights go out if high level sensors and associated circuits are serviceable.

LTS : Lights on panel and all 8's on FQI and preselector come on.

(7) PRESELECTED display

This display shows the preselected total fuel quantity in kg (lb) × 1000 (multiply by 1000 to get actual amount).

(8) Preselector rocker switch

Pressing the left or right side of the switch decreases or increases the preselected quantity.

(9) ACTUAL display

This display shows the total fuel on board.

(10) END lt

– This green light comes on steady when automatic refueling is completed.
– It flashes green if refueling is aborted.

(11) CKPT lt

Not used.

(12) BATT POWER toggle sw ◁

ON : When flight crew switches this switch ON momentarily and releases it, HOT BUS 1 supplies the FQI. After completion of the FQI tests (about 40 secondes), the fuel quantity indications appear and the refuel operation can be selected.
The electrical supply is cut off automatically :
– after 10 minutes, if no refuel operation is selected
– or, at the end of refueling

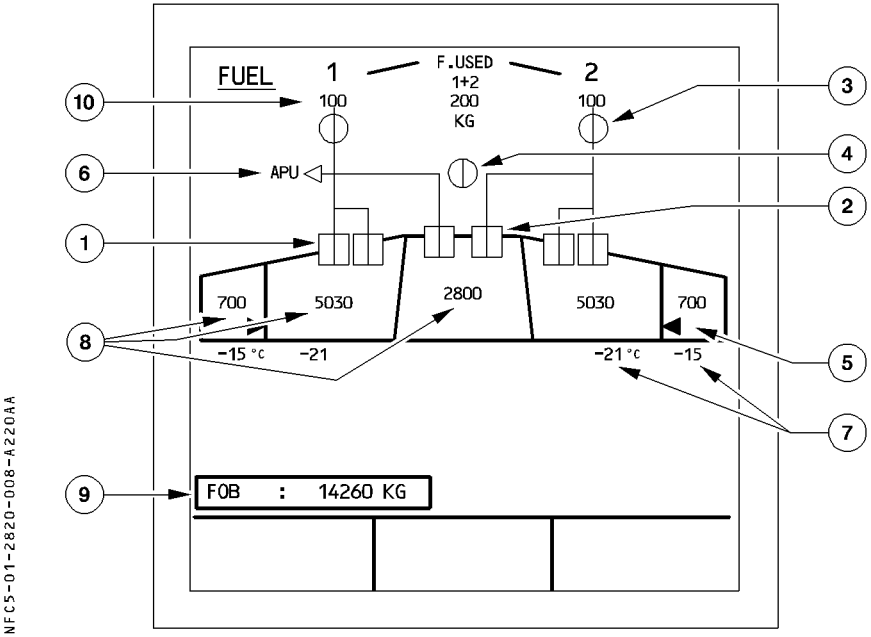
NORM : The FQI is not supplied by batteries

MAINTENANCE PANEL

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ECAM FUEL PAGE



(1) Wing pump indications

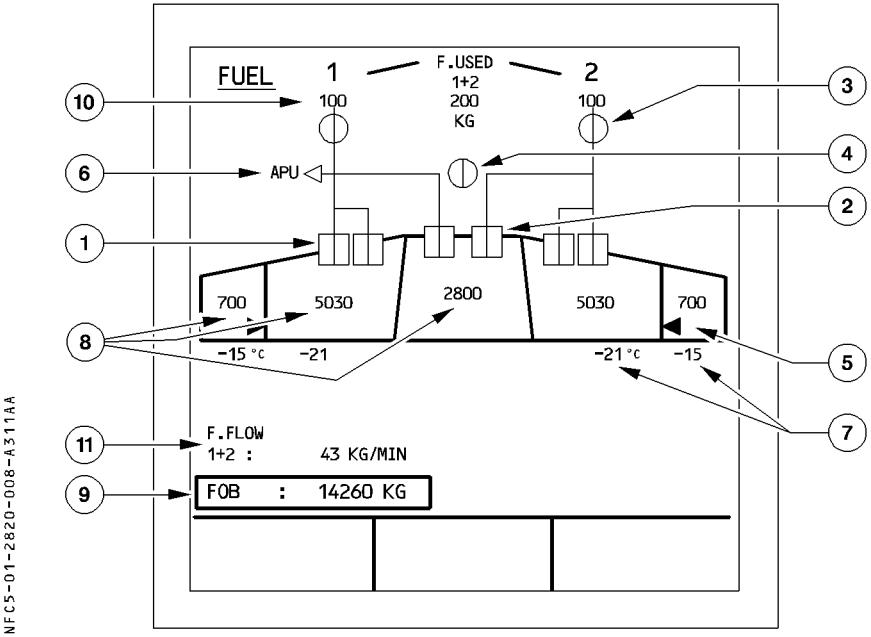
Inline – Green : Pump pressure is normal (pump contactor on).
"LO" – Amber : Pump pressure is low (pump contactor on).
Crossline – Amber : Pump contactor is off.

(2) CTR tank pump indications

Inline – Green : Pump pressure is normal (pump contactor on).
"LO" – Amber : Pump pressure is low (pump contactor on).
Crossline – Green : Pump contactor is off, and auto shut-off is required.
Crossline – Amber : Pump contactor is off, and auto shut-off is not required.

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ECAM FUEL PAGE



(1) Wing pump indications

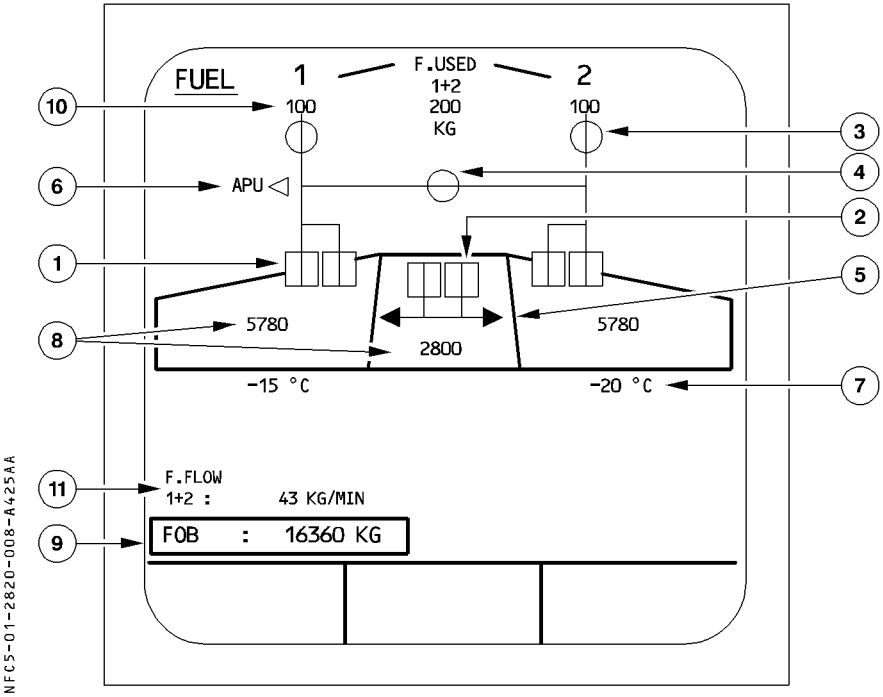
Inline — Green : Pump pressure is normal (pump contactor on).
"LO" — Amber : Pump pressure is low (pump contactor on).
Crossline — Amber : Pump contactor is off.

(2) CTR tank pump indications

Inline — Green : Pump pressure is normal (pump contactor on).
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Crossline — Amber : Pump contactor is off, and auto shut-off is not required.

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ECAM FUEL PAGE



(1) Wing pumps indications

Inline – Green : Pump pressure is normal (pump contactor on).
"LO" – Amber : Pump pressure is low (pump contactor on).
Crossline – Amber : Pump contactor is off.

(2) CTR tanks-valve indications

Inline – Green : Transfer valve is open.
Inline – Amber : Transfer valve is open, whereas commanded closed in automatic or manual mode.
Crossline – Green : Transfer valve is closed.
Crossline – Amber : Transfer valve is closed, whereas commanded open in automatic or manual mode.

(3) LP valve (ENG) indications

Inline — Green : The valve is open.
Inline — Amber : The valve is open, with the ENG MASTER switch OFF.
Crossline — Amber : The ENG valve is fully closed.
Transit — Amber : The valve is in transit.

(4) X feed indications

Inline — Green : The valve is open.
Inline — Amber : The valve is open, with the X Feed pushbutton off.
Crossline — Green : The valve is closed.
Crossline — Amber : The valve is closed with X feed pushbutton ON.
Transit — Amber : The valve is in transit.

(5) Transfer valve indications

Outer to Inner Transfer

NFC5-01-2820-009-A220AA



▷ : The triangle is green, during a transfer to inner.
▶ : The triangle is in solid amber, when the valves are open, while commanded closed.
▷ : The triangle is in amber, when a valve is in transit.

(6) APU indications

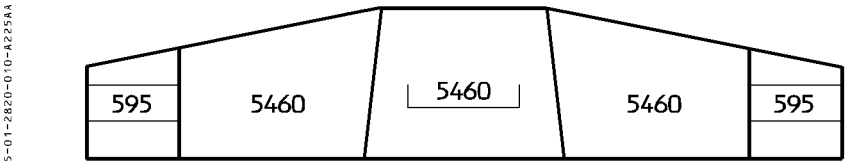
NFC5-01-2820-009-B220AA

APU ◁— : "APU" is in white and the triangle is in green : APU valve is open.
APU ◀— : "APU" and the triangle are in amber : APU valve is open, with APU Fire pushbutton out, or APU MASTER switch OFF.
APU : "APU" is in amber : APU valve is closed and the APU Fire pushbutton is out, or APU MASTER Switch ON.
APU ◁ : "APU" and the triangle are in white, the APU valves is closed.

⑦ Fuel temperature indication

This appears, when its associated temperature sensor is wet. It is normally green.
Advisory only in phases 2 and 6, when fuel temperature is :
· Above 45° C for the inner cell, or 55° C for the outer cell.
· Below – 40° C.
It becomes amber, and the ECAM displays a caution, if the temperature goes above the high limit or below the low limit.

⑧ Fuel quantity indication



NFCS-01-2820-010-A225AA

– It is normally in green.
– An amber line appears across the last two digits, when the FQI is inaccurate (Refer to 3.04.28). The outer indication is boxed amber, if both transfer valves fail to open when the inner is at low level.
– The center tank indication is boxed amber, if both center tank pumps are failed, or are switched OFF.
– Advisory in flight phases 2 and 6, when the difference between the fuel quantities in the two wings is greater than 1500 kg (3300 lb). The wing inner and outer tank indications pulse with the highest fuel level.

⑨ Fuel on Board (FOB) indication

It is normally in green.
An amber line appears across the last two digits when the FQI is inaccurate (Refer to 3.04.28).
The indication is half-boxed in amber, if :
– Center tank pumps fail, or are switched OFF.
– Both transfer valves fail to open, when the inner cell is at low level.

⑩ Fuel Used indication

F.USED 1
3100
– The engine identification number is in amber, when the engine is below idle. It is in white, when it is at, or above, idle.
– The fuel used indication is in green from flight phase 2, until electrical power is cut off at the end of the flight. It is automatically reset, when the engine is started on ground.

(3) LP valve (ENG) indications

Inline — Green : The valve is open.
Inline — Amber : The valve is open with ENG MASTER switch OFF.
Cross line — Amber : The ENG valve is fully closed.
Transit — Amber : The valve is in transit.

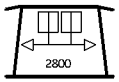
(4) X-feed indications

In line — Green : The valve is open.
In line — Amber : The valve is open with the X-feed pushbutton off.
Cross line — Green : The valve is closed.
Cross line — Amber : The valve is closed with the X-feed pushbutton ON.
Transit — Amber : The valve is in transit.

(5) TRANSFER Valve indications :

Center to inner transfer

NFC5-01-2820-009-A315AA



◁— Displayed in Green, when there is a center to inner tank transfer.

◀— Displayed in amber, when the tranfer valve is open, whereas commanded closed in automatic or manual mode.

(6) APU Indications

NFC5-01-2820-009-B315AA

APU ◁— : APU is in white and the triangle is in green: the APU valve is open.

APU ◀— : APU and solid triangle are in amber : the APU valve is open, with the APU Fire Pushbutton out, or the APU MASTER switch OFF.

APU : APU is in amber : APU valve is closed and APU Fire pushbutton is out / or APU MASTER switch ON.

APU ◁ : APU and triangle are in white : the APU valve is closed.

(7) Fuel temperature indication

- It is normally in green.
- It is advisory in phases 2 and 6 only, if the fuel temperature is above 45° C, or below – 40° C.
- It becomes amber, and the ECAM displays an associated caution, if the temperature goes above the high limit, or below the low limit.

(8) Fuel quantity indication



MFCS-01-2820-010-A3154A

It is normally in green.

- The wing tank indication turns amber, if a wing tank overflows.
- An amber line appears across the last two digits, when the FQI is inaccurate (See 3.04.28).
- The center tank indication is boxed amber, if both transfer valves fail in the closed position.
- It is advisory in phases 2 and 6, when the difference between the fuel quantities in the two wings is greater than 1500 kg (3300 lb). The indication for the wing with the higher fuel level pulses.

(9) Fuel On Board (FOB) indication

It is normally in green.
An amber line appears across the last two digits, when the FQI is inaccurate (Refer to 3.04.28).
It is half boxed amber, when both center tank transfer valves fail in the closed position.

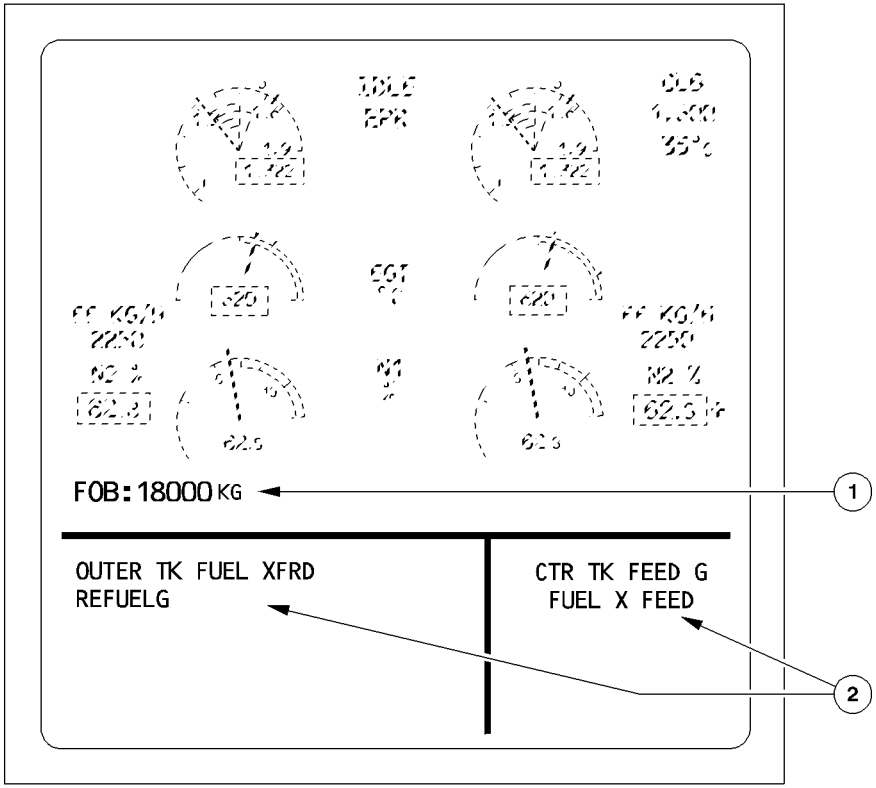
(10) Fuel Used indication

- The engine identification number is in amber, when the engine is below idle. It is in white when it is at, or above, idle.
- The fuel used indication is green from flight phase 2, until electrical power is cut off at the end of the flight. It is automatically reset, when the engine is started on ground.

(11) Fuel Flow indication

The Total Fuel Flow is displayed in kg/mn.
– It is normally in green.
– It is replaced by an amber “XX”, if there is no valid data.

ECAM UPPER DISPLAY

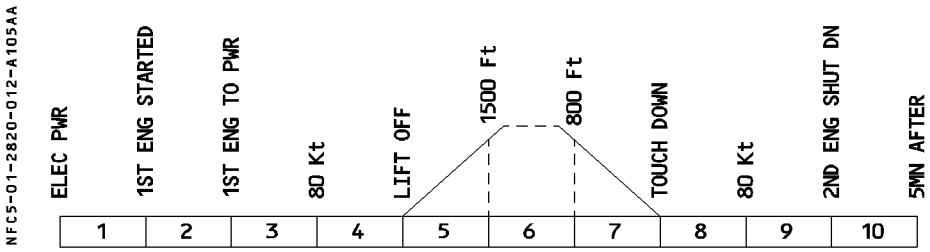


(1) Total fuel indication

A half amber box appears around FOB, when the displayed quantity is not all usable (intercell transfer valve failure, or loss of center tank pumps).
In case of degraded data, the last two significant digits are dashed (refer to 3.04.28).

(2) Memo indications : (green)

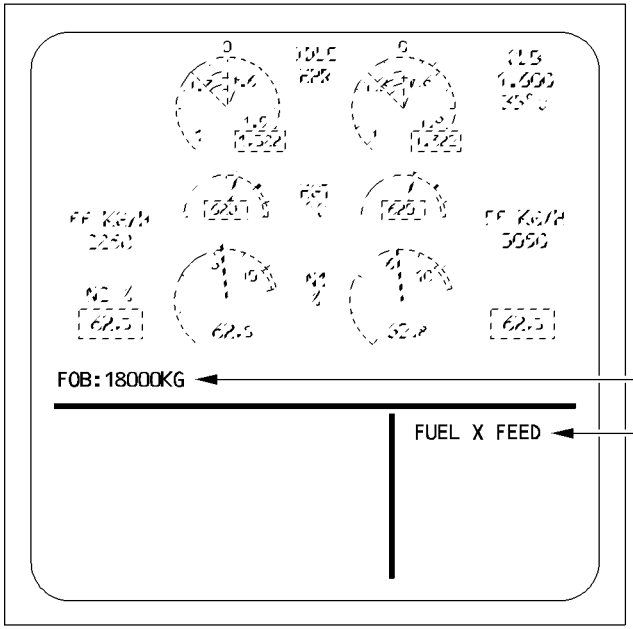
WARNINGS AND CAUTIONS



E / WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
L(R) TK PUMP 1 + 2 LO PR	SINGLE CHIME	MASTER CAUT	FUEL	L(R) TK PUMP 1 + 2 FAULT lt	
CTR TK PUMP 1(2) LO PR				CTR TK PUMP 1(2) FAULT lt	3, 4, 5, 7, 8 *
CTR TK PUMPS LO PR				CTR TK PUMP FAULT lts	
CTR TK PUMPS OFF CTR TK pb at OFF with no FAULT				OFF lt on CTR TK PUMP pb	1, 3, 4, 5, 7, 8, 9, 10
AUTO FEED FAULT (CTR TK > 250 kg (550 lb) and L or R WING TK < 5000 kg (11000 lb) ——————OR—————— (CTR TK pumps do not stop after slat extension or CTR TK low level)				MODE SEL FAULT lts ——— NIL	3, 4, 5, 8
L(R) WING TK LO LVL (750 kg - 1650 lb)				NIL	
L + R WING TK LO LVL Low level detected in both wing inner cells (remaining flight time is about 30 min)					3, 4, 5, 7, 8, 9
L(R) OUTER TK HI TEMP or L(R) INNER TK HI TEMP Fuel temp above : in outer cell above 55° on ground in outer cell above 60° in flight in inner cell above 45° on ground in inner cell above 54° in flight					3, 4, 5, 7, 8
L(R) XFR VALVE CLOSED both transfer valves fail to open after inner cell low level					
ENG 1(2) LP VALVE OPEN valve disagree in open position					4, 5, 7, 8

* inhibited if pump selected OFF

ECAM UPPER DISPLAY



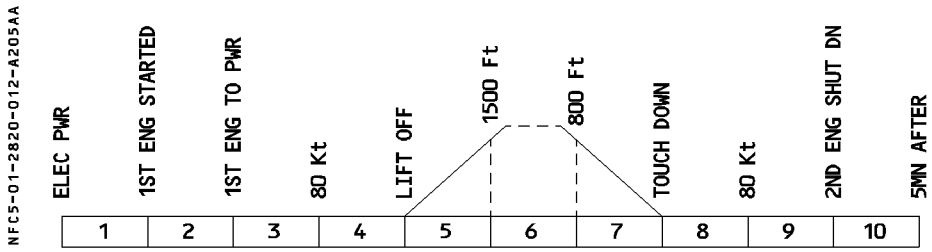
NFC5-01-2820-011-A315AA

(1) Total fuel indication

An half amber box appears around FOB, when the displayed quantity is not all usable (both center tank transfer valves fail in the closed position).
In case of degraded data, the last two significant digits are dashed (Refer to 3.04.28).

(2) Memo indications : (green)

WARNINGS AND CAUTIONS



R

E / WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
L(R) TK PUMP 1 + 2 LO PR	SINGLE CHIME	MASTER CAUT	FUEL	L(R) TK PUMP 1 + 2 FAULT lt	3, 4, 5, 7, 8 *
L(R) XFR VALVE FAULT . valve failed open				L(R)XFR FAULT lt	3, 4, 5, 7, 8
L(R) XFR VALVE FAULT . valves failed closed				MODE SEL FAULT lt	
XFR VALVES FAULT . valves failed open				NIL	4, 5, 7, 8
XFR VALVES FAULT . valves failed closed				MODE SET FAULT lt	
L(R) WING TK OVERFLOW				L(R) CTR TK XFR FAULT lt	3, 4, 5, 7, 8
AUTO TRANSFER FAULT (CTR TK > 250 kg (550 lb) and L or R WING TK < 5000 kg (11000 lb)				MODE SEL FAULT lt	2, 3, 4, 5, 7, 8
CTR TK XFR OFF Both CTR TK XFR pb sw at OFF when in AUTO mode				L(R) CTR TK XFR OFF lt	1,3,4,5, 7,8,9,10
L(R) wing TK LO LVL (750 kg - 1650 lb)				NIL	3, 4, 5, 7, 8, 9
L + R WING TK LO LVL Low level detected in both wing inner cells					
L(R) WING TK HI TEMP Fuel temp above 45° on ground, 54° in flight					3, 4, 5, 7, 8
ENG 1(2) LP VALVE OPEN valve disagree in open position					4, 5, 7, 8

* inhibited if pump selected OFF

R

E / WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
APU LP VALVE FAULT Valve position disagree	NIL	NIL	FUEL	NIL	3, 4, 5, 7, 8 *
L(R) OUTER TK LO TEMP, or L(R) INNER TK LO TEMP Fuel temperature < approx. – 43°C					
L(R) TK PUMP 1(2) LO PR				L(R) TK PUMP 1(2) FAULT lt	
L(R) XFR VALVE OPEN Either transfer valve opens before inner tank reaches low level				NIL	
X FEED VALVE FAULT Valve position disagree					
FQI CH 1 (2) FAULT					

* PUMP LO PR is inhibited, if the pump is selected OFF in phases 1 and 10.

MEMO DISPLAY

– OUTR TK FUEL XFRD appears in green, if at least one transfer valve is open in one wing tank.
– CTR TK FEEDG appears in green, if at least one center tank pump is energized.
– FUEL X FEED appears in green, if the fuel X FEED valve pushbutton is ON, and the X FEED valve is not fully closed. It appears in amber in flight phases 3, 4, or 5.
– REFUELG appears in green, when the door of the refuel control panel on the fuselage is open.

R

E / WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
APU LP VALVE FAULT Valve position disagree	NIL	NIL	FUEL	NIL	3, 4, 5, 7, 8 *
L(R) WING TK LO TEMP Fuel temperature < – 44°C					
L(R) TK PUMP 1(2) LO PR				L(R) TK PUMP 1(2) FAULT lt	
X FEED VALVE FAULT Valve position disagree				NIL	
FQI CH 1 (2) FAULT					

* PUMP LO PR is inhibited, if the pump is selected OFF in phases 1 and 10.

MEMO DISPLAY

- FUEL X FEED appears in green, if the fuel X FEED valve pushbutton is ON, and the X FEED valve is not fully closed. It appears in amber in flight phases 3, 4, or 5.
- REFUELG appears in green, when the door of the refuel control panel on the fuselage is open.
- FOB BELOW 3 T appears in green, when the fuel quantity in either wing is below 1500 kilograms.

BUS EQUIPMENT LIST

R

		NORM		EMER ELEC		
		AC	DC	AC ESS	DC ESS	HOT
FQI	CH 1				SHED	(1)
	CH 2		DC2			(1)
INNER TANK PUMPS	L 1	AC1 (3)	DC1		X (2) (3)	
	L 2	AC2	DC2			
	R 1	AC1 (3)	DC1		X (2) (3)	
	R 2	AC2	DC2			
CTR TK PUMPS (◁)	1	AC1	DC1			
	2	AC 2	DC2			
CROSS FEED VALVE	MOT 1				SHED	
	MOT 2		DC2			
ENGINE LP VALVES	ENG 1 MOT 1				X	
	ENG 1 MOT 2		DC2			
	ENG 2 MOT 1				X	
	ENG 2 MOT 2		DC2			
XFR VALVES	L 1				SHED	
	L 2		DC2			
	R 1				SHED	
	R 2		DC2			
APU	PUMP			AC STAT INV or AC ESS SHED		HOT 1
	LP VALVE		DC BAT			HOT1
REFUEL VALVES			DC2			(1)

(1) HOT BUS supplies power during refueling on battery.
(2) This occurs if DC BUS 1 is lost.
(3) In smoke configuration (GEN 1 LINE pushbutton OFF), inner tank pumps 1 are supplied directly by IDG (instead of AC 1) and pump relays by DC ESS (instead of DC 1).

BUS EQUIPMENT LIST

R

		NORM		EMER ELEC		
		AC	DC	AC ESS	DC ESS	HOT
FQI	CH 1				SHED	(1)
	CH 2		DC2			(1)
WING TANK PUMPS	L 1	AC1 (3)	DC1		X (2) (3)	
	L 2	AC2	DC2			
	R 1	AC1 (3)	DC1		X (2) (3)	
	R 2	AC2	DC2			
CROSS FEED VALVE	MOT 1				SHED	
	MOT 2		DC2			
ENGINE LP VALVES	ENG 1 MOT 1				X	
	ENG 1 MOT 2		DC2			
	ENG 2 MOT 1				X	
	ENG 2 MOT 2		DC2			
CTR TK XFR VALVES			DC1 DC2			
APU	PUMP			AC STAT INV or AC ESS SHED		HOT 1
	LP VALVE		DC BAT			HOT1
REFUEL VALVES			DC2			(1)

(1) HOT BUS supplies power during refueling on battery.
(2) This occurs if DC BUS 1 is lost.
(3) In smoke configuration (GEN 1 LINE pushbutton OFF), wing tank pumps 1 are supplied directly by IDG (instead of AC 1) and pump relays by DC ESS (instead of DC 1).

29.00 CONTENTS

29.10 DESCRIPTION
– GENERAL 1
– GENERATION 1
– DISTRIBUTION 6

29.20 CONTROLS AND INDICATORS
– OVERHEAD PANEL 1
– MAINTENANCE PANEL 3
– ECAM HYD PAGE 4
– WARNINGS AND CAUTIONS 7
– MEMO DISPLAY 8

29.30 ELECTRICAL SUPPLY

GENERAL

The aircraft has three continuously operating hydraulic systems : blue, green, and yellow. Each system has its own hydraulic reservoir. Normal system operating pressure is 3000 PSI (2500 PSI when powered by the RAT). Hydraulic fluid cannot be transferred from one system to another.

GENERATION

GREEN SYSTEM PUMP

A pump driven by engine 1 pressurizes the green system.

BLUE SYSTEM PUMPS

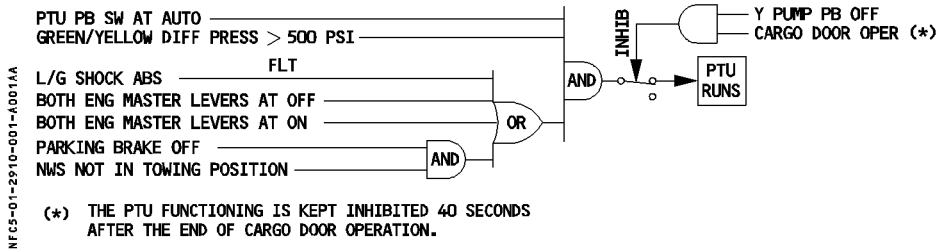
An electric pump pressurizes the blue system. A pump driven by a ram air turbine (RAT) pressurizes this system in an emergency.

YELLOW SYSTEM PUMPS

A pump driven by engine 2 pressurizes the yellow system.
An electric pump can also pressurize the yellow system, which allows yellow hydraulics to be used on the ground when the engines are stopped.
Crew members can also use a hand pump to pressurize the yellow system in order to operate the cargo doors when no electrical power is available.

POWER TRANSFER UNIT (PTU)

A bidirectional power transfer unit enables the yellow system to pressurize the green system and vice versa.
The power transfer unit comes into action automatically when the differential pressure between the green and the yellow systems is greater than 500 PSI.
The PTU therefore allows the green system to be pressurized on the ground when the engines are stopped.



RAM AIR TURBINE (RAT)

A drop-out RAT coupled to a hydraulic pump allows the blue system to function if electrical power is lost or both engines fail. The RAT deploys automatically if AC BUS 1 and AC BUS 2 are both lost. It can be deployed manually from the overhead panel. It can be stowed only when the aircraft is on the ground.

SYSTEM ACCUMULATORS

An accumulator in each system helps to maintain a constant pressure by covering transient demands during normal operation.

PRIORITY VALVES

Priority valves cut off hydraulic power to heavy load users if hydraulic pressure in a system gets low.

FIRE SHUTOFF VALVES

Each of the green and yellow systems has a fire shutoff valve in its line upstream of its engine-driven pump. The flight crew can close it by pushing the ENG 1(2) FIRE pushbutton.

LEAK MEASUREMENT VALVES

Each system has a leak measurement valve upstream of the primary flight controls. These valves, which measure the leakage in each circuit, are closed by operation of the LEAK MEASUREMENT VALVES pushbutton switch on the maintenance panel.

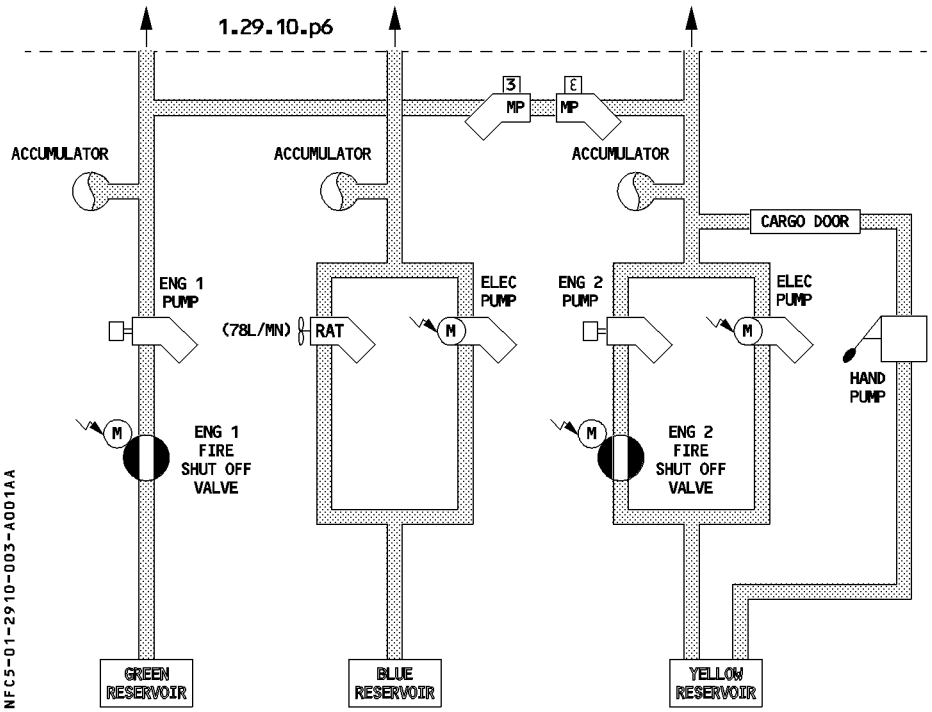
FILTERS

FOR INFO

Filters clean the hydraulic fluid as follows :

- *HP filters on each system and on the reservoir filling system and the normal braking system*
- *return line filters on each line*
- *case drain filters on engine pumps and the blue electric pump (which permit maintenance to monitor engine wear by inspecting the filters for the presence of metallic particles).*

GENERATION

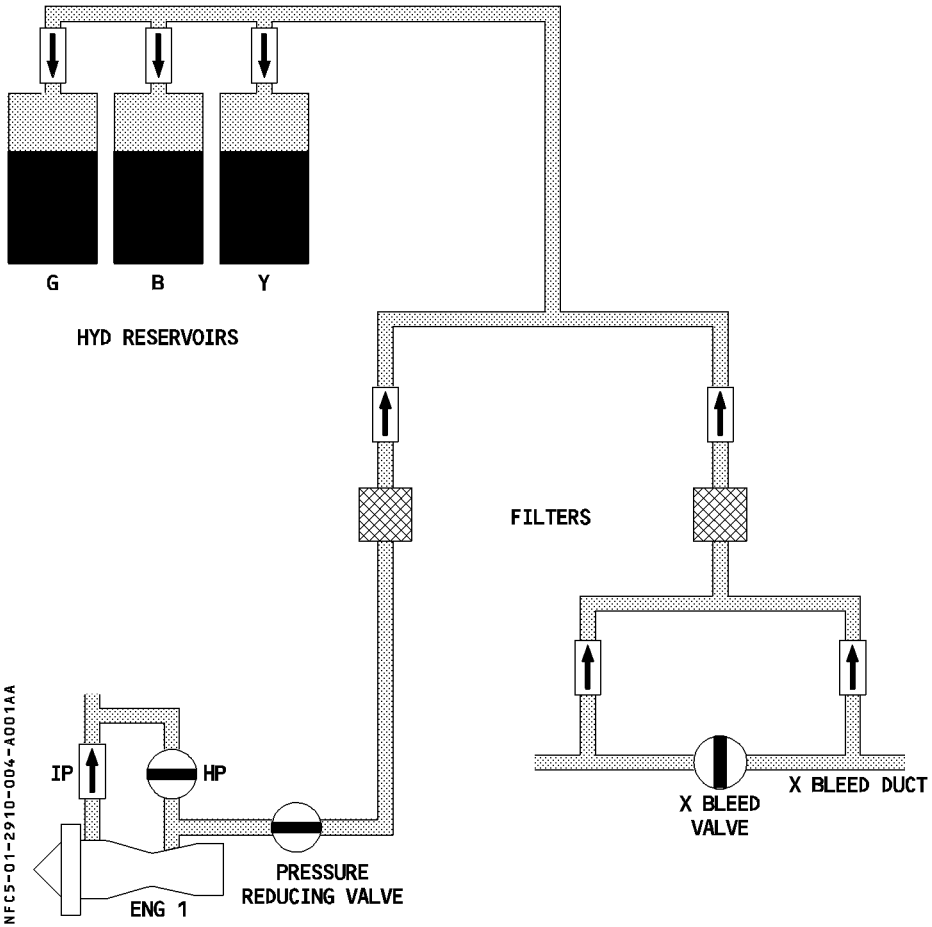

1.29.10.p6
3
MP
MP
ACCUMULATOR
ACCUMULATOR
ACCUMULATOR
CARGO DOOR
ENG 1
PUMP
(78L/MN)
RAT
ELEC
PUMP
ENG 2
PUMP
ELEC
PUMP
HAND
PUMP
M
ENG 1
FIRE
SHUT OFF
VALVE
ENG 2
FIRE
SHUT OFF
VALVE
GREEN
RESERVOIR
BLUE
RESERVOIR
YELLOW
RESERVOIR
NFCS-01-2910-003-A001AA

RESERVOIR PRESSURIZATION

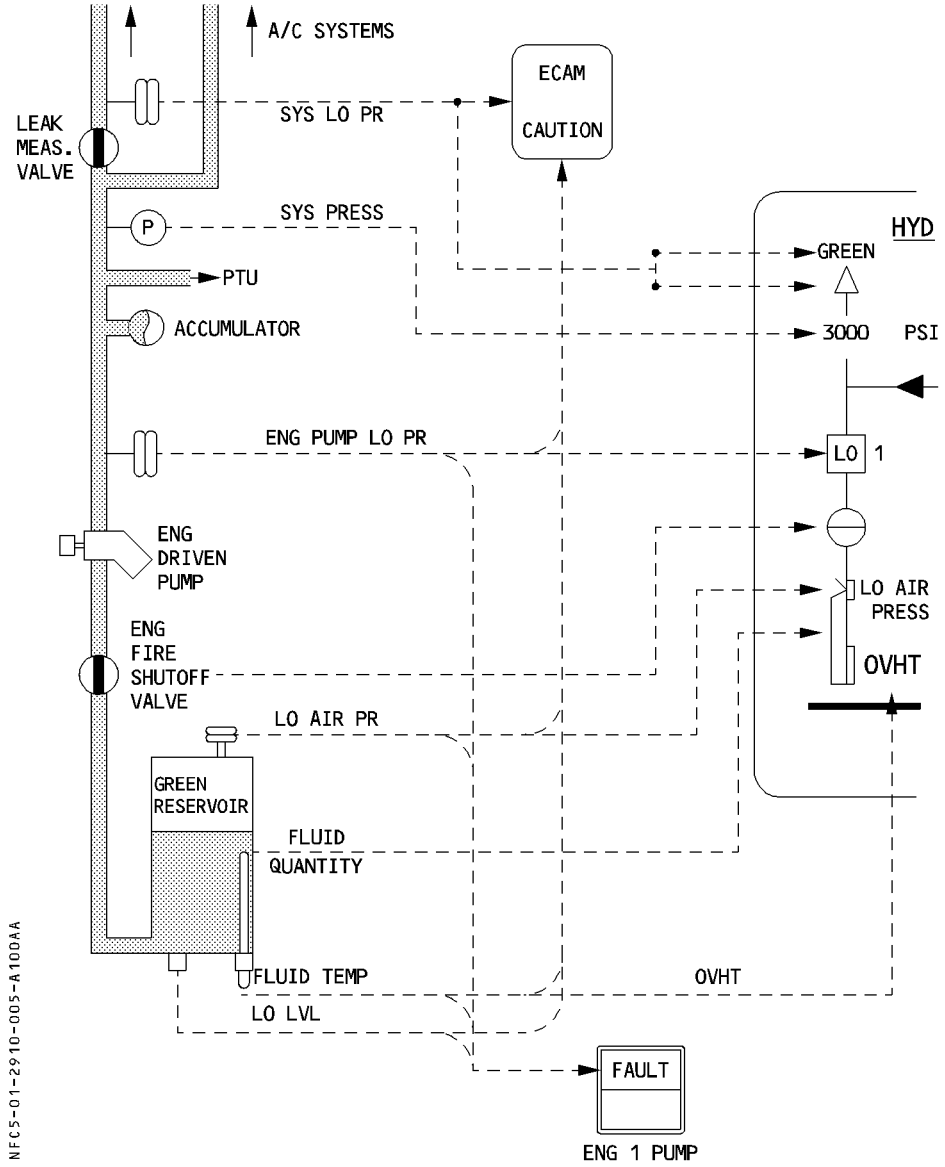
Normally, HP bleed air from engine 1 pressurizes the hydraulic reservoirs automatically. If the bleed air pressure is too low, the system takes bleed air pressure from the crossbleed duct.

The systems maintain a high enough pressure to prevent their pumps from cavitating.

FOR INFO

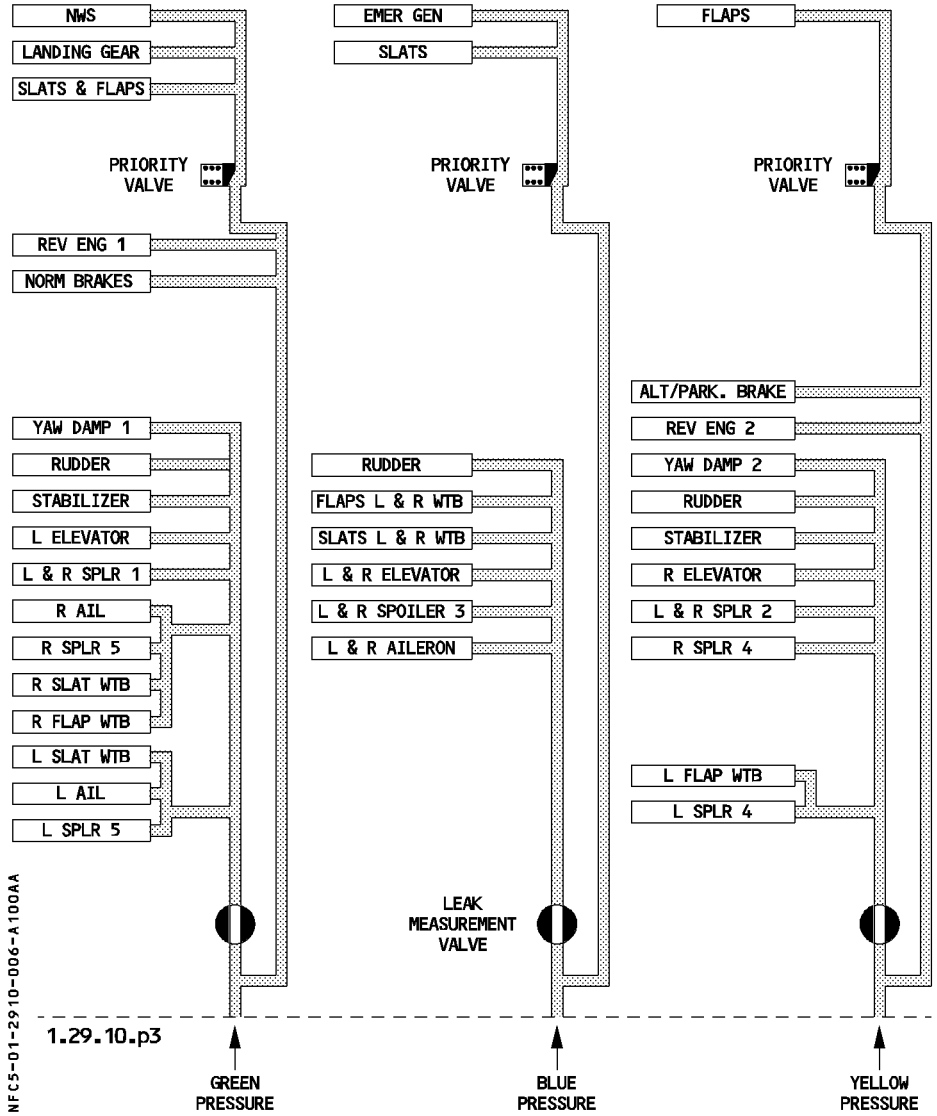


INDICATIONS

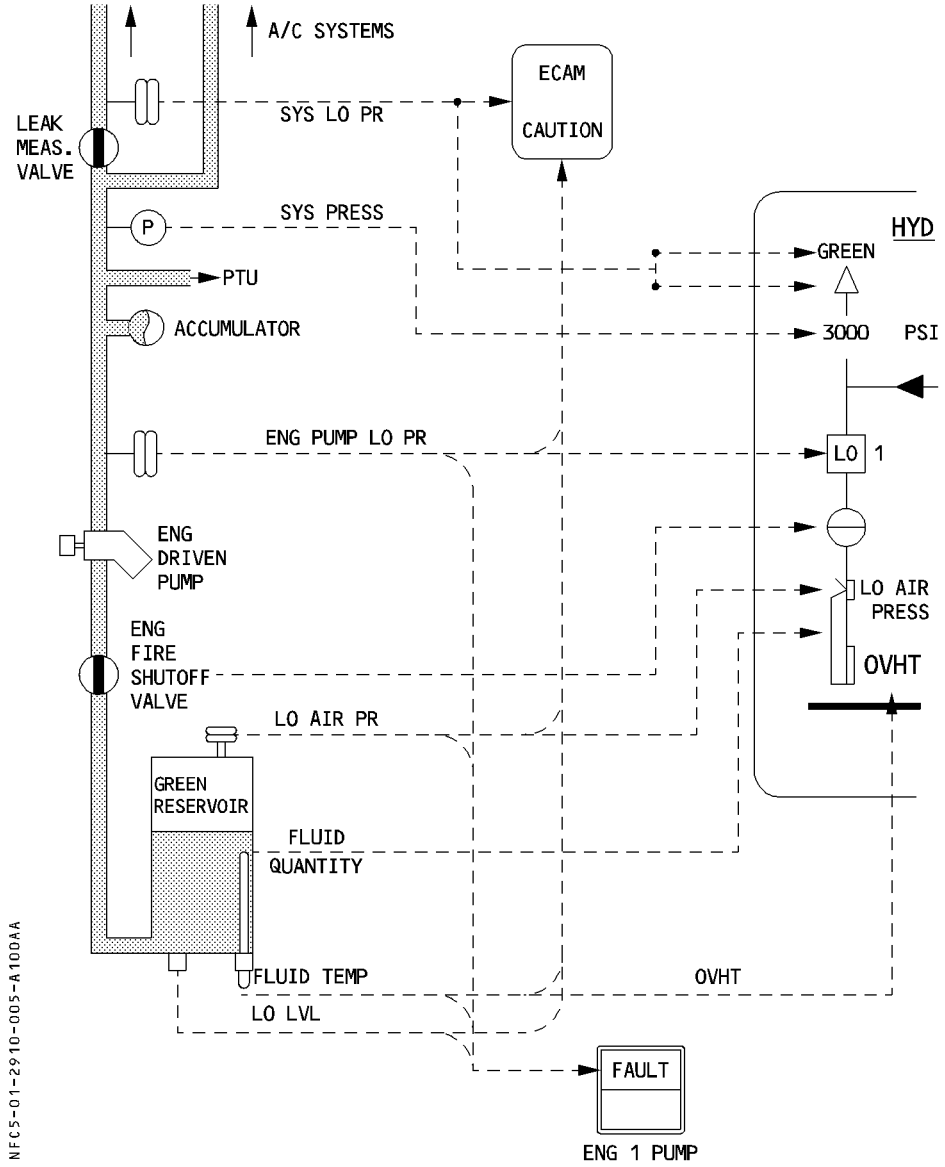


NFCS-01-2910-005-A100AA

DISTRIBUTION

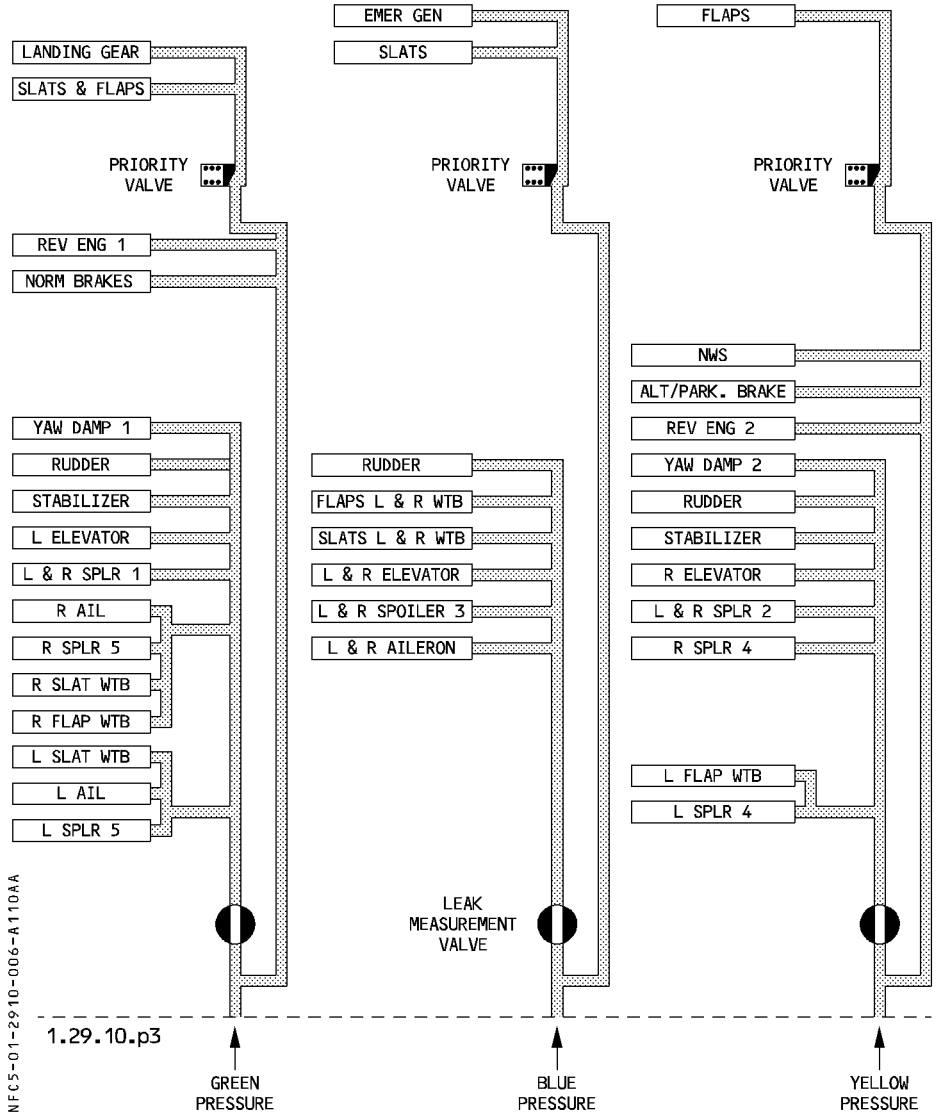


INDICATIONS



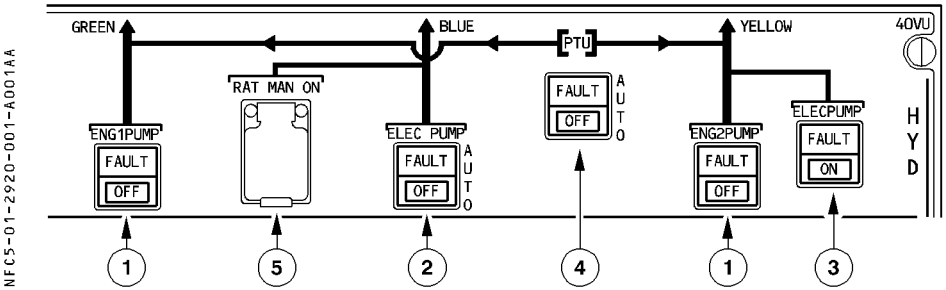
NFCS-01-2910-005-A100AA

DISTRIBUTION



R

OVERHEAD PANEL



(1) ENG 1 (2) PUMP pb

On : The pump pressurizes the system when the engine is running.
OFF : The pump is depressurized. The generation of hydraulic power stops.
FAULT lt : This amber light comes on, and the ECAM caution appears, if :
- The reservoir level is low
- The reservoir overheats
- The reservoir air pressure is low
- The pump pressure is low (inhibited on the ground, when the engine is stopped).

This light goes out, when the crew selects OFF, except during an overheat. (The light stays on as long as the overheat lasts).

(2) BLUE ELEC PUMP pb

AUTO : If AC power is available, the electric pump operates :
- In flight
- On the ground, if one engine is running or if the crew has pressed the BLUE PUMP OVRD pushbutton on the maintenance panel.

OFF : The pump is de-energized.
FAULT lt : This amber light comes on, and a caution appears on the ECAM, if :
- The reservoir level is low
- The reservoir overheats
- The air pressure in the reservoir is low
- The pump is delivering low pressure (inhibited on the ground, when the engines are stopped)
- The pump overheats.

The light goes out, when the crew selects OFF, except during an overheat. (The light stays on as long as the overheat lasts).

(3) YELLOW ELEC PUMP pb sw (springloaded)

ON : The electric pump is ON.
If the electrical power supply is removed, the pump will remain off when electrical power is applied again.

Off : The pump is off.
It comes on automatically when a crewman sets the lever of the cargo door manual selector valve to OPEN or CLOSE.
This inhibits the operation of other yellow system functions (except alternate braking and engine 2 reverse).

FAULT lt : This amber light, accompanied by an ECAM caution, comes on if :
- the reservoir level is low
- air pressure in the reservoir is low
- the reservoir overheats
- pump pressure is low
- the pump overheats.

The light goes out when the crew selects OFF, except during an overheat. (The light stays on as long as the overheat lasts).

(4) PTU pb sw

AUTO : The bidirectional power transfer unit is armed and both the yellow and the green electrohydraulic valves are open.
The power transfer unit runs automatically when the differential pressure between the green and yellow systems is more than 500 PSI.

Note : The PTU is inhibited during the first engine start and automatically tested during the second engine start.

OFF : Both the green and the yellow PTU electrohydraulic valves close. Power transfer stops.

FAULT lt : This amber light comes on, and a caution appears on the ECAM, if :
- the green or the yellow reservoir overheats
- the green or the yellow reservoir has low air pressure
- the green or the yellow reservoir has a low flluid level.

The light goes out when the crew selects OFF, except during an overheat. (The light stays on as long as the overheat lasts).

(5) RAT MAN ON pb

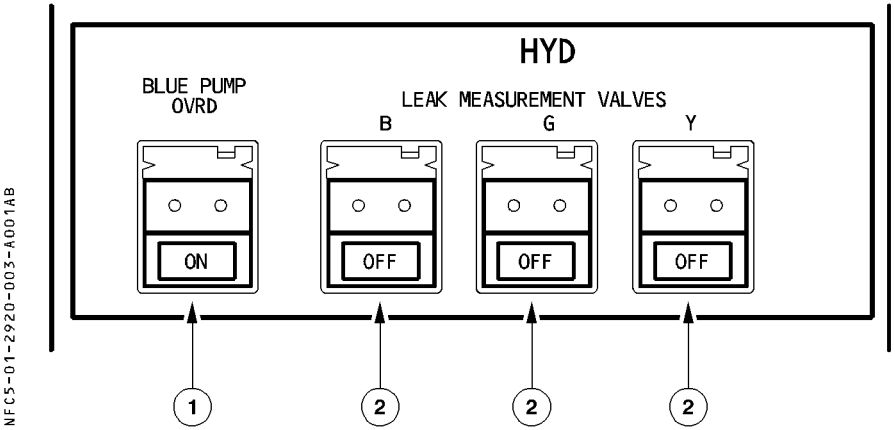
The flight crew may extend the RAT at any time by pressing the RAT MAN ON pushbutton.

Note : The RAT extends automatically if AC BUS 1 and AC BUS 2 are lost. (refer to 1.24.20).

R

R

MAINTENANCE PANEL



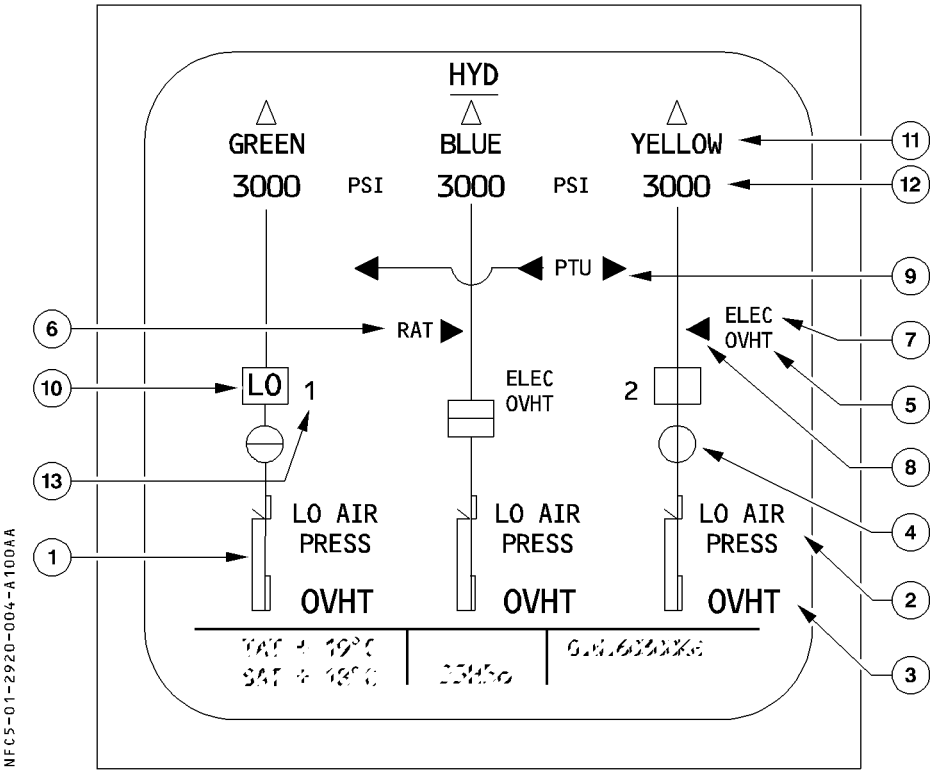
(1) BLUE PUMP OVRD pb sw (springloaded)

ON : The blue electric pump is on if the ELEC PUMP pushbutton switch on the HYD panel is at AUTO.
Off : The blue electric pump is off.

(2) LEAK MEASUREMENT VALVES pb sw

OFF : The corresponding electrohydraulic valve closes and shuts off hydraulic supply to the primary flight controls.
On : The corresponding electrohydraulic valve opens to go back to normal hydraulic supply.

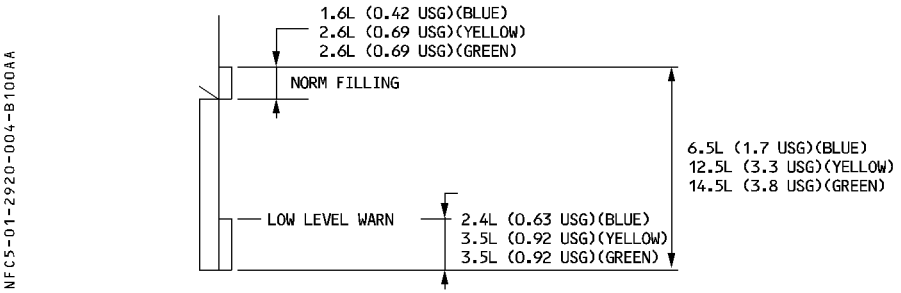
ECAM HYD PAGE



(1) Reservoir quantity

It is in green, unless the fluid level goes below the warning level, in which case it becomes amber.

FOR INFO



(2) Reservoir LO AIR PRESS

This appears in amber, and a caution appears on ECAM, if the air pressure for the indicated reservoir drops below normal.

(3) Reservoir OVHT

This appears in amber, and a caution appears on ECAM, if the temperature of returning hydraulic fluid temperature at the inlet to its reservoir is above normal.

(4) FIRE VALVE

Cross line Amber : The valve is fully closed.
In line Green : The valve is not fully closed.

(5) OVHT

This appears in amber if the electric pump for that system (blue or yellow) overheats.

(6) RAT

RAT ▷ : white	The RAT is stowed.
RAT ▶– : Green	The RAT is not stowed.
RAT ▶ : Amber	Pressure for stowing the RAT has been applied, or the RAT pump is not available.

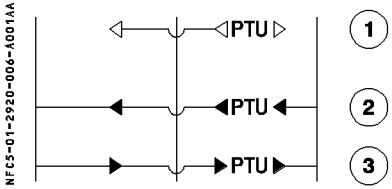
(7) ELEC

This legend, normally white, becomes amber if the associated power supply fails.

(8) YELLOW ELEC PUMP control

◁ : White	The electric pump is off.
–◀ : Green	The electric pump is ON.
◀ : Amber	The electric pump is ON and the yellow system has low pressure.

(9) PTU control



(1) Green : The power transfer unit (PTU) pushbutton switch is in AUTO and the PTU is not transferring pressure.
Amber : The PTU pushbutton switch is OFF.

(2) Green : The PTU is supplying the green hydraulic system.

(3) Green : The PTU is supplying the yellow hydraulic system.

(10) ENG PUMP control and low pressure indication

In line (Green) : The pushbutton switch for the designated PUMP is on and hydraulic pressure is normal.
Cross line (Amber) : The pushbutton switch for the designated PUMP is OFF.
"LO" (Amber) The pushbutton switch for the designated PUMP is on and hydraulic pressure is low.

(11) System label

	pressure > 1450 psi	pressure < 1450 psi
YELLOW	white	amber
△	green	amber

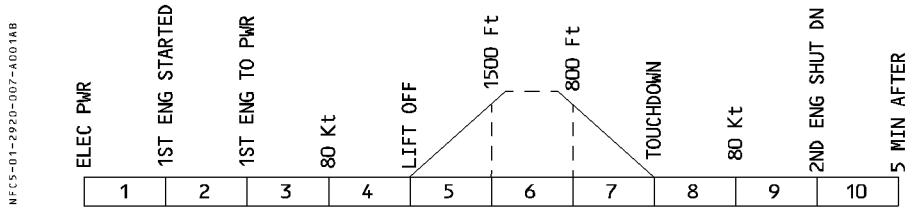
(12) System pressure

This legend, normally green, becomes amber when system pressure is below 1450 psi.

(13) PUMP

This legend, normally white, becomes amber when N2 is below idle.

WARNINGS AND CAUTIONS



R

E / WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
B + Y B + G SYS LO PR Y + G system pressure ≤ 1450 psi (reset if pressure ≥ 1750 psi)	CRC	MASTER WARN	HYD	FAULT lt	4, 5 *
G (Y)(B) RSVR LO AIR PR reservoir air pressure ≤ 22 psi (reset if air pressure ≥ 25 psi)	SINGLE CHIME	MASTER CAUT		FAULT lt on associated pump(s) pb and on PTU pb if Y or G sys affected	3, 4, 5, 7, 8
G (Y)(B) RSVR OVHT fluid temperature ≥ 93°C (reset if temp ≤ 88°C)					
G (Y)(B) RSVR LO LVL fluid quantity : < 3.5 L (0.92 USG) (green-yellow) < 2.4 L (0.63 USG) (blue)					4, 5, 7, 8
G (Y) ENG 1(2) PUMP LO PR pump outlet pressure ≤ 1750 psi (reset if pressure ≥ 2200 psi)				FAULT lt on affected pump pb	
Y ELEC PUMP LO PR yellow system pressure ≤ 1450 psi (reset if pressure ≥ 1750 psi) with - Y ELEC PUMP pb at ON - Y ENG PUMP and PTU not available					
B ELEC PUMP LO PR pump outlet pressure ≤ 1450 psi (reset if pressure ≥ 1750 psi)					
B ELEC PUMP OVHT Y ELEC PUMP OVHT					3, 4, 5, 7, 8
G (Y) SYS LO PR pump outlet pressure ≤ 1450 psi (reset if pressure ≥ 1750 psi)					4, 5, 7, 8*
B SYS LO PR system pressure ≤ 1450 psi (reset if pressure ≥ 1750 psi)				NIL	1, 4, 5, 7, 8, 10

R

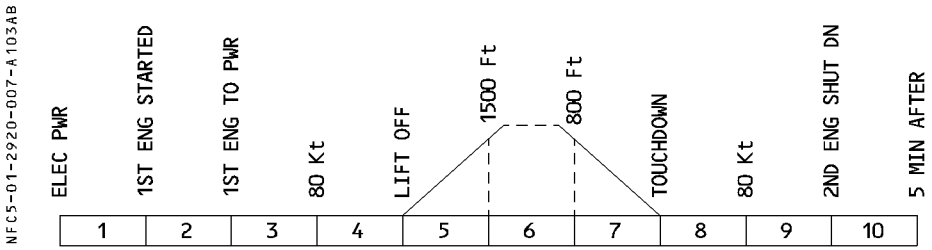
E / WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
PTU FAULT PTU not running on ground in case differential pressure higher than 650 psi between G and Y system, or in flight PTU still at AUTO position in case of G or Y reservoir low level and G or Y system low pressure.	SINGLE CHIME	MASTER CAUT	HYD	FAULT lt only in case of G or Y RSVR LO LVL or RSVR LO AIR PR or RSVR OVHT	3, 4, 5, 8, 9, 10
RAT FAULT RAT not fully stowed or pressure present in RAT stowing actuator or RAT pump not available				NIL	3, 4, 5, 6, 7, 8, 9

* Inhibited on the ground (flight phases 1, 2, 9, 10) when corresponding engine is shut down.

MEMO DISPLAY

– "RAT OUT" appears green, if the ram air turbine is not fully stowed. The color changes to amber during flight phases 1 and 2.
– "HYD PTU" appears green, when the power transfer unit is running.

WARNINGS AND CAUTIONS



R

E / WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
B + Y B + G SYS LO PR Y + G system pressure ≤ 1450 psi reset if pressure ≥ 1750 psi	CRC	MASTER WARN	HYD	FAULT lt	4, 5 *
G (Y) RSVR LO AIR PR reservoir air pressure ≤ 22 psi reset if air pressure ≥ 25 psi	SINGLE CHIME	MASTER CAUT		FAULT lt on associated pump(s) pb and on PTU pb if Y or G sys affected	3, 4, 5, 7, 8
B RSVR LO AIR PR reservoir air pressure ≤ 30 psi (detected in flight but only displayed on ground after landing)					1, 2, 3, 4, 5, 6, 7
B RSVR LO AIR PR reservoir air pressure ≤ 22 psi reset if pressure ≥ 25 psi					3, 4, 5, 7, 8
G (Y)(B) RSVR OVHT fluid temperature ≥ 93°C reset if temp ≤ 88°C					
G (Y)(B) RSVR LO LVL fluid quantity : < 3.5 L (0.92 USG) (green-yellow) < 2.4 L (0.63 USG) (blue)					
G (Y) ENG 1(2) PUMP LO PR pump outlet pressure ≤ 1750 psi reset if pressure ≥ 2200 psi				FAULT lt on affected pump pb	4, 5, 7, 8
Y ELEC PUMP LO PR yellow system pressure ≤ 1450 psi (reset if pressure ≥ 1750 psi) with - Y ELEC PUMP pb at ON - Y ENG PUMP and PTU not available					
B ELEC PUMP LO PR pump outlet pressure ≤ 1450 psi reset if pressure ≥ 1750 psi					
B ELEC PUMP OVHT Y ELEC PUMP OVHT					3, 4, 5, 7, 8
G (Y) SYS LO PR system pressure ≤ 1450 psi reset if pressure ≥ 1750 psi				NIL	4, 5, 7, 8 *
B SYS LO PR system pressure ≤ 1450 psi reset if pressure ≥ 1750 psi					1, 4, 5, 7, 8, 10

R

E / WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
PTU FAULT PTU not running on ground in case differential pressure higher than 650 psi between G and Y system, or in flight PTU still at AUTO position in case of G or Y reservoir low level and G or Y system low pressure.	SINGLE CHIME	MASTER CAUT	HYD	FAULT lt only in case of G or Y RSVR LO LVL or RSVR LO AIR PR or RSVR OVHT	3, 4, 5, 8, 9, 10
RAT FAULT RAT not fully stowed or pressure present in RAT stowing actuator or RAT pump not available				NIL	3, 4, 5, 6, 7, 8, 9

* Inhibited on the ground (flight phases 1, 2, 9, 10) when corresponding engine is shut down.

MEMO DISPLAY

– "RAT OUT" appears green, if the ram air turbine is not fully stowed. The color changes to amber during flight phases 1 and 2.
– "HYD PTU" appears green, when the power transfer unit is running.

BUS EQUIPMENT LIST

R

		NORM		EMER ELEC		
		AC	DC	AC ESS	DC ESS	HOT
ENG 1 driven PUMP control			DC1			
ENG 2 driven PUMP control			DC2			
ENG 1 FIRE shut off valve					X	
ENG 2 FIRE shut off valve					X	
BLUE ELEC PUMP	power	AC1				
	control				X	
Yellow ELEC PUMP	power	AC2 *				
	control		DC2			
Power Transfer Unit			DC2			
LEAK MEASUREMENT VALVES			DC GRND/FLT			
RAT	Manual control					HOT 2
	Auto control					HOT 1

* or from external power.

30.00 CONTENTS

30.10 GENERAL
– DESCRIPTION 1

30.20 WING ANTI-ICE
– DESCRIPTION 1
– CONTROLS AND INDICATORS 2
– WARNINGS AND CAUTIONS 3

30.30 ENGINE ANTI-ICE
– DESCRIPTION 1
– CONTROLS AND INDICATORS 2
– WARNINGS AND CAUTIONS 3

30.40 WINDOW HEAT
– DESCRIPTION 1
– CONTROLS AND INDICATORS 2
– WARNINGS AND CAUTIONS 2

30.50 PROBE HEAT
– DESCRIPTION 1
– CONTROLS AND INDICATORS 2
R – WARNINGS AND CAUTIONS 3

30.60 RAIN REMOVAL
– DESCRIPTION 1
– CONTROLS AND INDICATORS 2

30.70 ICE DETECTION
– DESCRIPTION 1
– WARNINGS AND CAUTIONS ◁ 1

30.80 ELECTRICAL SUPPLY

DESCRIPTION

The ice and rain protection system allows unrestricted operation of the aircraft in icing conditions and heavy rain.

ANTI-ICING

Either hot air or electrical heating protects critical areas of the aircraft as follows.

HOT AIR

- three outboard leading-edge slats of each wing.
- engine air intakes.

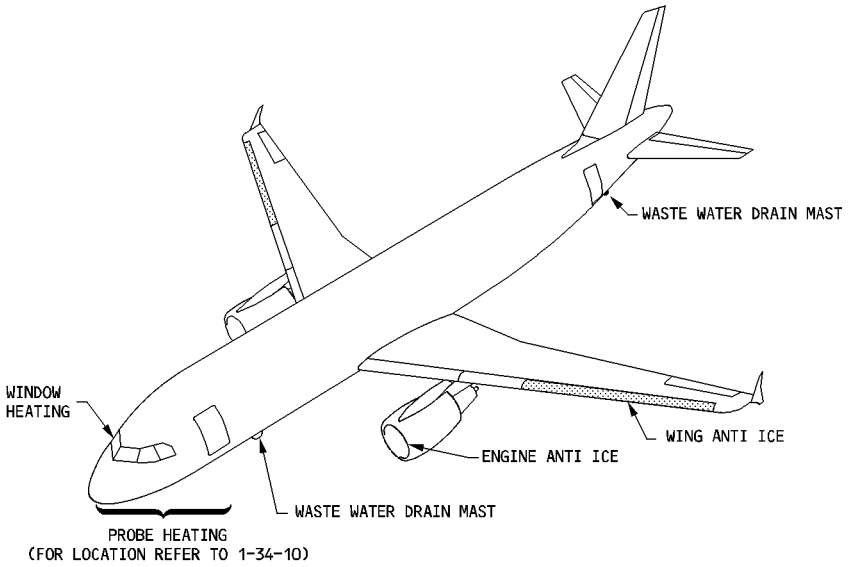
ELECTRICAL HEATING

- flight compartment windows.
- sensors, pitot probes and static ports.
- waste-water drain mast.

RAIN REMOVAL

Wipers and when necessary, fluid rain repellent, remove rain from the front windshield panels.

R



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DESCRIPTION

In flight, hot air from the pneumatic system heats the three outboard slats (3-4-5) of each wing.

Air is supplied through one valve in each wing.

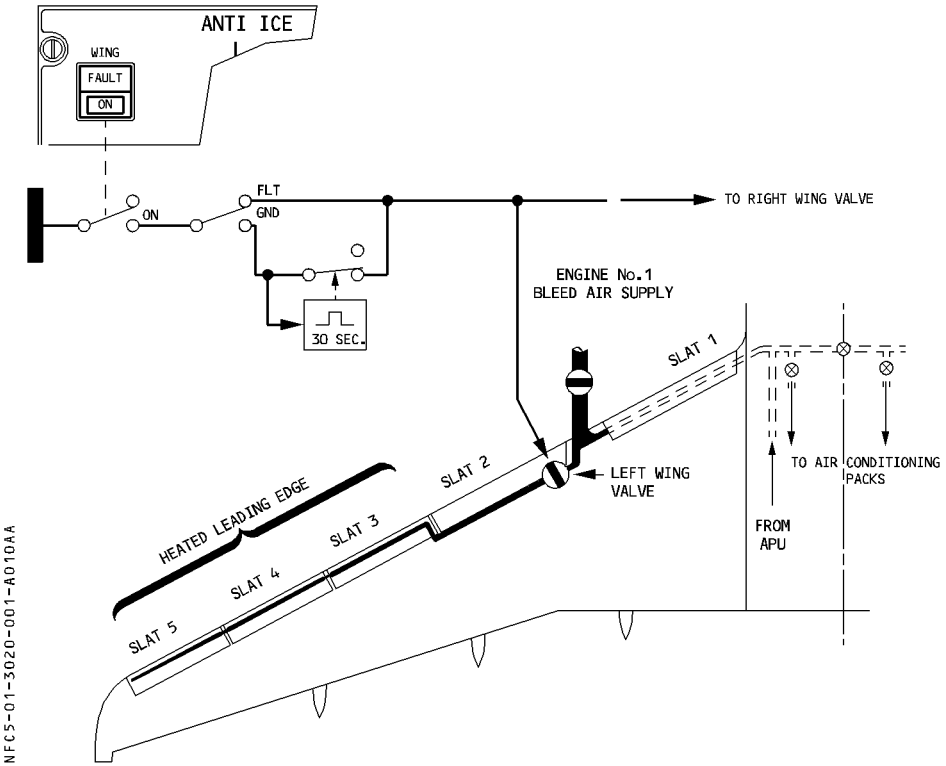
The WING pushbutton on the ANTI-ICE panel controls the valves.

When the aircraft is on ground, the flight crew can initiate a 30-second test sequence by turning the system ON.

If the system detects a leak during normal operation, the affected side's wing anti-ice valve automatically closes (see 1.36.10).

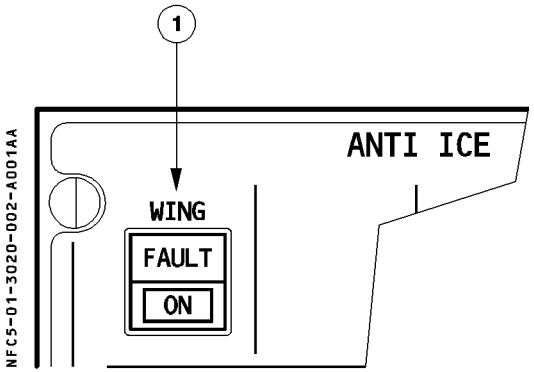
R When wing anti-ice is selected, the N1 limit is automatically reduced, and the idle N1 is
R automatically increased.

If the electrical power supply fails, the valves close.



CONTROLS AND INDICATORS

OVERHEAD PANEL



(1) WING ANTI ICE pb sw

R This switch controls the wing anti ice system on the left and right sides simultaneously.

ON : It lights up blue.
WING A. ICE appears on the ECAM MEMO page.

R Wing anti ice control valves open if a pneumatic supply is available.
On the ground the wing anti-icing control valves open for 30 seconds only (test sequence).

Off : ON light goes off.
Wing anti-icing control valves close.

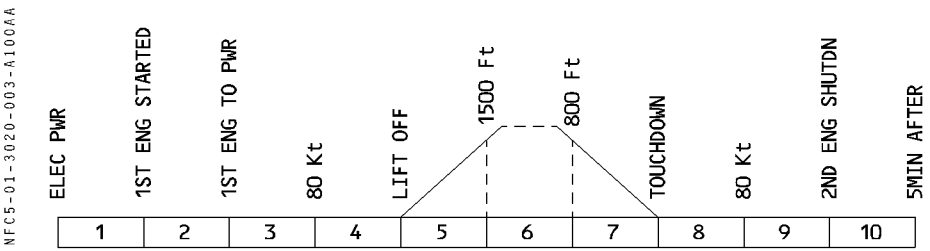
FAULT : Amber light comes on, and caution appears on ECAM, if :
— the position of the anti-icing control valve is not the required position, or
— low pressure is detected.

Note : The amber FAULT light comes on briefly as the valves transit.

ECAM BLEED PAGE

See 1.36.20.

WARNINGS AND CAUTIONS



E / WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
WING A. ICE OPEN ON GND On ground, valves remain open more than 35 seconds after wing anti-ice is selected ON.	SINGLE CHIME	MASTER CAUT	BLEED	NIL	3, 4, 5, 6, 7, 8
SYS FAULT Valve not open when wing anti-ice selected ON.				ANTI ICE WING FAULT lt	3, 4, 5, 7, 8
L (R) VALVE OPEN Valve not closed when wing anti-ice selected off					4, 5, 7, 8
HI PR High pressure detected when the wing anti-ice is selected ON.	NIL	NIL		NIL	3, 4, 5, 7, 8

MEMO DISPLAY

The "WING A. ICE" message is displayed in green, if the WING ANTI ICE pushbutton is ON.
The "ICE NOT DET" message is displayed in green, if ice is no longer detected after 190 seconds.

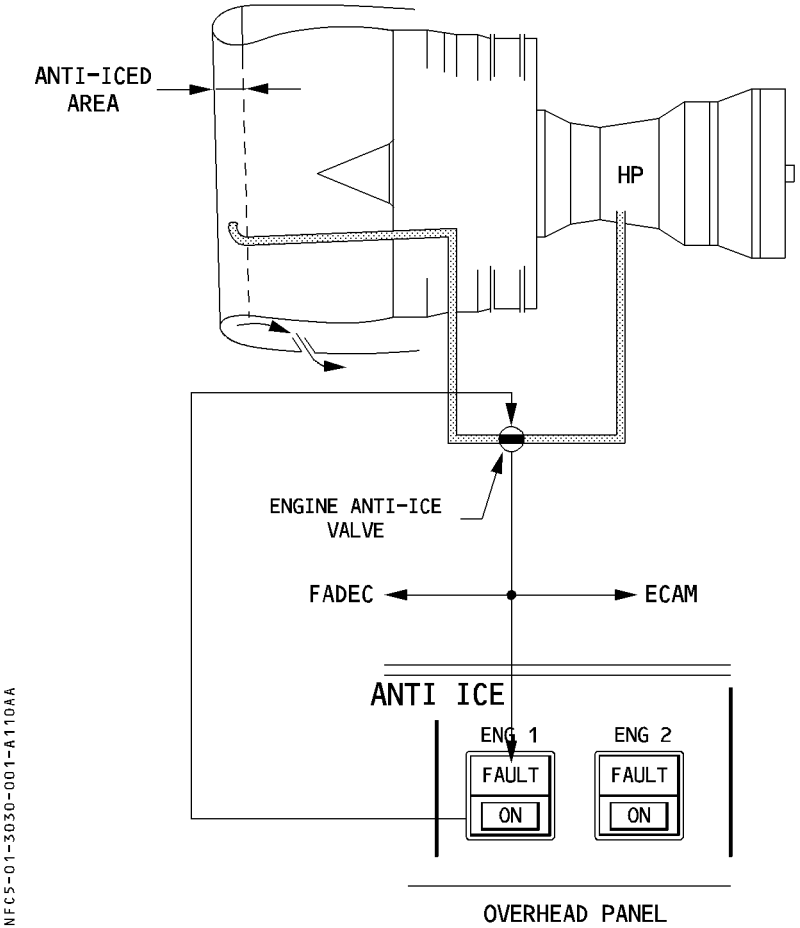
DESCRIPTION

An independent air bleed from the high pressure compressor protects each engine nacelle from ice. Air is supplied through a two-position (open and closed) valve that the flight crew controls with two pushbuttons, one for each engine.

The valve automatically closes, if air is unavailable (engine not running).

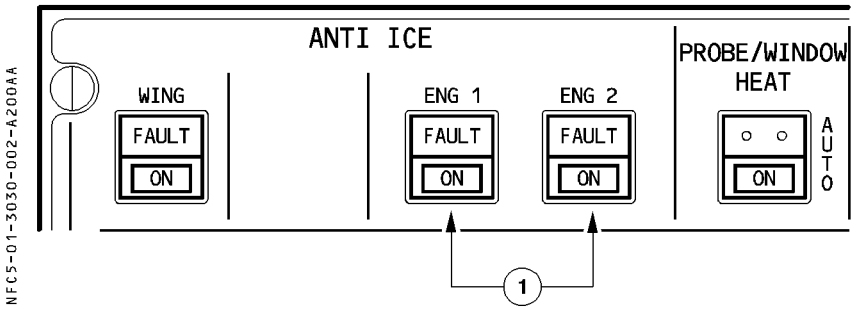
R When an engine anti-ice valve is open, the N1 limit is automatically reduced and, if necessary, the idle N1 is automatically increased for both engines in order to provide the required pressure.

If electrical power fails, the valves open.



CONTROLS AND INDICATORS

OVERHEAD PANEL



(1) ENG 1 (2) pushbutton

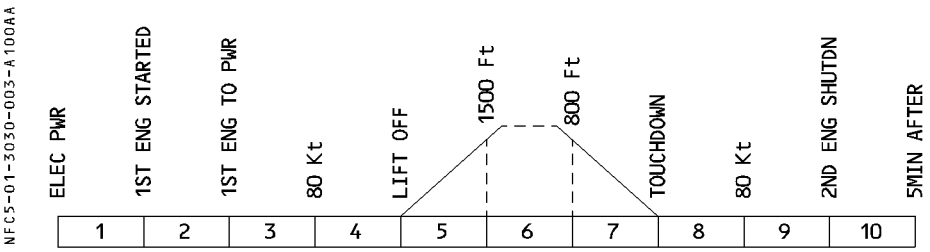
ON : The ON light comes on blue.
The ECAM MEMO displays "ENG A. ICE".
The engine anti-ice valve opens, if bleed air is available from the engine.

Off : The ON light goes off.
The engine anti-ice valve closes.

FAULT : Comes on amber, along with an associated ECAM caution, if the position of the anti-icing valve disagrees with the ENG 1 (2) pushbutton selection.

Note : The amber FAULT light comes on briefly, while the valve transits.

WARNINGS AND CAUTIONS



E / WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
ENG 1(2) VALVE OPEN Valve disagree in the open position.	SINGLE CHIME	MASTER CAUT	NIL	ENG 1 (2) ANTI ICE FAULT lt	3, 4, 5, 7, 8
ENG 1(2) VALVE CLSD Valve disagree in the closed position.					

MEMO DISPLAY

This display shows "ENG A. ICE" in green, if one or both ENG A. ICE pushbuttons are ON. The "ICE NOT DET" message appears in green, if no ice has been detected 190 seconds after the flight crew has selected the ENG A.ICE pushbutton ON.

DESCRIPTION

The aircraft uses electrical heating for anti-icing each windshield and demisting the cockpit side windows.

Two independent Window Heat Computers (WHCs), one on each side, automatically regulate the system, protect it against overheating, and indicate faults.

Window heating comes on :

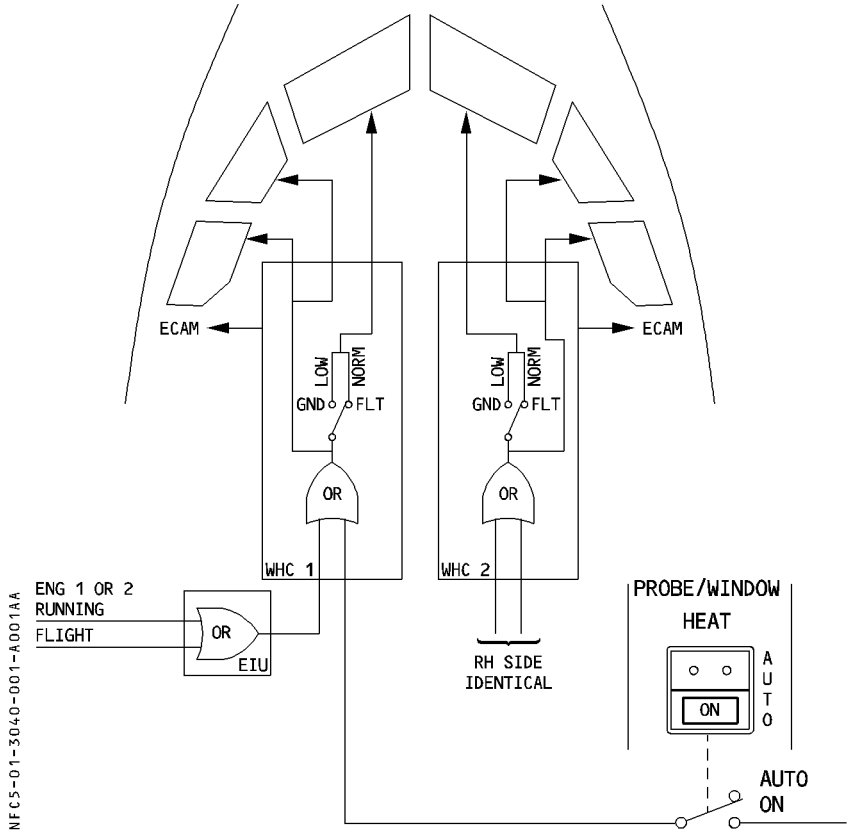
- automatically when at least one engine is running, or when the aircraft is in flight.
- manually, before engine start, when the flight crew switches ON the PROBE/WINDOW HEAT pushbutton switch.

R Windshield heating operates at low power on the ground and at normal power in flight. The changeover is automatic.

R Only one heating level exists for the windows.

FOR INFO

R

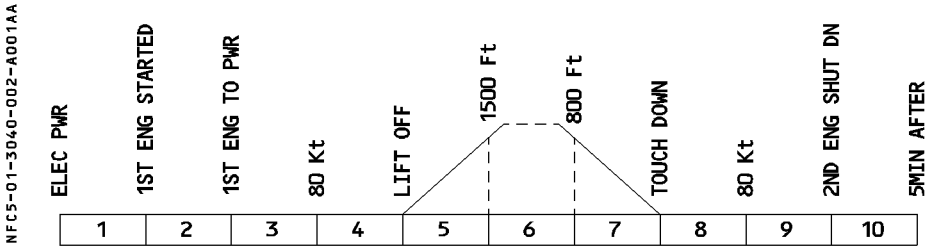


CONTROLS AND INDICATORS

OVERHEAD PANEL

Refer to 1.30.50.

WARNINGS AND CAUTIONS



E / WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNINGS	FLT PHASE INHIB
L(R) WINDSHIELD Failure of L or R windshield heating	SINGLE CHIME	MASTER CAUT	NIL	NIL	3, 4, 5, 7, 8
L+R WINDSHIELD Failure of both windshield heating					
L(R) WINDOW Failure of L or R window heating	NIL	NIL			

DESCRIPTION

Electrical heating protects :
- pitot heads
- static ports
- Angle-Of-Attack probes (AOAs)
- Total Air Temperature (TAT) probes

Three independent Probe Heat Computers (PHCs) automatically control and monitor :
- Captain probes
- F/O probes
- STBY probes

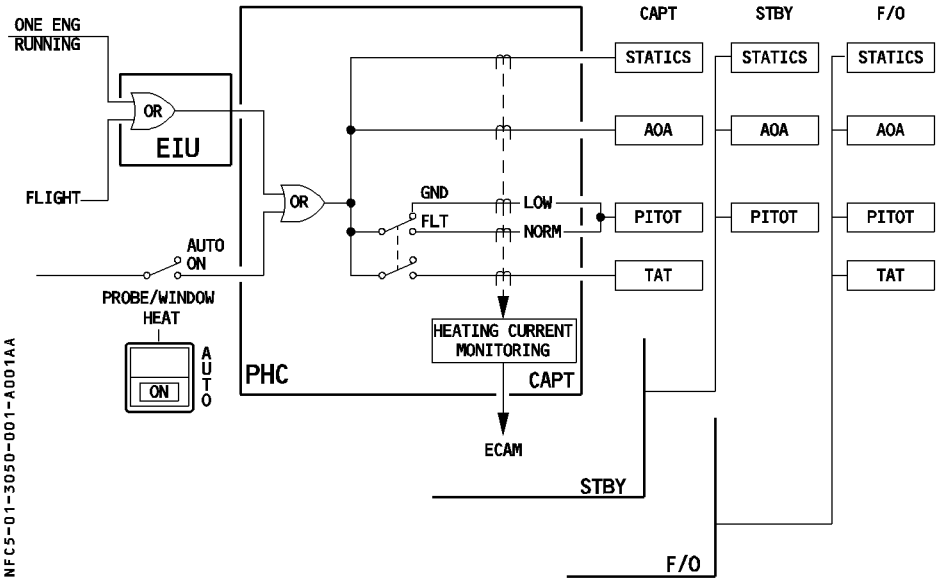
They protect against overheating and indicate faults.

The probes are heated :

R
- automatically when at least one engine is running, or when the aircraft is in flight.
- manually, when the flight crew switches ON the PROBE/WINDOW HEAT pushbutton switch

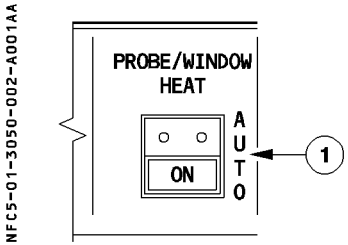
On the ground, the TAT probes are not heated and pitot heating operates at a low level (the changeover to normal power in flight is automatic).

FOR INFO



CONTROLS AND INDICATORS

OVERHEAD PANEL

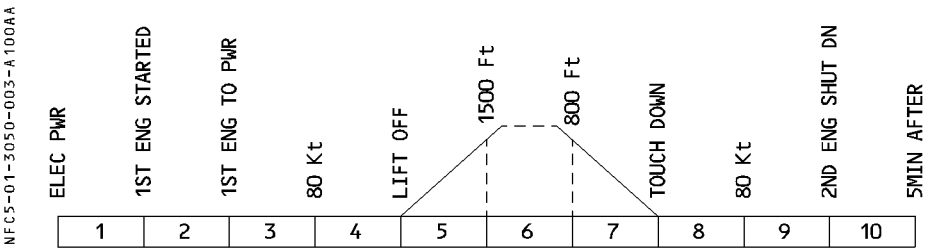


(1) PROBE/WINDOW HEAT pb

AUTO : Probes/Windows are heated automatically :
— in flight or
— on the ground (except TAT probes) provided one engine is running.

R ON : Probes and windows are heated permanently. Blue light comes on.

WARNINGS AND CAUTIONS



E / WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
CAPT (F/O) PITOT CAPT (F/O) L(R) STAT CAPT (F/O) AOA CAPT (F/O) TAT Failure of corresponding probe heating	SINGLE CHIME	MASTER CAUT	NIL	NIL	3, 4, 5, 7,8
STBY PITOT STBY L(R) STAT STBY AOA Failure of corresponding probe heating					
CAPT (F/O) (STBY) PROBES Failure of one probe heat channel/computer					
CAPT + F/O PITOT CAPT+ STBY PITOT F/O + STBY PITOT Failure of the corresponding probes heating					4, 5, 8
ALL PITOT Failure of CAPT, F/O and STBY probes heating					

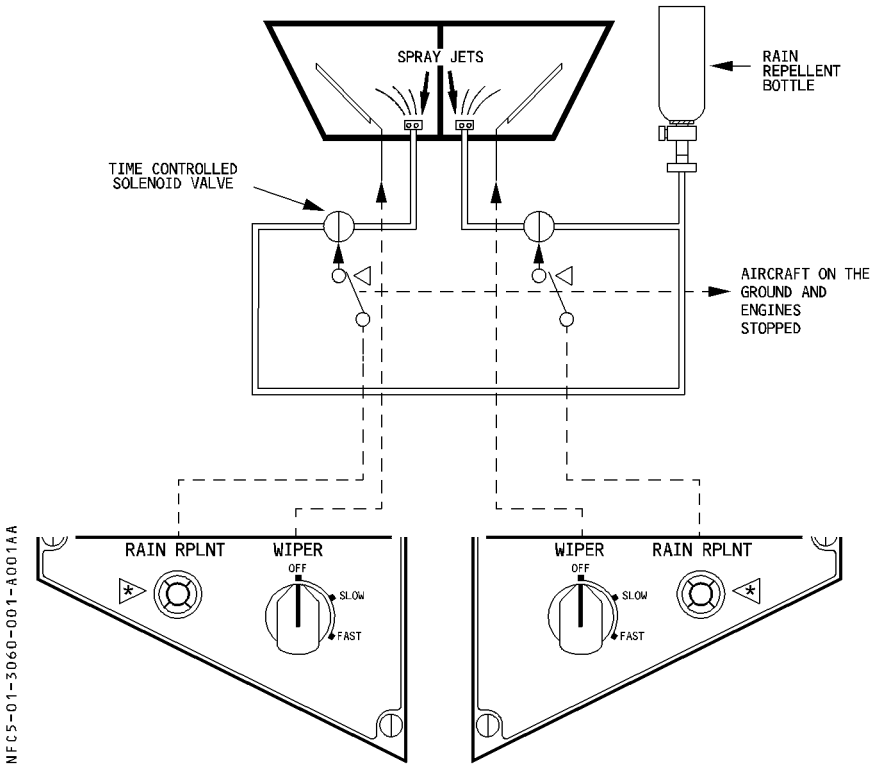
DESCRIPTION

WIPERS

Each front windshield has a two-speed electric wiper.
A rotary selector controls each.

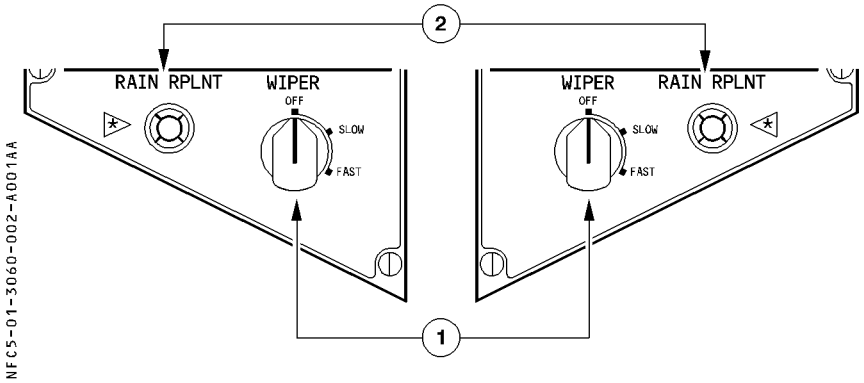
R RAIN REPELLENT ◁

In moderate to heavy rain, the flight crew can spray a rain repellent liquid on the windshield to improve visibility.
After about 30 seconds, the windows is covered by spray.
Separate pushbuttons control the rain repellent application on each side of the windshield.



CONTROLS AND INDICATORS

OVERHEAD PANEL



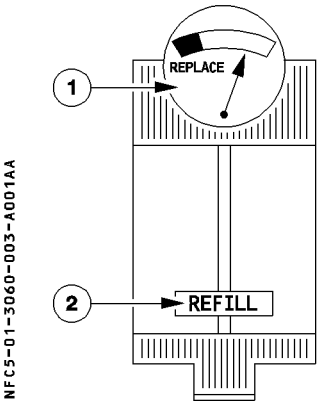
(1) WIPER rotary selector

R Each rotary selector controls its wiper at low or high speed. When turned off, the wiper stops out of view.

(2) RAIN RPLNT pushbuttons ◁

Each of these buttons controls the application of rain repellent fluid to the corresponding side of the front windshield.
When the flight crew pushes the button, the timer applies a measured quantity of rain repellent to the windshield. To repeat the cycle, the flight crew must push the button again.
This function is inhibited when the aircraft is on the ground and the engines are stopped.

REAR COCKPIT



(1) RAIN RPLNT pressure indicator

This gauge shows the nitrogen pressure in the rain repellent bottle. When the needle is in the yellow sector the bottle should be replaced.

(2) RAIN RPLNT quantity indicator

When the REFILL float is in view the bottle should be replaced.

DESCRIPTION

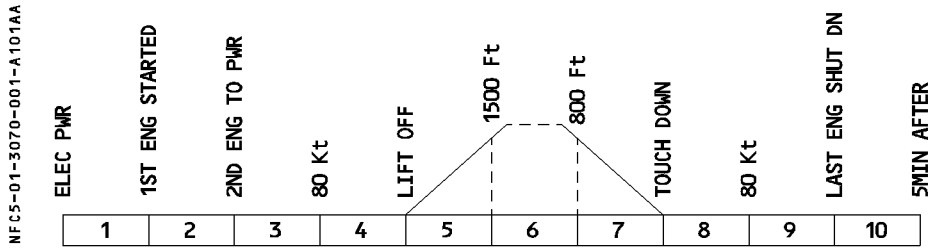
VISUAL ICE INDICATOR

An external visual ice indicator is installed between the two windshields.
R The indicator has also a light (◁).

ICE DETECTION SYSTEM

The ice detection system has two separate ice detector probes on the forward lower section of the fuselage.
The probes detect ice build-up. They also indicate, through the MEMO display, that icing conditions have disappeared. The system logic generates ECAM messages according to ice detector signals and the flight crew's selection of engine or wing anti-icing systems.
The ice detection system does not control the ENG or WING anti-icing systems.

WARNINGS AND CAUTIONS



E / WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNINGS	FLT PHASE INHIB
ICE DETECTED In FLT ≥ 1500 ft and TAT < 10°C and ice detected by at least one detector and ENG A. ICE pb at OFF	SINGLE CHIME	MASTER CAUT	NIL	NIL	3,4,5 7,8
SEVERE ICE DETECTED In FLT ≥ 1500 ft and TAT < 10°C and heavy icing detected by at least one detector and WING A. ICE pb at OFF					
ICE DETECT FAULT Ice detector 1 and 2 fault					

MEMO DISPLAY

Refer to 1.30.20 p 3 and 1.30.30 p 3.

BUS EQUIPMENT LIST

			NORM		EMER ELEC		
			AC	DC	AC ESS	DC ESS	HOT
WING ANTI ICE	L and R SHUT OFF VALVES					SHED	
ENG ANTI ICE CLOSURE	VALVE	1		DC1			
		2		DC2			
WINDOW HEAT	WHC	1		DC1			
		2		DC2			
	HEATING POWER	L	AC1				
		R	AC2				
PROBE HEAT	PHC	CAPT				X	
		F/O		DC2			
		STBY		DC1			
	STATICS	CAPT and STBY		DC1			
		F/O		DC2			
	PITOT	CAPT			X (1)		
		F/O	AC2				
		STBY	AC1				
	AOA	CAPT			SHED		
		F/O	AC2				
		STBY	AC1				
	TAT	CAPT	AC1				
		F/O	AC2				
RAIN REMOVAL	WIPER	CAPT		DC1			
		F/O		DC2			
	RAIN REPELLENT ◁	CAPT				X	
		F/O		DC2			
ICE DETECT SYSTEM ◁	DETECTOR 1		AC1				
	DETECTOR 2		AC2				

(1) When AC1 and AC2 are lost and AIR DATA is switched to "CAPT 3", the STBY pitot is switched to AC ESS bus and CAPT pitot heating is lost.

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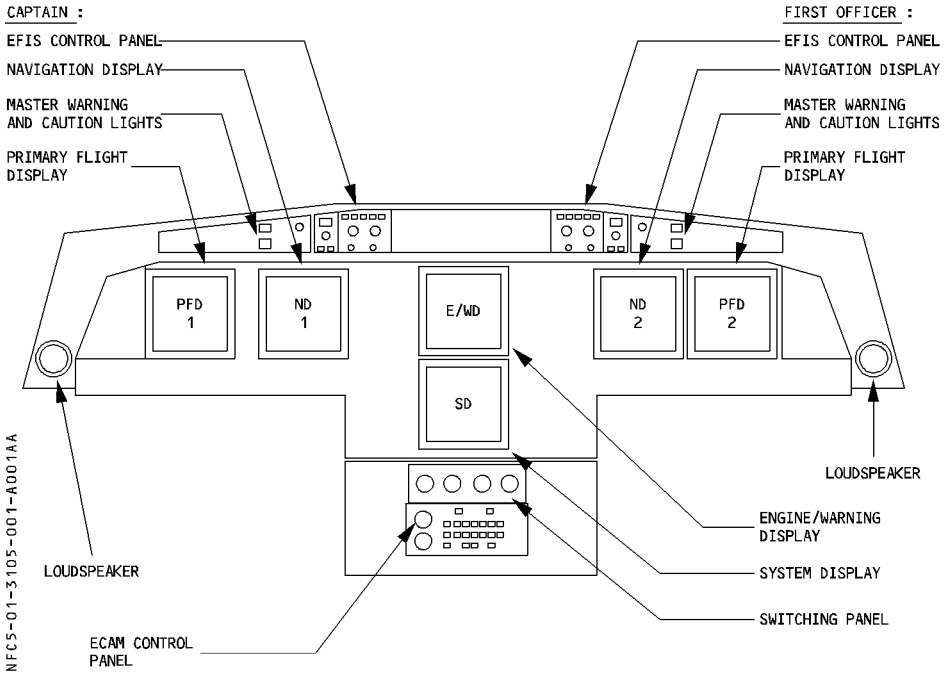
INTRODUCTION

The Electronic Instrument System (EIS) presents data on six identical Display Units (DUs):

- The Electronic Flight Instrument System (EFIS) displays mostly flight parameters and navigation data on the Primary Flight Displays (PFDs) and Navigation Displays (NDs).
- The Electronic Centralized Aircraft Monitor (ECAM) presents data on the Engine/Warning Display (E/WD) and System Display (SD) :
  - Primary engine indications, fuel quantity, flap and slat position
  - Warning and caution alerts, or memos
  - Synoptic diagrams of aircraft systems, and status messages
  - Permanent flight data

COCKPIT ARRANGEMENT

R



ARCHITECTURE

DISPLAY UNIT (DU)

The instrument panels have six identical units.
These DUs are full-color Liquid Crystal Displays (LCD).

DISPLAY MANAGEMENT COMPUTER (DMC)

R Three identical Display Management Computers (DMCs) obtain data from the different
R sensors and computers, and send it to the display units. The display units then generate
R and display the applicable images. Each DMC has a single DMC channel, and can
R simultaneously supply one PFD, one ND and both ECAM display units (E/WD and SD).

SYSTEM DATA ACQUISITION CONCENTRATOR (SDAC)

The two identical SDACs acquire data, then generate signals. Some of these signals go to the three DMCs, which use them to generate displays of system pages and engines parameters. Others go to the flight warning computers, which use them to generate ECAM messages and aural alerts.

FLIGHT WARNING COMPUTER (FWC)

The two identical FWCs generate alert messages, memos, aural alerts, and synthetic voice messages. For this purpose they acquire data :
– Directly from aircraft sensors, or systems, to generate red warnings.
– Through the SDACs to generate amber cautions.
The ECAM display units display the alert messages generated by the FWCs.
The FWCs also generate :
– Radio altitude callouts
– Decision height callouts
– Landing distance and landing speed increments.

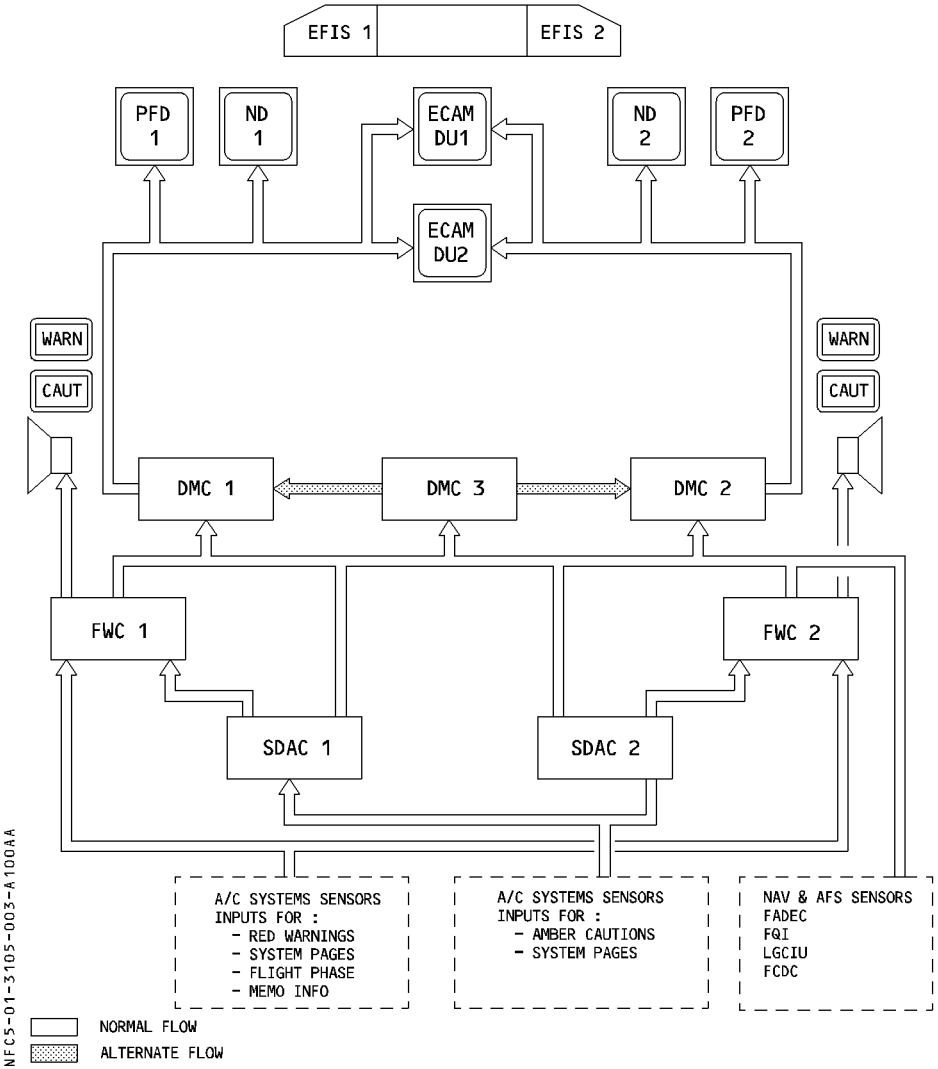
ATTENTION-GETTERS

The FWCs also drive the attention-getters. Each pilot has a set of these on the panel under the glareshield. They are :
– A master warning light, that flashes “MASTER WARN” in red, for red warnings.
– A master caution light, that illuminates “MASTER CAUT” in amber, for amber cautions.

LOUDSPEAKER

The communications loudspeakers announce aural alerts and voice messages, and do so even when they are turned off.

EIS BLOCK DIAGRAM



CONTROLS AND SWITCHING

ECAM CONTROL PANEL (ECP)

R The ECAM Control Panel, located on the pedestal, includes :
R — Such E/WD controls, as CLR, STS, and the brightness control knob.
R — Such SD controls, as ENG, BLEED, PRESS..., system page selector, and the brightness
R control knob.

EIS DMC SWITCHING SELECTOR

R A switch near the center of the SWITCHING panel which is located just above the ECAM
R control panel, enables the flight crew to replace the Captain or First Officer's Display Management Computer (DMC 1, or DMC 2) by DMC 3.

ECAM/ND SWITCHING

A switch on the right-hand side of the SWITCHING panel enables the flight crew to transfer the ECAM System Display to either the Captain or First Officer's Navigation Display.

EFIS SWITCHING

A PFD/ND XFR pushbutton on each side console enables the pilot to swap displays to the respective onside DUs.

RECONFIGURING THE DISPLAY MANAGEMENT COMPUTER (DMC)

R In normal operation, each DMC drives the following Display Units :
R – DMC 1 drives the CAPT PFD, CAPT ND the ECAM DUs.
R – DMC 2 drives the F/O PFD and F/O ND.
R – DMC 3 is on standby, ready to drive any DU.
R If DMC 1 or 2 fails (the "INVALID DATA" message is displayed on the DUs), the crew
R manually selects the DMC 3 source ("CAPT 3" or "F/O 3").
R If DMC 1 fails (or DMC 3, if "CAPT 3" was selected), DMC 2 automatically drives the
R ECAM.

RECONFIGURING DISPLAY UNITS (DUs)

FAILURE OF UPPER ECAM DU (OR CTL/BRIGHTNESS KNOB TURNED TO OFF)

If the upper ECAM display fails, or is switched off :
– The engine/warning page automatically replaces the system/status page on the lower ECAM DU.

The flight crew can display the system/status page by :
– Using the "ECAM/ND XFR" switch, on the SWITCHING panel, to move it to a Navigation Display Unit (NDU), or
– Pushing and holding (for a maximum of 3 minutes) the related system page pushbutton, on the ECAM control panel, to temporarily display it on the lower ECAM DU (instead of the engine/warning page).

FAILURE OF LOWER ECAM DU (OR CTL/BRIGHTNESS KNOB TURNED TO OFF)

If the lower ECAM display fails, or is switched off, the flight crew can display the system/status page by :
– Using the "ECAM/ND XFR" switch, on the SWITCHING panel, to display it on the NDU, or
– Pushing and holding (for a maximum of 3 minutes) the related system page pushbutton, on the ECAM control panel, to temporarily display it on the upper ECAM DU (instead of the engine/warning page).

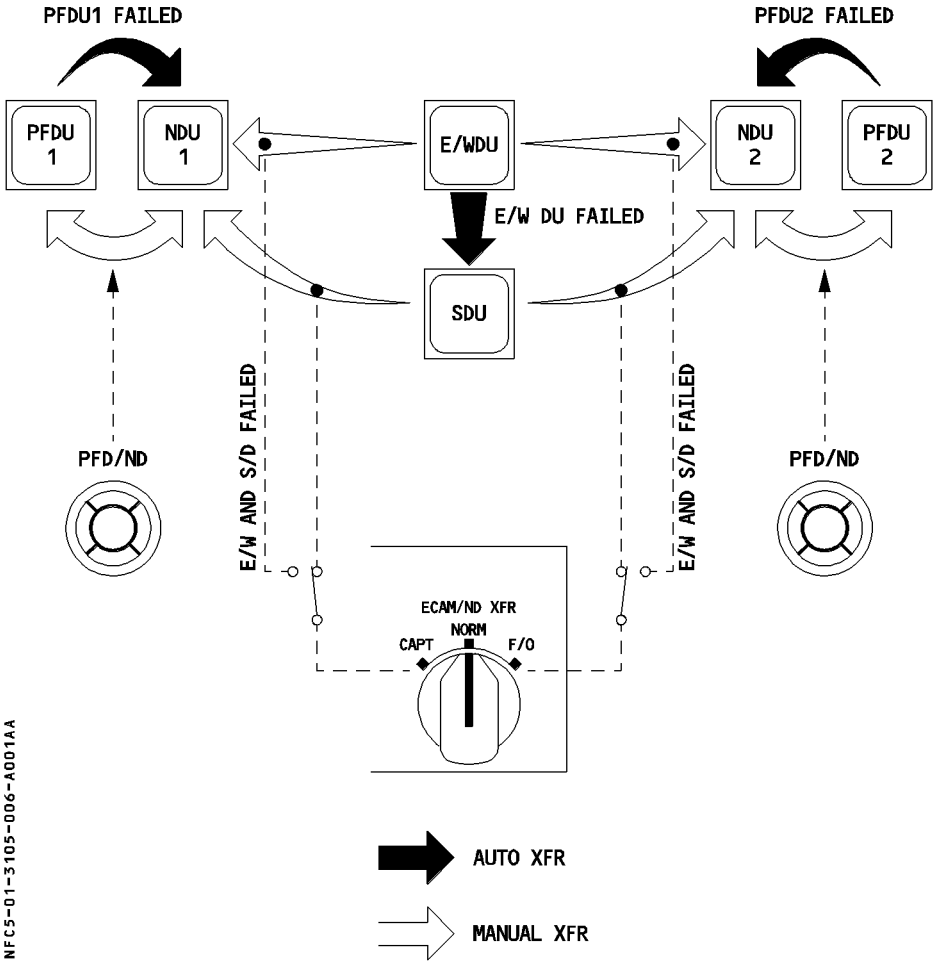
FAILURE OF BOTH ECAM DUs

If both ECAM displays fail, the flight crew may :
– Use the "ECAM/ND XFR", on the SWITCHING panel, to display the engine/warning page on a navigation display and, if needed,
– Push and hold (for a maximum of 3 minutes) the related system page pushbutton, on the ECAM control panel, to temporarily display the system/status page on an ND.

PFDU/NDU RECONFIGURATION

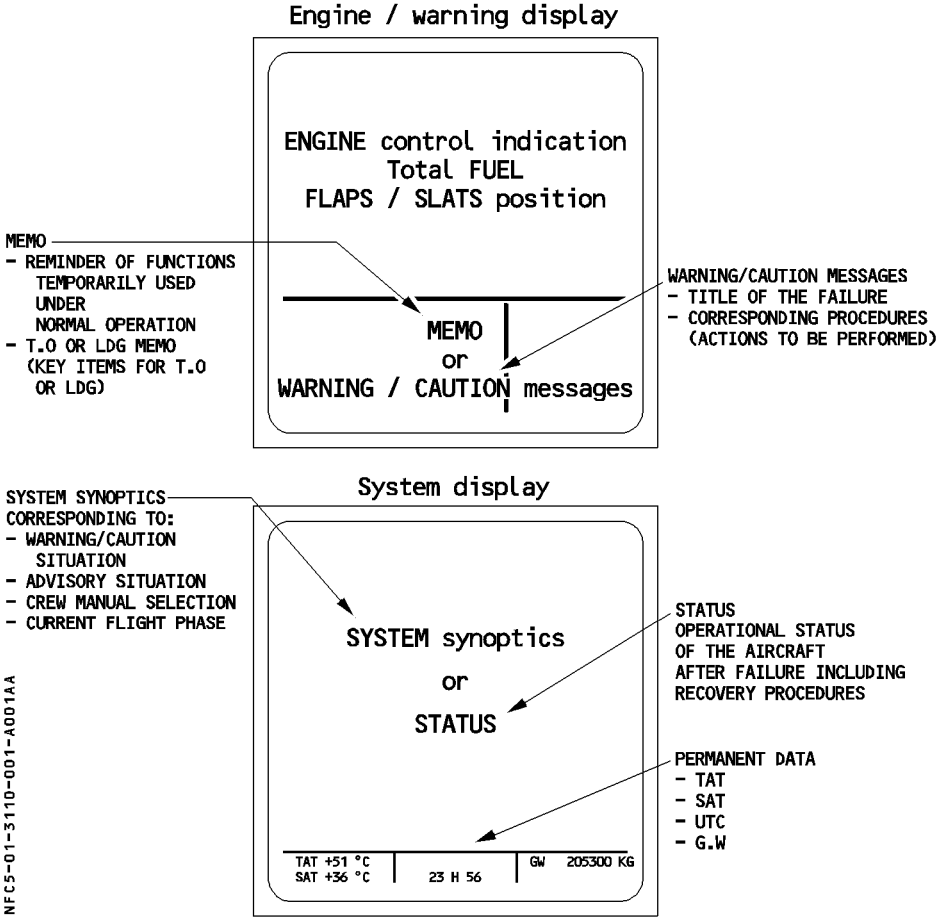
R If a PFDU fails, the system automatically transfers the PFD image to the NDU.
The pilot can also make this transfer manually by :
– turning the PFD ON-OFF/brightness control OFF, or
– pressing the PFD/ND/XFR pushbutton, which cross-changes the images between the PFDU and the NDU.
If an NDU fails, the pilot can use the PFD/ND/XFR pushbutton to transfer the ND image to the PFDU.

DU RECONFIGURATION



ECAM DU ARRANGEMENT

The ECAM has two display units :
— one for the engine/warning display (E/WD).
— one for the system/status display (SD).



COLOR CODE

The ECAM display uses a color code that indicates the importance of the failure or the indication.

RED : The configuration or failure requires immediate action.
AMBER : The flight crew should be aware of the configuration or failure, but need not take immediate action.
GREEN : The item is operating normally.
WHITE : These titles and remarks guide the flight crew, as they execute various procedures.
BLUE : These are actions to be carried out, or limitations.
MAGENTA : These are particular messages that apply to particular pieces of equipment or situations (inhibition messages, for example).

WARNING/CAUTION CLASSIFICATION

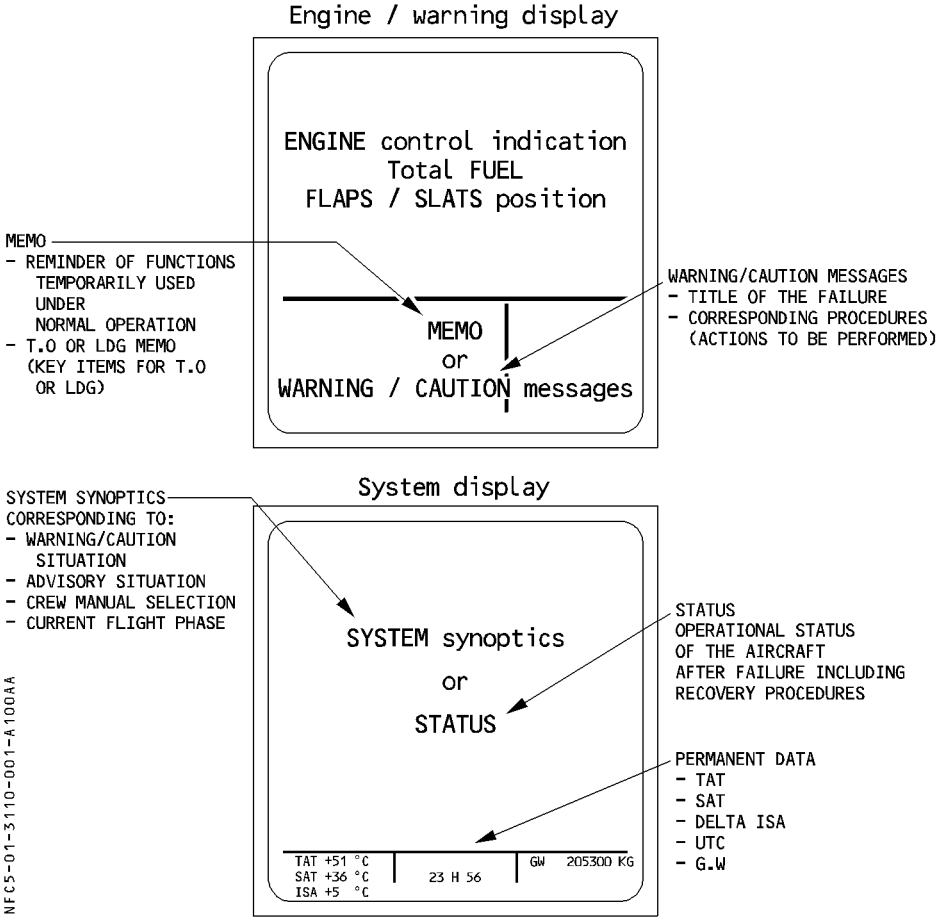
R

	LEVEL	SIGNIFICATION	AURAL	VISUAL
FAILURE MODE	Level 3	Red warning : The configuration, or failure requires immediate action : – Aircraft in dangerous configuration, or limit flight conditions (eg: stall, o/speed) – System failure altering flight safety (eg : Eng fire, excess cab alt)	Continuous Repetitive Chime (CRC) or specific sound or synthetic voice	– MASTER WARN light red flashing or specific red light – Warning message (red) on E/WD – Automatic call of the relevant system page on the S/D *
	Level 2	Amber caution : The flight crew should be aware of the configuration or failure, but does not need to take any immediate action. However, time and situation permitting, these cautions should be considered without delay to prevent any further degradation of the affected system : – System failure without any direct consequence on the flight safety (eg: HYD G SYS LO PR)	Single Chime (SC)	– MASTER CAUT light amber steady –Caution message (amber) on E/WD – Automatic call of the relevant system page on the S/D * .
	Level 1	Amber caution : Requires crew monitoring : – Failures leading to a loss of redundancy or system degradation (eg : FCDC fault)	NONE	– Caution message (amber) on E/WD generally without procedure.
INFORMATION	ADVISORY	System parameters monitoring	NONE	– Automatic call of the relevant system page on the S/D. The affected parameter pulses green.
	MEMO	Information : Recalls normal or automatic selection of functions which are temporarily used	NONE	– Green, Amber, or Magenta message on E/WD

* except in some cases

ECAM DU ARRANGEMENT

The ECAM has two display units :
— one for the engine/warning display (E/WD).
— one for the system/status display (SD).



COLOR CODE

The ECAM display uses a color code that indicates the importance of the failure or the indication.

RED : The configuration or failure requires immediate action.
AMBER : The flight crew should be aware of the configuration or failure, but need not take immediate action.
GREEN : The item is operating normally.
WHITE : These titles and remarks guide the flight crew, as they execute various procedures.
BLUE : These are actions to be carried out, or limitations.
MAGENTA : These are particular messages that apply to particular pieces of equipment or situations (inhibition messages, for example).

WARNING/CAUTION CLASSIFICATION

R

	LEVEL	SIGNIFICATION	AURAL	VISUAL
FAILURE MODE	Level 3	Red warning : The configuration, or failure requires immediate action : – Aircraft in dangerous configuration, or limit flight conditions (eg: stall, o/speed) – System failure altering flight safety (eg : Eng fire, excess cab alt)	Continuous Repetitive Chime (CRC) or specific sound or synthetic voice	– MASTER WARN light red flashing or specific red light – Warning message (red) on E/WD – Automatic call of the relevant system page on the S/D *
	Level 2	Amber caution : The flight crew should be aware of the configuration or failure, but does not need to take any immediate action. However, time and situation permitting, these cautions should be considered without delay to prevent any further degradation of the affected system : – System failure without any direct consequence on the flight safety (eg: HYD G SYS LO PR)	Single Chime (SC)	– MASTER CAUT light amber steady –Caution message (amber) on E/WD – Automatic call of the relevant system page on the S/D * .
	Level 1	Amber caution : Requires crew monitoring : – Failures leading to a loss of redundancy or system degradation (eg : FCDC fault)	NONE	– Caution message (amber) on E/WD generally without procedure.
INFORMATION	ADVISORY	System parameters monitoring	NONE	– Automatic call of the relevant system page on the S/D. The affected parameter pulses green.
	MEMO	Information : Recalls normal or automatic selection of functions which are temporarily used	NONE	– Green, Amber, or Magenta message on E/WD

* except in some cases

PRIORITY RULES

There are three priority levels for warnings and cautions :

– A level 3 warning has priority over a level 2 caution which has priority over a level 1 caution.

The FWC observes these priorities.

TYPES OF FAILURES

Independent : a failure that affects an isolated system or item of equipment without degrading the performance of others in the aircraft.

Primary : a failure of a system or an item of equipment that costs the aircraft the use of other systems or items of equipment.

Secondary : the loss of a system or an item of equipment resulting from a primary failure.

AURAL INDICATORS

WARNING SIGNAL	CONDITION	DURATION	SILENCING *
CONTINUOUS REPETITIVE CHIME	RED WARNINGS	PERMANENT	Press * MASTER WARN lt
SINGLE CHIME	AMBER CAUTION	0.5 seconds	
CAVALRY CHARGE ***	A/P DISCONNECTION BY TAKE OVER pb	1.5 seconds	Second push on TAKE OVER pb
	A/P DISCONNECTION DUE TO FAILURE	PERMANENT	Press MASTER WARN lt or TAKE OVER pb
TRIPLE CLICK	Landing capability downgrade or "GPS PRIMARY LOST" in approach, or mode reversion	0.5 sec. (3 pulses)	
CRICKET + "STALL" message (synthetic voice)	STALL	PERMANENT	NIL
BUZZER	CABIN CALL	3 seconds	NIL
	EMER CABIN CALL	3 seconds REPEATED 3 TIMES	NIL
	MECH CALL **	As long as outside pb pressed	NIL
CONTINUOUS BUZZER **	SELCAL CALL	PERMANENT	Press RESET key on ACP
"WINDSHEAR" (synthetic voice)	WINDSHEAR	REPEATED 3 TIMES	NIL
" GO AROUND WINDSHEAR AHEAD" (synthetic voice)	Windshear ahead detected during the landing phase	PERMANENT	NIL
"WINDSHEAR AHEAD" (twice) (synthetic voice)	Windshear ahead detected during the takeoff phase	PERMANENT	NIL
"MONITOR RADAR DISPLAY" (synthetic voice)	Windshear ahead detected caution message	PERMANENT	NIL

* The pilot can cancel any aural warning, by pressing the :
— EMER CANC pushbutton on the ECAM control panel, or
— MASTER WARN pushbutton, except for OVERSPEED or L/G NOT DOWN warnings.

** The pilot can cancel the continuous buzzer, by pressing the MASTER CAUT pushbutton.

*** When the flight crew presses the MASTER WARN pushbutton (following a warning that leads to an AP disconnection), the Cavalry Charge sound is only inhibited when it has been emitted, in order to avoid an unintended cancellation.

R

WARNING SIGNAL	CONDITION	DURATION	SILENCING *
C CHORD	ALTITUDE ALERT (Refer to 1.31.40)	1.5 seconds or PERMANENT	new ALTITUDE selection or press MASTER WARN pb
AUTO CALL OUT (synthetic voice)	HEIGHT ANNOUNCEMENT BELOW 2500 FT (Refer to 1.34.10)	PERMANENT	NIL
GROUND PROXIMITY WARNING (synthetic voice)	(Refer to 1.34.70)	PERMANENT	NIL
"PRIORITY LEFT" "PRIORITY RIGHT" (synthetic voice)	A/P TAKE OVER pb	1 second	NIL
"RETARD" (synthetic voice)	THRUST LEVER NOT IN IDLE POSITION FOR LANDING	PERMANENT	THRUST LEVER
TCAS (synthetic voice)	(Refer to 1.34.80)	PERMANENT	NIL
"SPEED, SPEED, SPEED" (Synthetic voice)	Current thrust is not sufficient to recover a positive flight through pitch control	Every 5 seconds until thrust is increased	THRUST LEVER(s)
"DUAL INPUT" (synthetic voice)	Both sidesticks are moved simultaneously	Every 5 seconds	One sidestick deactivated

* The pilot can cancel any aural warning by pressing :
- The EMER CANC pushbutton on the ECAM control panel,
- The MASTER WARN pushbutton, except for OVERSPEED or L/G NOT DOWN warnings.

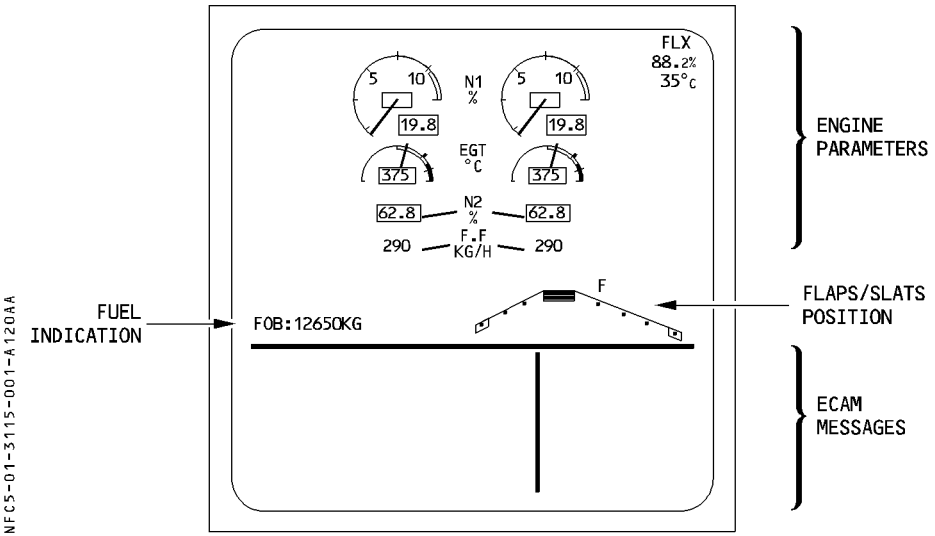
WARNING SIGNAL	CONDITION	DURATION	SILENCING *
C CHORD	ALTITUDE ALERT (Refer to 1.31.40)	1.5 seconds or PERMANENT	new ALTITUDE selection or press MASTER WARN pb
AUTO CALL OUT (synthetic voice)	HEIGHT ANNOUNCEMENT BELOW 2500 FT (Refer to 1.34.10)	PERMANENT	NIL
GROUND PROXIMITY WARNING (synthetic voice)	(Refer to 1.34.70)	PERMANENT	NIL
"PRIORITY LEFT" "PRIORITY RIGHT" (synthetic voice)	A/P TAKE OVER pb	1 second	NIL
"RETARD" (synthetic voice)	THRUST LEVER NOT IN IDLE POSITION FOR LANDING	PERMANENT	THRUST LEVER
TCAS (synthetic voice)	(Refer to 1.34.80)	PERMANENT	NIL
"SPEED, SPEED, SPEED" (Synthetic voice)	Current thrust is not sufficient to recover a positive flight through pitch control	Every 5 seconds until thrust is increased	THRUST LEVER(s)
"DUAL INPUT" (synthetic voice)	Both sidesticks are moved simultaneously	Every 5 seconds	One sidestick deactivated
"PITCH, PITCH" (Synthetic voice)	Aircraft pitch attitude becomes excessive during flare and landing.	one time	NIL

* The pilot can cancel any aural warning by pressing :
- The EMER CANC pushbutton on the ECAM control panel,
- The MASTER WARN pushbutton, except for OVERSPEED or L/G NOT DOWN warnings.

GENERAL

The Engine Warning Display (E/WD) appears on the ECAM's upper Display Unit (DU).

– The upper part of this DU displays :
  · Engine parameters (Refer to 1.70.90).
  · Fuel On Board (FOB) (Refer to 1.28.20).
  · Slats/Flaps' position (Refer to 1.27.40).
– The lower part of this DU displays messages generated by the FWC :
  · Warning and caution messages, when a failure occurs.
  · Memos, when there is no failure.



The lower part, dedicated to ECAM messages, is divided into two sections of several lines each.

Bottom left : – Primary or independent warnings and cautions, or
– Memo information

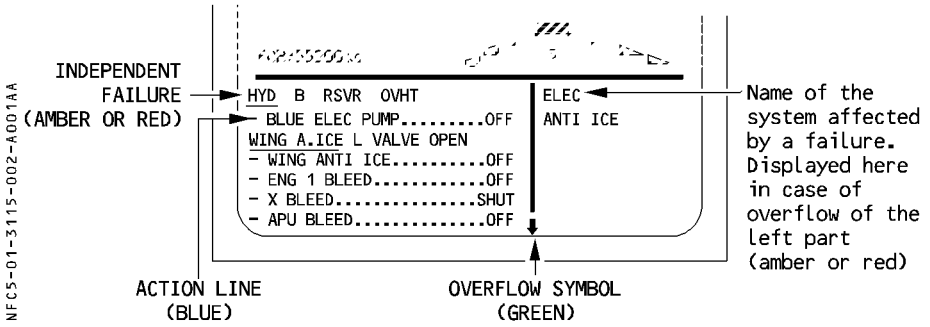
Bottom right : – Title of the system affected by a primary or independent warning or caution, in case of overflow on the bottom left part, or
– Secondary failure, or
– Memo, or
– Special lines (such as "AP OFF", "LAND ASAP").

As soon as the FWC detects a failure, and if there is no flight phase inhibition active, the E/WD displays the title of the failure and actions to be taken.

The action line automatically clears, when the flight crew has performed the required action.

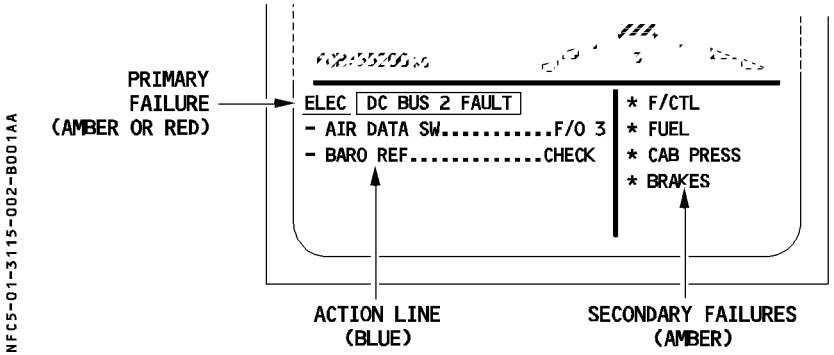
Note : Certain actions lines will not disappear after being done.

INDEPENDENT FAILURE



If there are too many ECAM messages for the amount of space available in the lower part of the E/WD, a green arrow appears at the bottom of the display, pointing down to show that the information has overflowed off the screen. The pilot can scroll down to view additional messages by pushing the CLR pushbutton on the ECAM control panel (on the pedestal, just below the lower ECAM DU).

PRIMARY and SECONDARY FAILURE



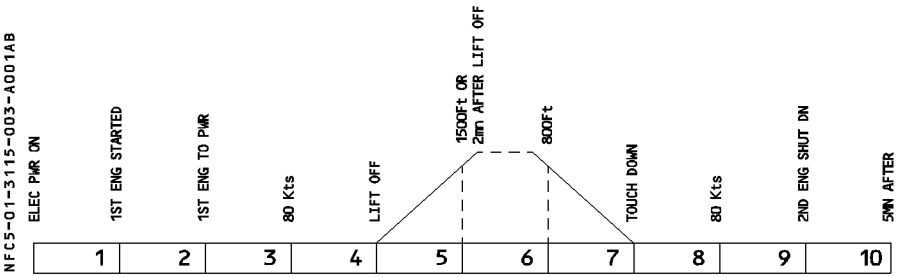
The ECAM DU displays a primary failure as a boxed title.
It identifies a secondary failure by putting a star in front of the title of the affected system.

R *Note : The DU displays the overflow symbol, if primary or secondary failures overflow. In*
R *case of ELEC EMER CONFIG, the secondary failures are inhibited.*

FLIGHT PHASES

GENERAL

The FWC divides its functions according to these ten flight phases :

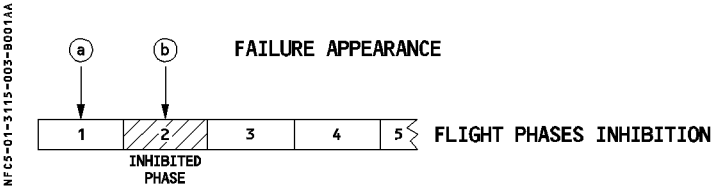


To improve its operational efficacy, the computer inhibits some warnings and cautions for certain flight phases. It does so to avoid alerting the pilots unnecessarily at times when they have high workloads, such as during takeoff or landing. In these two phases, the DU displays magenta memos : "T.O. INHIBIT" (flight phases 3, 4, and 5), and "LDG INHIBIT" (flight phases 7 and 8).

Note : These flight phases are different from and independent of the ones that the FMGC uses.

FLIGHT PHASE INHIBITION

Two cases are possible (for instance) :



Effect on E/WD :

(a) The failure occurs during phase 1. The E/WD displays the warning immediately and continues to display it as long as the failure is present, even in phase 2.

(b) The failure occurs during phase 2. The E/WD displays the warning only when the aircraft has entered phase 3, where it is not inhibited. Then the warning remains displayed as long as the failure is present.

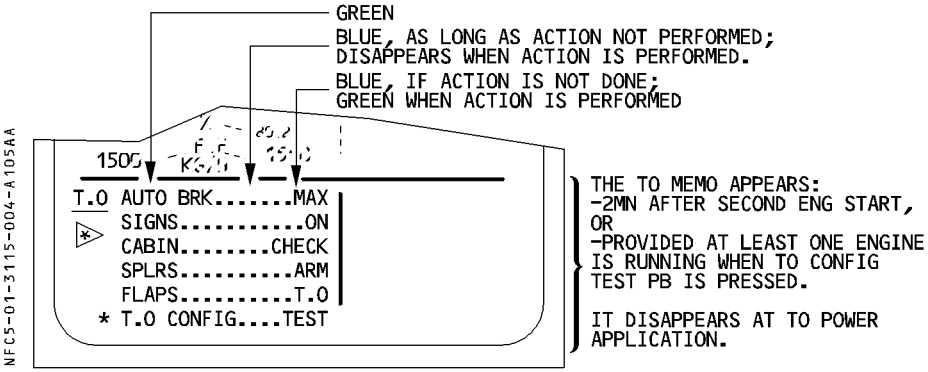
MEMOS

DISPLAY

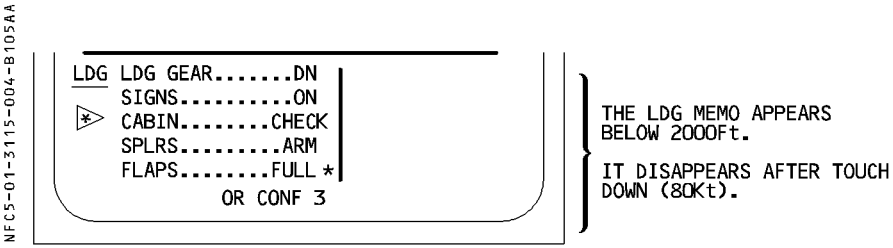
R Memos appear in the lower part of the E/WD. They are normally in green, but may be amber in abnormal situations.
Memos list functions or systems that are temporarily used in normal operations.
Each chapter of the "Warning and Cautions" section of this manual lists memo messages.

TO AND LDG MEMOS

During the takeoff and landing phases, the right side of the memo area displays specific T.O. INHIBIT or LDG INHIBIT (magenta) memos.
Takeoff and landing memos are displayed, as follows, during the related flight phases :



* This line disappears when the test is completed. It is replaced by "TO CONFIG NORMAL", if aircraft configuration is correct.
The test is requested again, if the configuration becomes abnormal.



* "CONF 3" is displayed in alternate or direct law, or if the GPWS LDG FLAP 3 pushbutton is ON.

CONFIGURATION WARNINGS

The following warnings and cautions appear in the lower part of the E/WD if the aircraft is not in takeoff configuration when the pilot presses the T.O. CONFIG pushbutton on the ECAM control panel or applies takeoff power.

WARNINGS/CAUTIONS	TO CONFIG TEST	TO POWER
SLATS/FLAPS NOT IN TO CONFIG (R)	TRIGGERED	TRIGGERED
PITCH TRIM NOT IN TO RANGE (R)		
RUD TRIM NOT IN TO RANGE (R)		
SPD BRK NOT RETRACTED (R)		
SIDESTICK FAULT (R) (BY TAKE OVER)		
BRAKES HOT (A)		
DOORS (A)		
PARK BRAKE ON (R)	NOT TRIGGERED	
FLEX TEMP NOT SET (A)		

(R) Red warning
(A) Amber caution

CONFIGURATION WARNINGS

The following warnings and cautions appear in the lower part of the E/WD if the aircraft is not in takeoff configuration when the pilot presses the T.O. CONFIG pushbutton on the ECAM control panel or applies takeoff power.

WARNINGS/CAUTIONS	TO CONFIG TEST	TO POWER
SLATS/FLAPS NOT IN TO CONFIG (R)	TRIGGERED	TRIGGERED
PITCH TRIM NOT IN TO RANGE (R)		
RUD TRIM NOT IN TO RANGE (R)		
SPD BRK NOT RETRACTED (R)		
SIDESTICK FAULT (R) (BY TAKE OVER)		
BRAKES HOT (A)		
DOORS (A)		
PARK BRAKE ON (R)	NOT TRIGGERED	
THR LEVERS NOT SET (A)		

(R) Red warning
(A) Amber caution

GENERAL

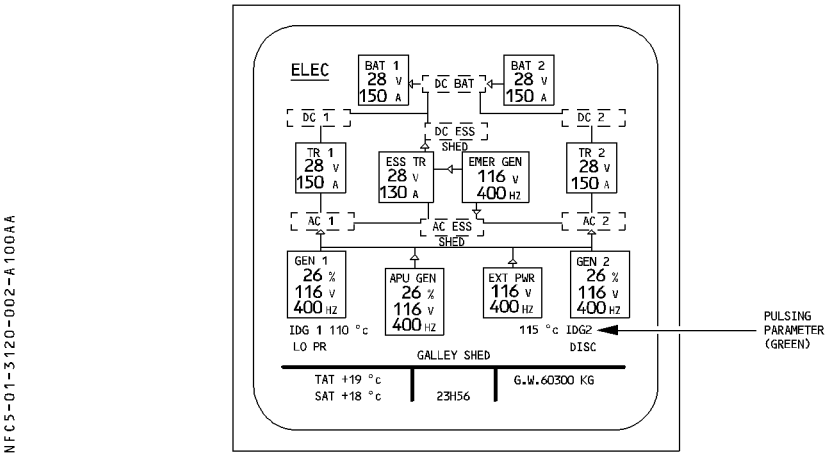
The system/status display (SD) uses the lower ECAM DU to display :
– pages showing synoptic diagrams of the aircraft systems, or
– the status page.

SYSTEM PAGES

The lower ECAM DU can display 12 system pages :
(For description see relevant FCOM chapter).
– ENGINE (secondary engine parameters)
– BLEED (air bleed)
– CAB PRESS (cabin pressurization)
– ELEC (electric power)
– HYD (hydraulic)
– FUEL (fuel)
– APU (auxiliary power unit)
– COND (air conditioning)
– DOOR/OXY (doors/oxygen)
– WHEEL (landing gear, braking, ground spoilers, etc.)
– F/CTL (flight controls)
– CRUISE (cruise)

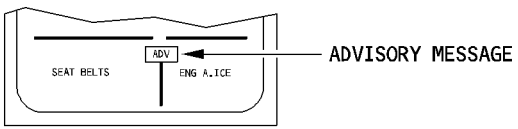
The pilot may manually call up a system page for display on the lower ECAM DU, or the system may automatically display a page.

- Manual :
  - The pilot can, at any time, use the pushbutton on the ECAM's control panel to call up and display any system page, except the CRUISE page.
  - The corresponding pushbutton on the ECAM control panel lights up.
  - A failure-related or advisory display automatically replaces a page that the pilot has manually called up.
- Automatic, related to a failure :
  - The relevant system page automatically appears, as soon as any fault or malfunction triggers a caution or warning message.
- Automatic, advisory :
  - The relevant system page automatically appears, when a parameter drifts out of its normal range.
  - The value (shown in green) pulses, as long as it is outside its limits.
  - The advisory mode is inhibited in some flight phases.



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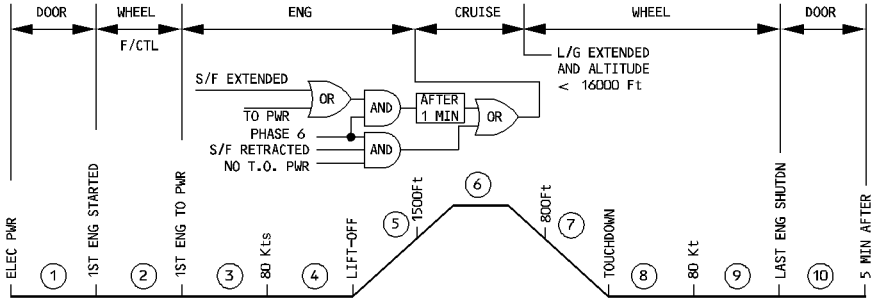
Note : If an advisory is triggered, when the ECAM is in the single-display configuration, an advisory message appears on the upper part of the E/WD, and the associated key on the ECAM control panel flashes to identify the appropriate system page.



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– Automatic, flight phase mode
  · If no other mode is engaged, the SD displays the system page related to the present flight phase, as shown in the following diagram.

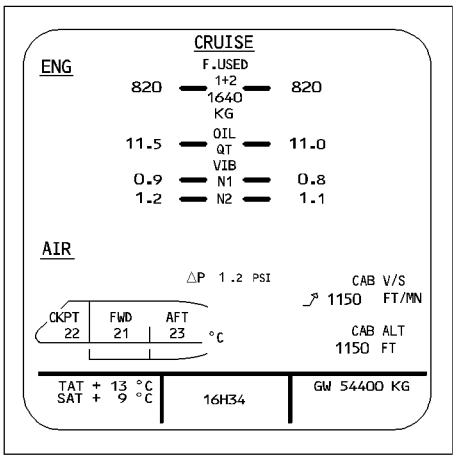
NFC5-01-3120-003-A100AA



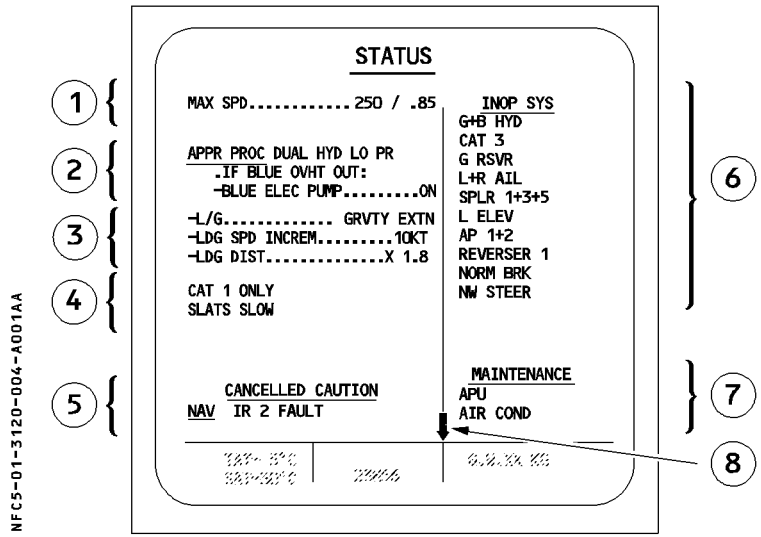
  · Phase 2 : The F/CTL page replaces the WHEEL page for 20 seconds, when either pilot moves his sidestick (more than 3° in pitch or roll), or when the rudder pedal deflection is more than 22°.
  · The APU page appears when the APU MASTER switch is ON. It disappears when APU RPM has been above 95 % for 10 seconds, or when the APU MASTER switch is switched OFF.
  · The ENGINE page appears at the beginning of the start sequence, or when a pilot selects “CRANK”. It disappears 10 seconds after the end of the start sequence, when the ENG MODE sel is set to NORM.

For a description of the ENGINE and AIR indications that appear, when the SD is displaying the CRUISE page, see the relevant FCOM chapter.

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STATUS PAGE



R The status page displays an operational summary of the aircraft status after the SD has displayed a failure. As shown in the illustration above, the summary includes :

(1) Limitations (speed, flight level) : Blue

(2) Approach procedures : White/Red or Amber

(3) Procedures (corrections to apply for landing) : Blue

(4) Information : Green

(5) Cancelled caution : White

(6) Inoperative system : Amber

(7) Maintenance status : White

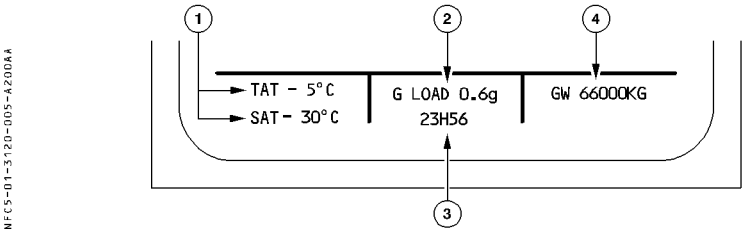
(8) Symbol displayed if data overflows the left or right area.

The pilot scrolls the display to view overflow by pressing the CLR pushbutton.

Note : The titles of the different parts of the display are white and underlined.

The STATUS page automatically appears, once the crew has cleared all the pages corresponding to the current failure. The STATUS page also appears automatically during descent, when the slats are extended, unless if the page is empty. The pilot may manually call up the status page by pressing the STS key on the ECAM control panel. If the STATUS page holds messages other than "CANCELLED CAUTION", or the MAINTENANCE part, the E/WD screen shows "STS" (status reminder). If the STATUS page holds messages in the MAINTENANCE part on engine shutdown, the "STS" (status reminder) flashes on the E/WD screen. The screen displays the MAINTENANCE, only when the aircraft is on ground, before engine start-up or after engine shutdown (Phases 1 and 10).

R **PERMANENT DATA**



① Temperature

"TAT" (Total Air Temperature) and "SAT" (Static Air Temperature) are displayed in green.

R ② G LOAD

R "G LOAD" (the load factor) is displayed in amber, when the value is above 1.4 g or, below
R 0.7 g. The display of the load factor is inhibited during flight phases 1 and 2.

③ UTC

The screen displays the Universal Time Coordinated (UTC), synchronized with the cockpit clock, in green.

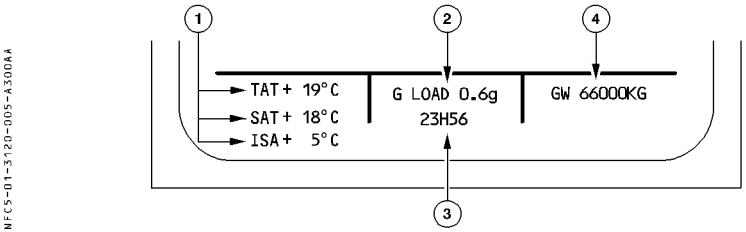
④ GW

The screen displays the gross weight (GW) in green, as soon as the first engine is started. The last two digits are dashed, if accuracy is degraded. On ground, the indication is replaced by blue dashes, if no computed data is available.

INTENTIONALLY LEFT BLANK

The STATUS page automatically appears, once the crew has cleared all the pages corresponding to the current failure. The STATUS page also appears automatically during descent, when the slats are extended, unless if the page is empty. The pilot may manually call up the status page by pressing the STS key on the ECAM control panel. If the STATUS page holds messages other than "CANCELLED CAUTION", or the MAINTENANCE part, the E/WD screen shows "STS" (status reminder). If the STATUS page holds messages in the MAINTENANCE part on engine shutdown, the "STS" (status reminder) flashes on the E/WD screen. The screen displays the MAINTENANCE, only when the aircraft is on ground, before engine start-up or after engine shutdown (Phases 1 and 10).

R **PERMANENT DATA**



(1) Temperature

"TAT" (Total Air Temperature), and "SAT" (Static Air Temperature) are displayed in green. "ISA" (International Standard Atmosphere temperature) is displayed in GREEN, in standard altitude mode and when SAT is valid.

R (2) G LOAD

R "G LOAD" (the load factor) is displayed in amber, when the value is above 1.4 g or, below
R 0.7 g. The display of the load factor is inhibited during flight phases 1 and 2.

(3) UTC

The screen displays the Universal Time Coordinated (UTC), synchronized with the cockpit clock, in green.

(4) GW

The screen displays the gross weight (GW) in green, as soon as the first engine is started. The last two digits are dashed, if accuracy is degraded. On ground, the indication is replaced by blue dashes, if no computed data is available.

INTENTIONALLY LEFT BLANK

GENERAL

If ECAM detects a failure :

- The E/WD displays warning or caution messages.
- The master warning or master caution lights light up (except in the case of a level 1 caution).
- The system sounds an aural signal (except in the case of a level 1 caution).
- The system display (SD) shows the system page for the affected system.

R - The CLR pushbutton on the ECAM control panel lights up.

In addition, a local warning light controlled directly by the affected system can light up.

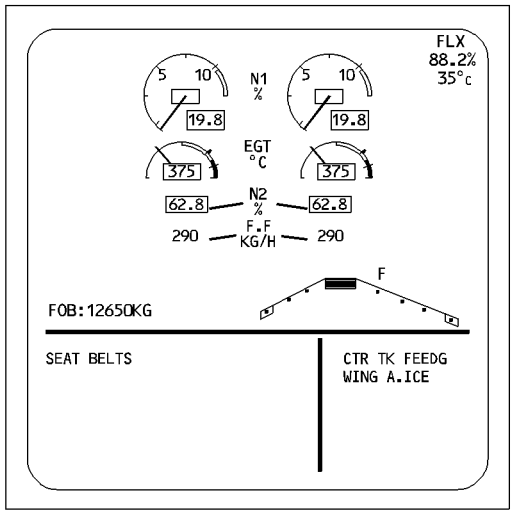
After completing remedial procedures, the flight crew must push the CLR pushbutton repeatedly until the displays return to their normal configurations :

- MEMO messages on the E/WD
- The system page related to the present flight phase on the SD.
- The CLR light on the ECAM control panel turned off.

EXAMPLE

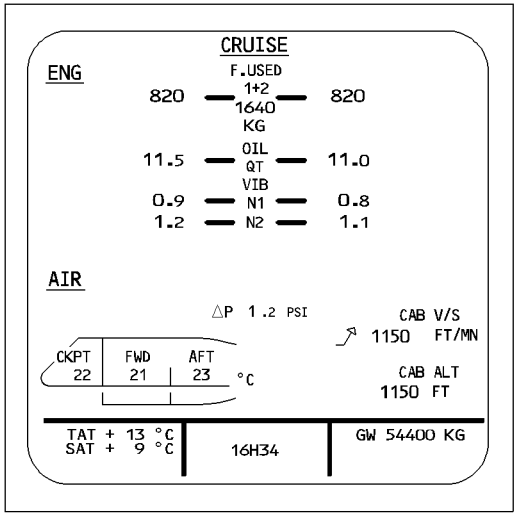
1 – THE ECAM DETECTS NO FAILURE

ECAM UPPER DISPLAY (E/WD)



- ENGINE CONTROL PARAMETERS
- FUEL QUANTITY INDICATION
- FLAPS/SLATS POSITION
- MEMO INFORMATION

ECAM LOWER DISPLAY (SD)



- FLIGHT PHASE RELATED SYSTEM PAGE (CRUISE PAGE IN THIS EXAMPLE)
- PERMANENT DATA

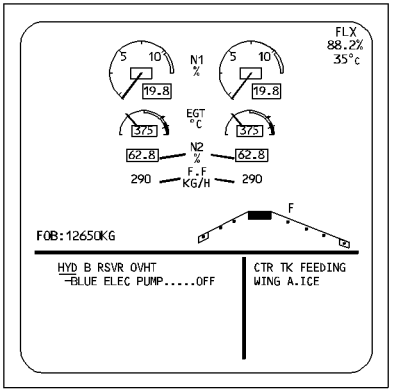
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2 – THE ECAM DETECTS A FAILURE

For example, a hydraulic reservoir is overheat.

COCKPIT INDICATIONS

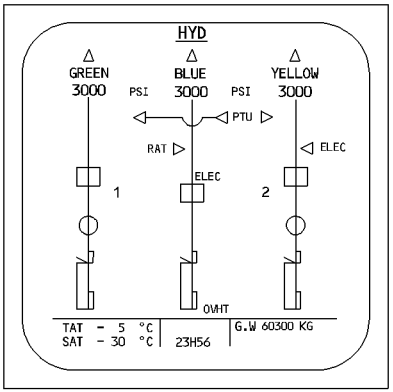
- A single chime sounds.
- Both MASTER CAUTION lights come on, and stay on.
- A FAULT light, on the overhead HYD panel, comes on.
- The memo space on the E/WD displays the "HYD B RSVR OVHT" message, and the "BLUE ELEC PUMP . . . . . OFF" instruction.
- The lower ECAM display (SD) automatically calls up the hydraulic systems' diagram, and displays "OVHT" in amber next to the blue system.
- The ECAM's CLR pushbutton lights up.



ECAM UPPER DISPLAY (E/WD)

- BOTTOM LEFT
  . INDEPENDENT FAILURE
    -TITLE OF THE FAILURE
    - ACTIONS TO BE PERFORMED

- BOTTOM RIGHT
  .MEMO INFORMATION



ECAM LOWER DISPLAY (SD)

- SUMMARY OF THE AFFECTED SYSTEM AUTOMATICALLY DISPLAYED. OVHT IS DISPLAYED IN AMBER.

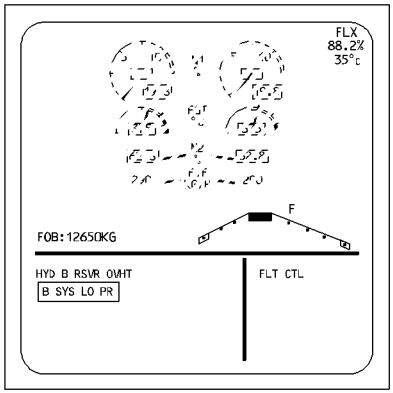
NFC5-01-3125-003-A120AA

3 – THE FLIGHT CREW FOLLOWS THE INSTRUCTIONS DISPLAYED ON THE E/WD

The flight crew switches off the BLUE ELEC PUMP pushbutton, depressurizing the blue hydraulic circuit.

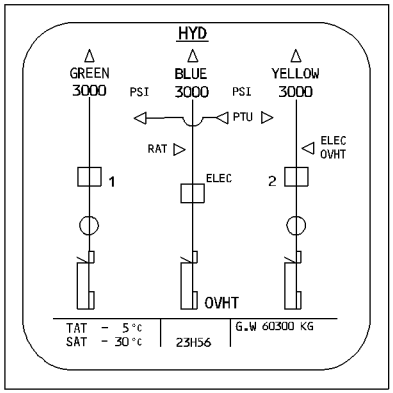
COCKPIT INDICATIONS

- A single chime sounds.
- Both MASTER CAUTION lights stay on.
- A FAULT/OFF light, on the overhead panel, comes on.
- The second part of the message on the E/WD changes to "B SYS LO PR".
- The SD's system diagram shows an amber zero for the pressure in the blue system, along with the amber "OVHT".
- The right side of the memo area indicates a secondary failure in the flight control system.
- The ECAM control panel's CLR pushbutton remains on.



ECAM UPPER DISPLAY (E/WD)

- BOTTOM LEFT
  . INDEPENDENT FAILURE AND PRIMARY FAILURE
- BOTTOM RIGHT
  .SECONDARY FAILURE



NFC5-01-3125-004-A100AA

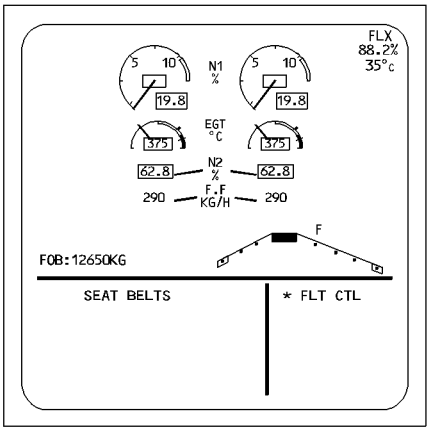
ECAM LOWER DISPLAY (SD)

- THE SYNOPTIC OF THE SYSTEM PAGE IS CHANGED ACCORDING TO THE NEW SYSTEM CONFIGURATION
OVHT AND THE PRESSURE ARE DISPLAYED IN AMBER

4 – ONE OF THE PILOTS PUSHES THE ECP's CLR PUSHBUTTON

COCKPIT INDICATIONS

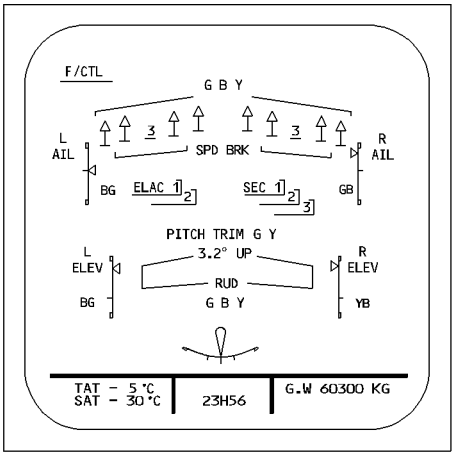
- The CLR pushbutton stays on.
- The FAULT/OFF light stays on.
- Hydraulic system messages disappear from the E/WD, and the right side of the memo area indicates a secondary failure in the flight control system.
- The SD automatically calls up the flight control system page, with surface actuator indications (associated with the blue hydraulic system) shown in amber.



ECAM UPPER DISPLAY (E/WD)

- BOTTOM LEFT
  .MEMO INFORMATION

- BOTTOM RIGHT
  .SECONDARY FAILURE



ECAM LOWER DISPLAY (SD)

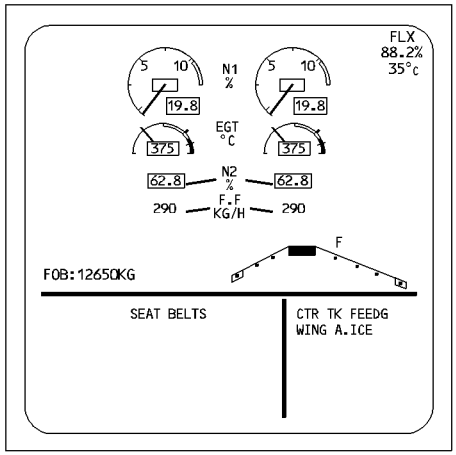
- F/CTL SYSTEM PAGE
AUTOMATICALLY DISPLAYS
FAULTY SPOILERS (n°3)
AND SURFACE ACTUATOR B PRESSURE
INDICATIONS IN AMBER

NFCS-01-3125-005-A110AA

5 – ONE OF THE PILOTS PUSHES THE CLR PUSHBUTTON A SECOND TIME

COCKPIT INDICATIONS

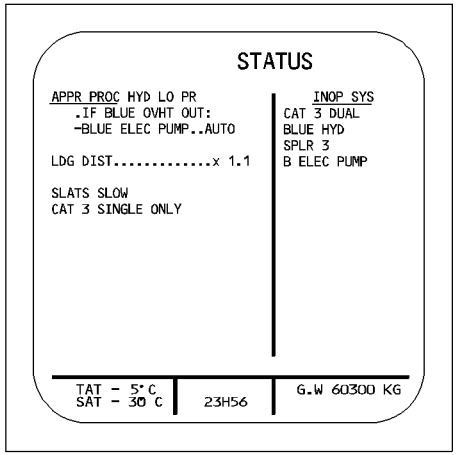
- The ECP's CLR and STS pushbuttons light up.
- The FAULT/OFF lights stay on.
- The E/WD's memo area returns to normal.
- The STATUS page automatically appears on the SD, displaying the procedures for completing the flight with a faulty blue system.



ECAM UPPER DISPLAY (E/WD)

– FULL MEMO DISPLAYED

ECAM LOWER DISPLAY (SD)



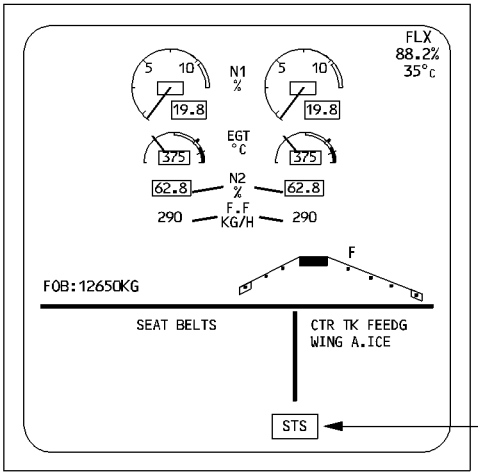
-THE STATUS PAGE IS AUTOMATICALLY DISPLAYED TO:
.PROVIDE THE PROCEDURE TO BE APPLIED FOR APPROACH.
.PROVIDE LANDING DISTANCE FACTORS AND INFORMATION.
.LIST THE INOPERATIVE SYSTEMS.

NFC5-01-3125-006-A110AA

6 – ONE OF THE PILOTS PUSHES THE CLR PUSHBUTTON A THIRD TIME

COCKPIT INDICATIONS

- The CLR pushbutton light goes off.
- The FAULT/OFF lights stay on.
- A status reminder appears at the bottom of the E/WD.
- The SD automatically displays the system page corresponding to the flight phase.

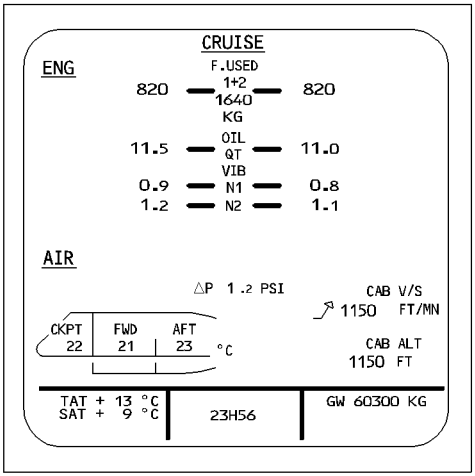


ECAM UPPER DISPLAY (E/WD)

- FULL MEMO DISPLAYED

STATUS REMINDER

ECAM LOWER DISPLAY (SD)



- RETURN TO THE FLIGHT PHASE RELATED SYSTEM PAGE : CRUISE PAGE

NFC5-01-3125-007-A110AA

GENERAL

The OEB reminder function provides operational help to the crew by enabling them to clearly identify (on the ECAM) all procedures and status messages affected by an OEB.
When a situation leading to a warning/caution occurs, a message informs the crew in real time that an OEB exists for the displayed warning and/or status and, consequently, that the procedure and/or status presented on the ECAM is not applicable.
Then the crew must refer to the QRH where the correct information is provided.

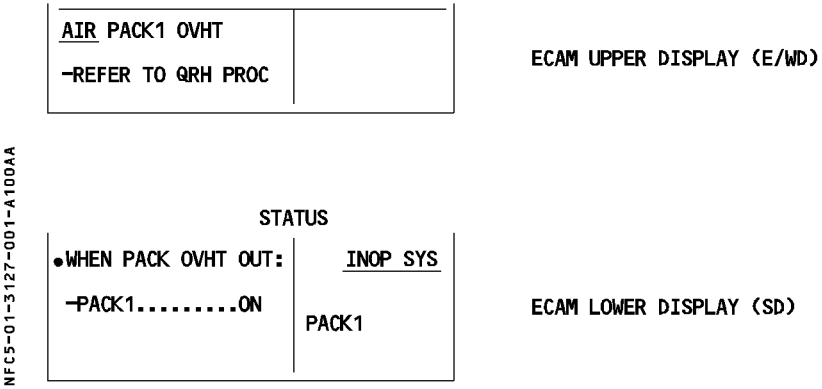
DESCRIPTION

The OEB reminder flag may apply to the :
- ECAM procedure only,
- ECAM procedure and corresponding status messages,
- Status message only.

PROCEDURE ONLY AFFECTED

- The ECAM warning title remains unaltered,
- All corresponding actions are suppressed and replaced by the "REFER TO QRH PROC" message,
- The related status messages on the ECAM system display remains unaltered.

COCKPIT INDICATION

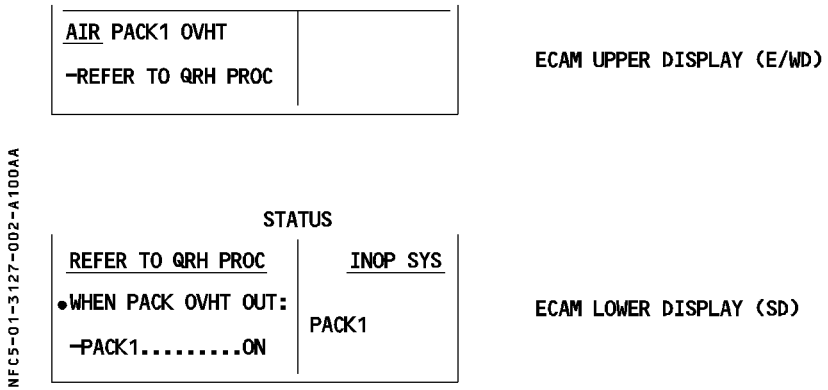


NFC5-01-3127-001-A100AA

PROCEDURE AND STATUS AFFECTED

- The ECAM warning title remains unaltered,
- All corresponding actions are suppressed and replaced by the "REFER TO QRH PROC" message,
- The related status messages on the ECAM system display remains unchanged, except for the additional "REFER TO QRH PROC" title.

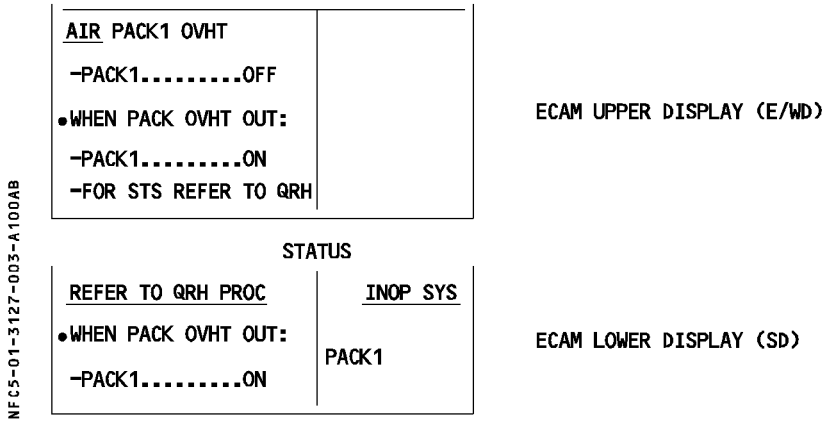
COCKPIT INDICATION



STATUS MESSAGE ONLY AFFECTED

- The ECAM warning title remains unaltered,
- The corresponding procedure remains unchanged, except for the additional "FOR STS REFER TO QRH" line.
- The related status messages on the ECAM system display remains unchanged, except for the additional "REFER TO QRH PROC" title.

COCKPIT INDICATION



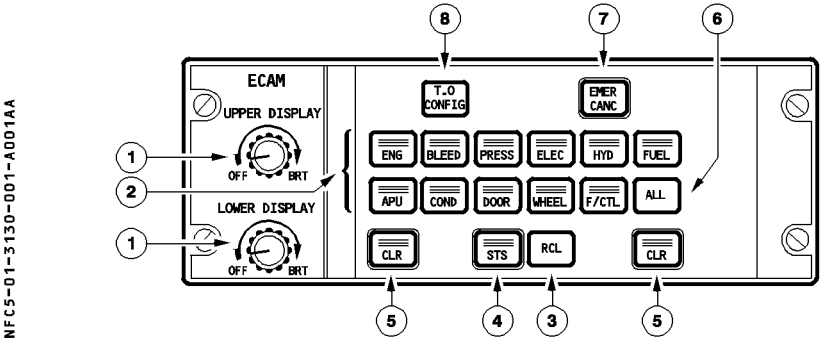
NFC5-01-3127-003-A100AB

OEB DATABASE

The OEB database lists the warnings and cautions affected by an OEB.
The OEB database can be :
- Loaded manually on the aircraft via the MCDU, and stored in both FWCs.
- Crossloaded from one FWC to the other FWC.
- Updated by entering a code via the MCDU.
- Checked via the MCDU.

Note : The code provided on the OEB is designed to ensure that the OEB database is not updated before the OEB is available.

ECAM CONTROL PANEL



NFCS-01-3130-001-A001AA

(1) OFF / BRT knobs

Used to turn the ECAM DUs on and off, and to control their brightness (automatic adjustment of brightness for ambient light conditions is superimposed on this manual control).

Note : When the pilot turns the UPPER DISPLAY knob to OFF, the engine/warning (E/W) display appears on the lower display unit (automatic transfer).

(2) System page pushbuttons

- Call up the corresponding system pages on the SD.
- Light up, when pushed for manual selection, or when an advisory is detected.
- Call up the aircraft system page corresponding to the present flight phase or the current warning when pushed a second time.

R When only one ECAM display is on, the pilot can display a system page for up to 3
R minutes by pushing and holding the system page pushbutton.
- If an advisory condition arises, the relevant system page is not automatically displayed, but the pushbutton light pulses.
- If an ECAM warning is triggered, the relevant system page is not automatically displayed, and the system page pushbutton does not light up.

(3) RCL pushbutton

The pilot pushes the RCL pushbutton to call up the warning messages, the caution messages, and the status page, that may have been suppressed by the activation of the CLR pushbutton or by flight-phase-related inhibition.
If there are no suppressed warnings or cautions, the E/WD shows “NORMAL” for five seconds.
If the pilot holds this pushbutton down for more than three seconds, the E/WD displays any caution messages that were suppressed by the EMER CANC pushbutton.

④ STS (status) pushbutton

The pilot pushes this pushbutton to display the STATUS page on the lower SD. The pushbutton remains lit, as long as the SD displays the STS page. If the system has no status messages, the status page displays "NORMAL" for five seconds.
The pilot can clear the STATUS page by pushing the CLR pushbutton, or by pushing the STS pushbutton a second time.
When only one ECAM display is on :

- It displays the STATUS page only when the pilot pushes the STATUS pushbutton and holds it. He can display the next STATUS page, if any, by releasing the pushbutton and pushing it again (before two seconds have elapsed). The new page then appears after a short delay.
- The pilot can keep the STS pushbutton pressed to display the STATUS page for a
R maximum of three minutes, after which the ECAM automatically displays the engine/warning page.

⑤ CLR pushbutton

This pushbutton remains lit as long as the E/WD is displaying a warning or caution
R message, or a status message on the SD.
If it is lit, pressing it changes the ECAM display.

⑥ ALL pushbutton

When this pushbutton is pressed and held down, the SD successively displays all the system pages at one-second intervals.
If the ECAM control panel fails, the pilot can use this pushbutton to page through the system pages until he comes to the one he wants to look at. He then releases the pushbutton to select that page.

⑦ EMER CANC pb

This pushbutton affects the following :

– Warnings :
  · Cancel (stop) an aural warning for as long as the failure condition continues.
  · Extinguishes the MASTER WARNINGS lights.
  · Does not affect the ECAM message display.
– Cautions :
  · Cancel any present caution (single chime, MASTER CAUTION lights, ECAM message) for the rest of the flight.
  · Automatically calls up the STATUS page, which displays "CANCELLED CAUTION" and the title of the failure that is inhibited.

  The inhibition is automatically suppressed when Flight Phase 1 is initiated. The pilot may restore it manually by pressing the RECALL pushbutton for more than three seconds.

R *Note : This pushbutton should only be used to suppress spurious MASTER CAUTIONS.*

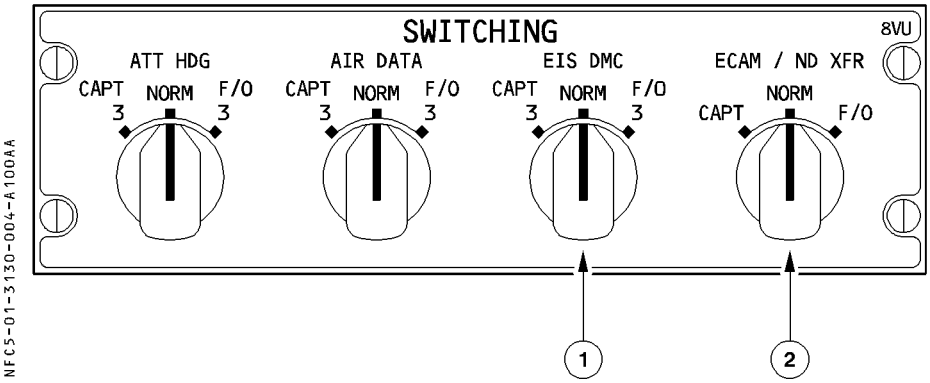
⑧ T.O. CONFIG pb

This pushbutton simulates the application of takeoff power. This is a test that triggers a warning, if the aircraft is not in takeoff configuration. (See 1.31.15).
If the configuration is correct, the E/WD displays the "TO CONFIG NORMAL" message in the TO MEMO section.

Note : If the ECAM control panel fails, the CLR, RCL, STS, EMER CANC, and ALL pushbuttons remain operative, because their contacts are directly wired to the flight warning and display management computers.

SWITCHING PANEL

ON PEDESTAL



(1) EIS DMC selector

NORM : DMC 1 drives the CAPT's PFD, the CAPT's ND, and the ECAM's DUs.
DMC 2 drives the F/O's PFD and the F/O's ND.
CAPT 3: DMC 3 replaces DMC 1.
F/O 3 : DMC 3 replaces DMC 2.

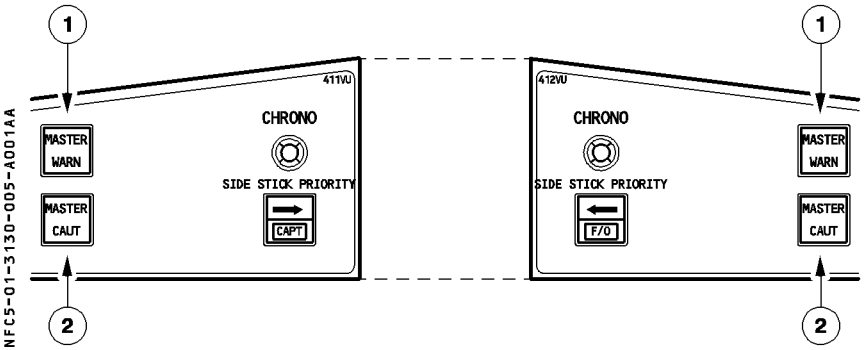
R *Note : If a DMC fails, each of its associated DUs displays an "INVALID DATA"*
R *message.*

(2) ECAM/ND transfer selector

Transfers the system/status display to either the Captain's or the First Officer's ND.

Note : If both ECAM DUs (E/WD and SD) fail, the flight crew can use this switch to transfer the E/WD display to either navigation display.

ATTENTION GETTERS



(1) MASTER WARN lights

- Flash red for level 3 warning.
- Accompanied by an aural warning (continuous repetitive chime, specific sounds or synthetic voice).

(2) MASTER CAUT lights

- Light up steady amber for a level 2 caution.
- Accompanied by a single chime.

These lights go out when :

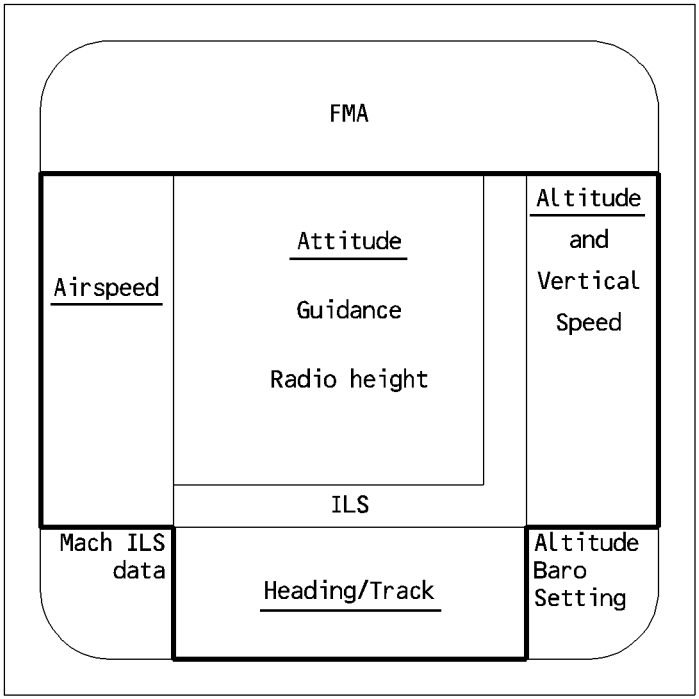
- One pilot presses the light (except for some red warnings, such as the overspeed and stall warnings).
- The warning/caution situation is over.
- The pilot presses the CLR pushbutton on the ECAM control panel (except for some red warnings, such as the overspeed and stall warnings).
- The pilot presses the EMER CANC pushbutton on the ECAM control panel.

The aural warnings cease when :

- One pilot presses the MASTER WARN light (except for some red warnings, such as the overspeed and stall warnings).
- The warning situation is over.
- The pilot presses the EMER CANC pushbutton on the ECAM control panel.

GENERAL

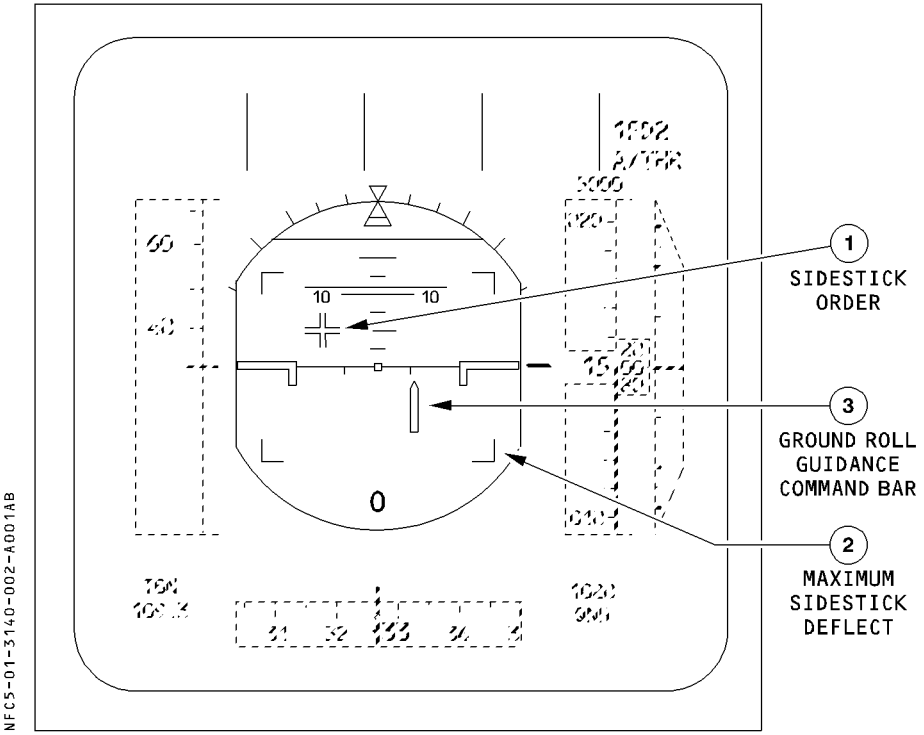
The Primary Flight Display (PFD) provides the following information :
- Attitude and Guidance
- Airspeed
- Altitude (Baro and Radio) and Vertical Speed
- Heading and Track
- FMGS modes (Flight Mode Annunciator)
- Vertical and Lateral Deviations
- Radio navigation information (ILS, DME).



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The FWC monitors such main parameters as : Attitude, heading, and altitude. For more information, refer to the "FLAGS AND MESSAGES DISPLAYED ON PFD" Chapter.

SPECIFIC GROUND INDICATIONS



(1) Sidestick order indication (white)

This is displayed, as soon as one engine is started.
It indicates the total of the pilot's and copilot's sidestick orders (shown here as left wing down, pitch up).

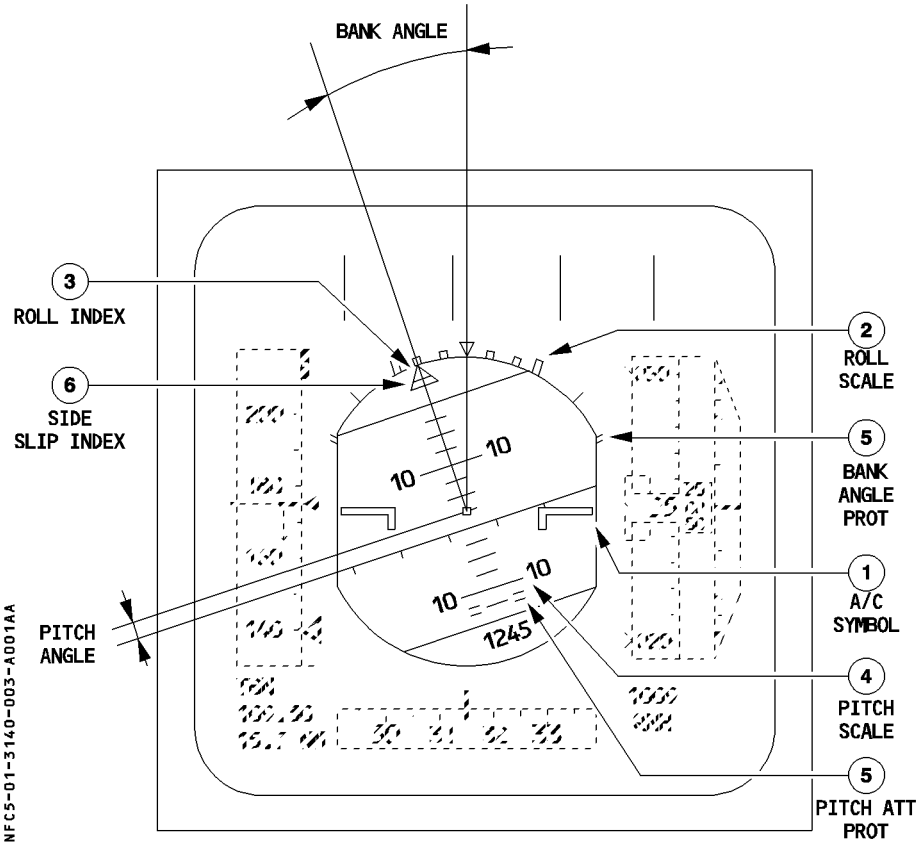
(2) Max Sidestick Deflection (white)

This is displayed, as soon as one engine is started.

(3) Ground Roll Guidance Command Bar (green)

R This symbol is displayed when the aircraft is on the ground, or below 30 feet radio
R altitude, provided a localizer signal is available. It shows the flight director yaw orders, to keep the runway centerline.

ATTITUDE DATA



(1) Fixed Aircraft Symbol

R This symbol is in black, and outlined in yellow. The yellow outline is dimmed if the crew
R selects TRK-FPA, unless the FMA is in the TOGA or FLX mode.

(2) Roll Scale

This scale is in white, and has markers at 0,10, 20, 30, and 45 degrees of bank.

(3) Roll Index (yellow)

This pointer indicates the bank angle. When the bank angle exceeds 45°, all the PFD symbols, except those for attitude, speed, heading, altitude, and vertical speed, disappear. The display returns to normal when the bank angle decreases below 40°.

(4) Pitch Scale (white)

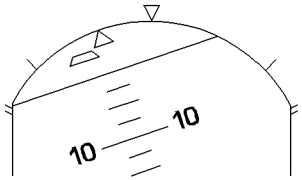
This scale has markers every ten degrees between 80° nose up and 80° nose down (every 2.5° between 10° nose down and 30° nose up). When pitch angle exceeds 25° nose up or 13° nose down, all the PFD displays except attitude, speed, speed trend, heading, altitude, and vertical speed disappear. Beyond 30°, large red arrowheads indicate that the attitude has become excessive and show the direction to move the nose in order to reduce it. The display returns to normal when pitch angle becomes less than 22° nose up or 10° nose down.

(5) Flight Control Protection Symbols

The display shows these symbols in green :
· on the roll scale at ± 67° to mark the bank angle limits
· on the pitch scale at 15° nose down or 30° nose up to mark the pitch limits.
An amber × replaces these symbols if the corresponding protection is lost.
(Refer to 1.27.30)

(6) Sideslip Index (yellow)

R This trapezoidal index moves beneath the roll index. On the ground it represents the lateral acceleration of the aircraft : in flight it shows sideslip (as computed by the FAC). One centimeter of displacement indicates 0.2g. The sideslip index is against its stop at 0.3g.



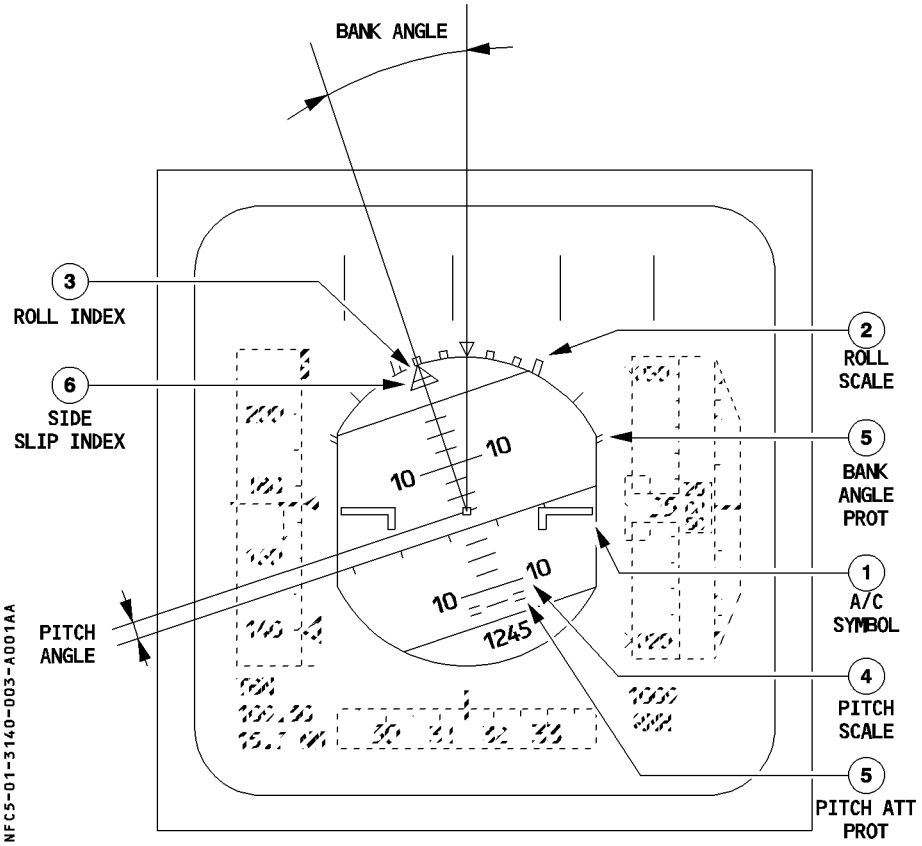
NFCS-01-3140-004-A00SAA

In case of engine failure at takeoff or go around, the sideslip index changes from yellow to blue.

Note : The sideslip target is blue if :
– CONF 1, 2, or 3 is selected, and
– any ENG N1 > 80%, and
– the difference between the ENG N1's exceeds 35%.
In this case the sideslip index is called β target.

When this index is centered with the roll index, the sideslip equals the sideslip target for optimum aircraft performance.

ATTITUDE DATA



(1) Fixed Aircraft Symbol

R This symbol is in black, and outlined in yellow. The yellow outline is dimmed if the crew
R selects TRK-FPA, unless the FMA is in the TOGA or FLX mode.

(2) Roll Scale

This scale is in white, and has markers at 0,10, 20, 30, and 45 degrees of bank.

(3) Roll Index (yellow)

This pointer indicates the bank angle. When the bank angle exceeds 45°, all the PFD symbols, except those for attitude, speed, heading, altitude, and vertical speed, disappear. The display returns to normal when the bank angle decreases below 40°.

(4) Pitch Scale (white)

This scale has markers every ten degrees between 80° nose up and 80° nose down (every 2.5° between 10° nose down and 30° nose up). When pitch angle exceeds 25° nose up or 13° nose down, all the PFD displays except attitude, speed, speed trend, heading, altitude, and vertical speed disappear. Beyond 30°, large red arrowheads indicate that the attitude has become excessive and show the direction to move the nose in order to reduce it. The display returns to normal when pitch angle becomes less than 22° nose up or 10° nose down.

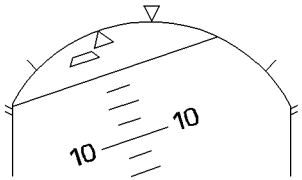
(5) Flight Control Protection Symbols

The display shows these symbols in green :
· On the roll scale at ± 67° to mark the bank angle limits
· On the pitch scale at 15° nose down or 30° nose up to mark the pitch limits.
An amber × replaces these symbols if the corresponding protection is lost.
(Refer to 1.27.30)

(6) Sideslip Index (yellow)

This trapezoidal index moves beneath the roll index. On ground, it represents the lateral acceleration of the aircraft. In flight, it shows sideslip (as computed by the FAC). One centimeter of displacement indicates 0.2g. The sideslip index is against its stop at 0.3g.

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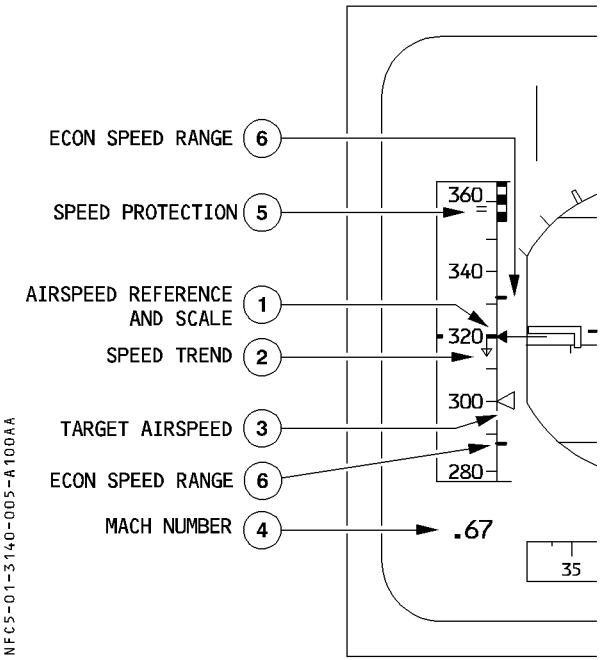


In case of engine failure at takeoff or go around, the sideslip index changes from yellow to blue.

Note : The sideslip target is blue, if :
– CONF 1, 2, or 3 is selected, and
– Any ENG N1 > 80% or one Thrust Lever > MCT (≥ FLX if FLX or DERATED TO), and
– The difference between the ENG N1's exceeds 35%.
In this case, the sideslip index is called β target.

When this index is centered with the roll index, the sideslip equals the sideslip target for optimum aircraft performance.

AIRSPEED



(1) Actual Airspeed Reference Line and Scale

A white scale, on a grey background, moves in front of a fixed yellow reference line (next to a yellow triangle) to indicate airspeed. The minimum airspeed indication is 30 knots.

(2) Speed Trend (yellow)

This pointer starts at the speed symbol. The tip indicates the speed the aircraft will reach in 10 seconds, if its acceleration remains constant. The pointer only appears, when it is greater than 2 knots, and disappears when it is less than 1 knot.
It also disappears, if the FACs fail.

(3) Target Airspeed (magenta or blue)

This symbol gives the target airspeed, or the airspeed corresponding to the target Mach number.
The target airspeed is the airspeed computed by FMGC in managed speed mode (magenta), or the airspeed manually entered on the FCU in selected speed mode (blue).
The target speed is indicated by a magenta or blue triangle.
When the target speed is off the speed scale, its value is displayed as numbers, either above or below the speed scale.

(4) Mach Number (green)

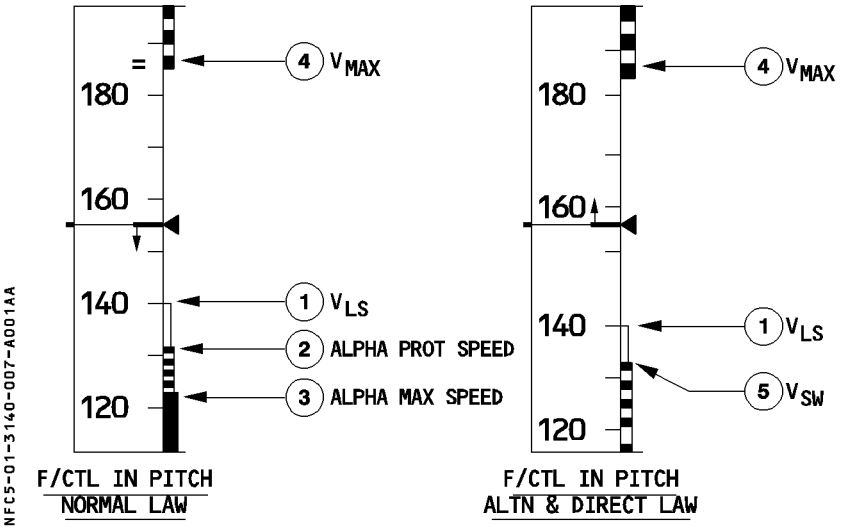
It is displayed, when it is greater than 0.5.

(5) Speed Protection (green)

This symbol indicates the speed (VMO + 6 kt or MMO + 0.01) at which overspeed protection becomes active (Refer to 1.27.30).

(6) ECON Speed Range (magenta)

In descent mode with the ECON/AUTO SPD mode active, these two thick lines replace the selected speed symbol. It shows the upper and lower limits, calculated by the FMGC.
- The upper speed is target speed + 20 knots, limited to VMAX or VMO – 3 knots or MMO – 0.006, whichever is lowest.
  If a speed limit or a speed constraint applies, the upper margin is limited to ECON SPD + 5 knots.
- The lower speed margin is the target speed – 20 knots, limited to green dot, F, S, or VLS, whichever is higher.



(1) Minimum Selectable Speed (VLS)

The top of the amber strip along the speed scale indicates this speed. It represents the lowest selectable speed providing an appropriate margin to the stall speed. (Refer to 3.04.10)
VLS information is inhibited from touchdown until 10 seconds after liftoff.

(2) Alpha Protection Speed

The top of a black and amber strip along the speed scale indicates this speed.
It represents the speed corresponding to the angle of attack at which alpha protection
R becomes active (Refer to 1.27.20).
It is displayed when in pitch normal law.

(3) Alpha Max Speed

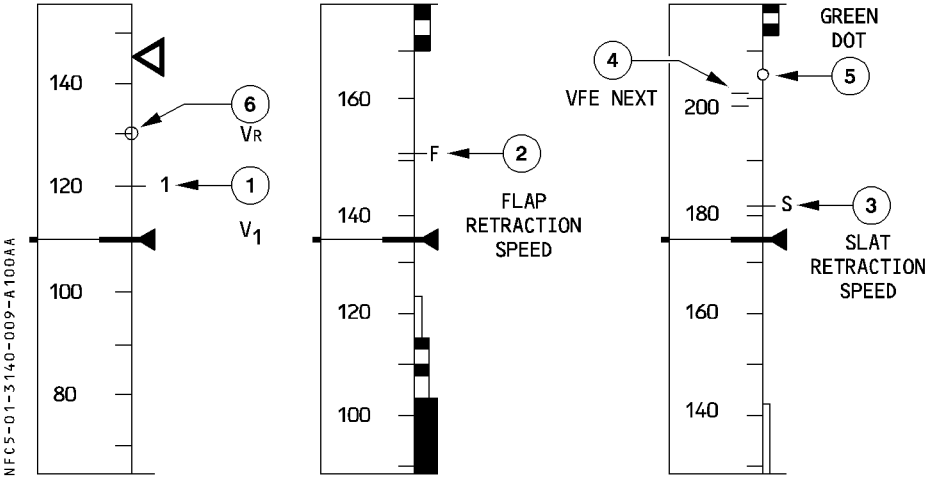
The top of a red strip along the speed scale indicates this speed. It represents the speed corresponding to the maximum angle of attack that the aircraft can attain in pitch normal
R law (Refer to 1.27.20).
It is displayed when in pitch normal law.

④ VMAX

The lower end of a red and black strip along the speed scale defines this speed.
It is the lowest of the following :
· VMO or the speed corresponding to MMO
· VLE
· VFE
(Refer to 3.04.10)

⑤ Stall Warning Speed (VSW)

The top of a red and black strip along the speed scale defines this speed.
R It is the speed corresponding to the stall warning. (Refer to 1.27.20).
VSW information is inhibited from touchdown until 5 seconds after liftoff.
It is displayed when operating in pitch alternate or pitch direct law.



(1) Decision Speed (V1)

This is a blue symbol (numeral one) that the crew manually inserts via the MCDU. When it is off the scale, the upper part of the scale shows it in numbers.
It disappears after liftoff. (Refer to 3.04.10).

(2) Minimum Flap Retraction Speed

This is a green symbol (letter F).
It appears when the flap selector is in position 3 or 2. (Refer to 3.04.10).

(3) Minimum Slat Retraction Speed

This is a green symbol (letter S).
It appears when the flap selector is in position 1. (Refer to 3.04.10).

(4) VFE NEXT

The VFE next symbol is an amber equal sign showing the VFE corresponding to the next flap lever position.
It appears when the aircraft altitude is below 15,000 or 20,000 feet, depending upon the FAC standard. (Refer to 3.04.10).

(5) Green Dot (Engine-out operating speed in clean configuration)

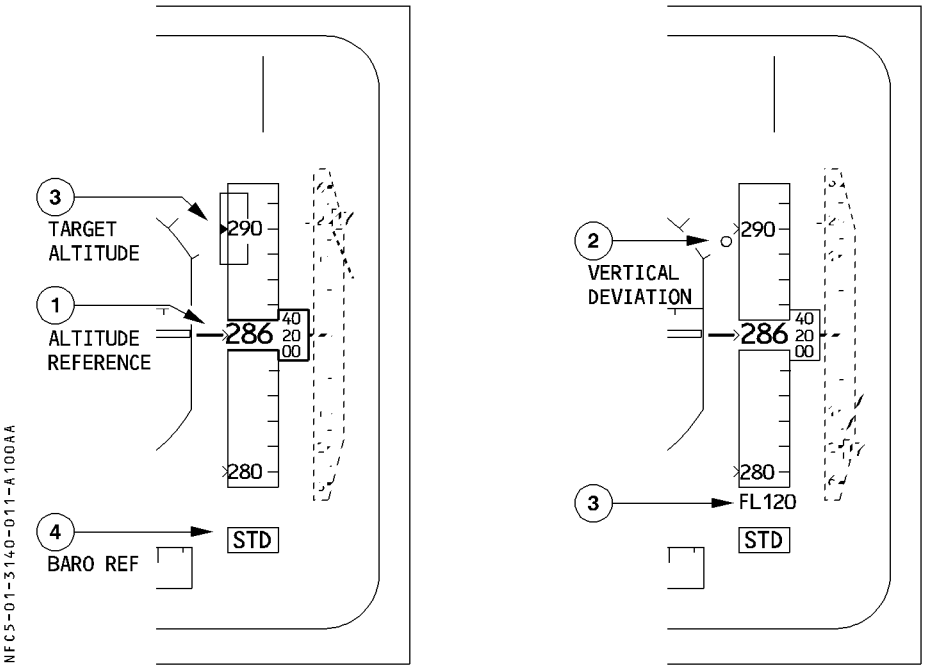
This green dot appears, when the aircraft is flying in the clean configuration.
It shows the speed corresponding to the best lift-to-drag ratio.

(6) Rotation speed : (VR)

R VR is entered on the PERF takeoff page of the MCDU, and is indicated by a cyan circle.
R This cyan circle is visible during takeoff.

Note : V2 is represented by the target speed index during takeoff.
V2 is manually inserted by the crew via the MCDU.

ALTITUDE



(1) Altitude Indication

This appears both as a white moving scale, and as a green digital readout on a grey
R background. Small white marks are positioned on the scale against the round values (e.g.
R 280, 290...). For negative altitudes, "NEG" appears in the window in white. The altitude window changes from yellow to amber, if the aircraft deviates from the FCU-selected altitude or flight level.
On any approach for which an MDA (MDH) is entered in the FMGS, the altitude numbers change from green to amber, when the aircraft goes below the MDA (MDH).

(2) Vertical Deviation (magenta)

This symbol appears next to the altitude corresponding to the theoretical vertical profile
R computed by the FMGC. It is displayed from the top of descent down to the MAP
R altitude.
The pilot can read the VDEV directly from the altitude scale. The range is ± 500 feet. When the VDEV value exceeds ± 500 feet, the symbol stays at the range limit and the PROG page displays the exact value.

(3) Target Altitude or Selected Flight Level Symbol (blue)

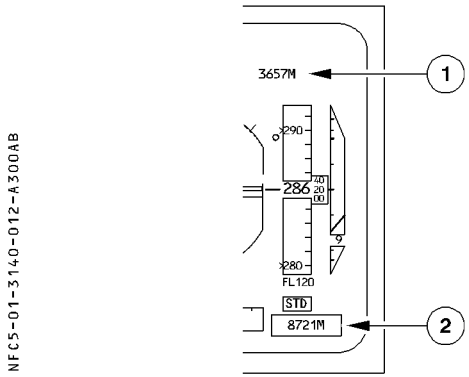
This symbol shows the FCU selected altitude (if QNH or QFE baro reference is selected) or the selected flight level (if STD baro reference is selected.)
When the FMGC operates in the vertical managed mode, this symbol is magenta if it represents a flight plan altitude constraint that the FMGC will follow. If the target altitude or flight level is on the scale, the symbol is displayed and the numerical value appears inside the symbol.
If it is off the scale, the symbol is not displayed, and the numerical value appears above or underneath the scale.

(4) Barometric Reference

The display shows "STD" or it shows "QNH" or "QFE" and the numerical setting in hectoPascals or inches of mercury.
It pulses when the selection made by the pilot is not correct (STD not selected above transition altitude in climb or STD still selected in approach below transition level or 2500 feet radio height if transition level is not available).

METRIC ALTITUDE INDICATION

If metric reference is selected on the FCU two additional symbols are displayed on PFD.



NFCS-01-3140-012-A300AB

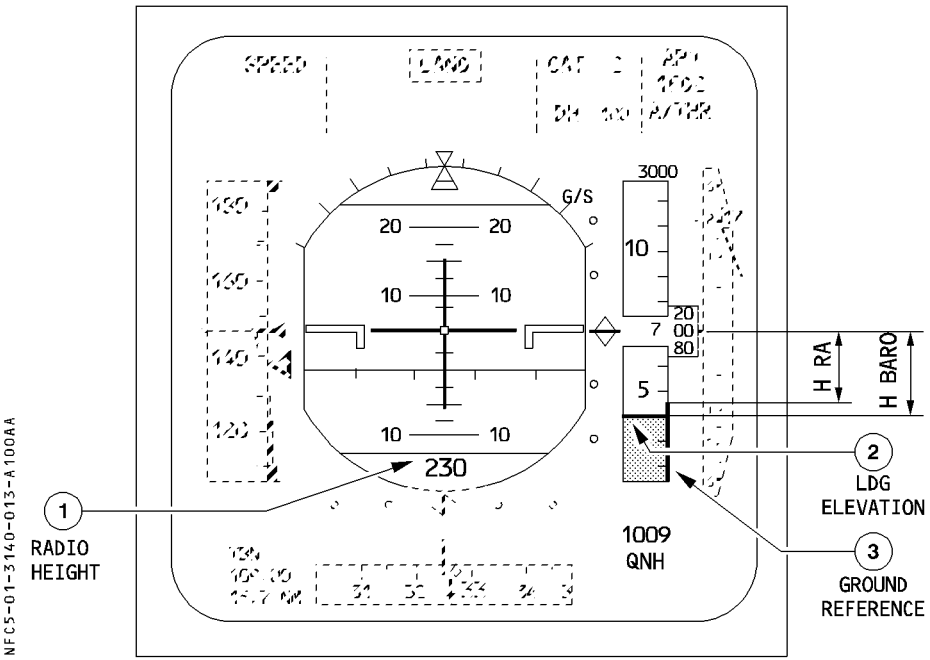
(1) Target altitude or selected flight level (magenta or blue)

The display shows the selected altitude value in meters.

(2) Altitude indication (green)

The display shows the actual aircraft altitude value in meters.

R



(1) Radio Height

This quantity appears, when it is less than 2500 feet.

– If a DH has been entered, the radio height appears :
  · In green, when DH + 100 feet < RA < 2500 feet
  · In amber, when RA < DH + 100 feet.
  If "NO" is entered as the DH on the MCDU APPROACH page, 0 feet becomes a default value.
  When the aircraft reaches the decision height selected on the MCDU, DH letters flash
R amber for nine seconds, then remain amber above the radio height indication.
– If no DH has been entered, or if both FMGCs fail, the radio height appears :
  · In green, when 400 feet < RA < 2500 feet
  · In amber, when RA ≤ 400 feet.

The radio altitude indication changes every 10 feet down to 50 feet, then every 5 feet down to 10 feet, then every foot.

(2) Landing Elevation (blue)

The top of the brown surface on the altitude scale represents the landing elevation at the flight-planned destination.
It is displayed during flight phases 7 and 8 and if the STD reference mode is not selected.

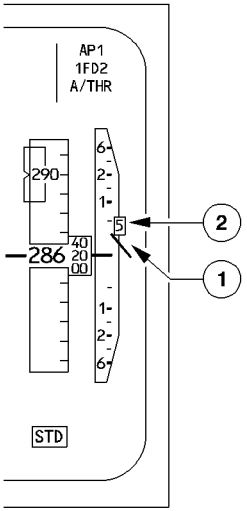
(3) Ground reference

A red ribbon on the right of the altitude scale represents the field elevation. This ribbon, driven by the radio altimeter signal, is displayed below 570 feet.
It moves up, as does the lower line of the attitude sphere, with the altitude scale as the aircraft descends. When the aircraft has touched down, the top of this ribbon is at the middle of the altitude window.

VERTICAL SPEED

The displayed vertical speed information is normally based on both inertial and barometric data. If inertial data is not available, it is automatically replaced by barometric information. In this case, the window around the numerical value becomes amber.

R



NFC5-01-3140-015-A100AA

(1) Analog pointer

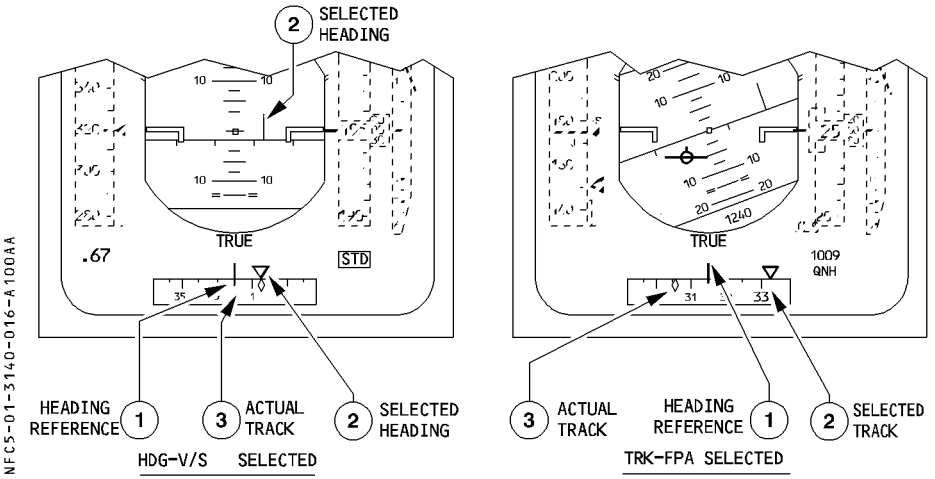
This pointer, which is normally in green, points to a white vertical speed scale, displayed on a grey background and graduated at intervals of 500 feet/minute.
If the V/S is greater than 6000 feet/minute, the pointer stays at the end of the scale.

(2) Digital indication

This number, normally in green, is the vertical speed in hundreds of feet per minute.
It disappears, if the vertical speed is less than 200 feet/minute.
The analog pointer and the digital indication become amber, if :
- V/S is greater than 6000 feet/minute, (climb or descent)
- V/S is greater than 2000 feet/minute, during descent when 1000 feet < RA < 2500 feet, or
- V/S is greater than 1200 feet/minute, during descent and RA < 1000 feet.

Note : For TCAS, refer to 1.34.80.

R **HEADING**



(1) Heading Reference Line and Scale

A white scale on a grey background moves in front of a fixed yellow reference line to show the actual magnetic heading.
"TRUE" appears, when the display shows true heading, instead of magnetic heading (latitude above 73° North or below 60° South).

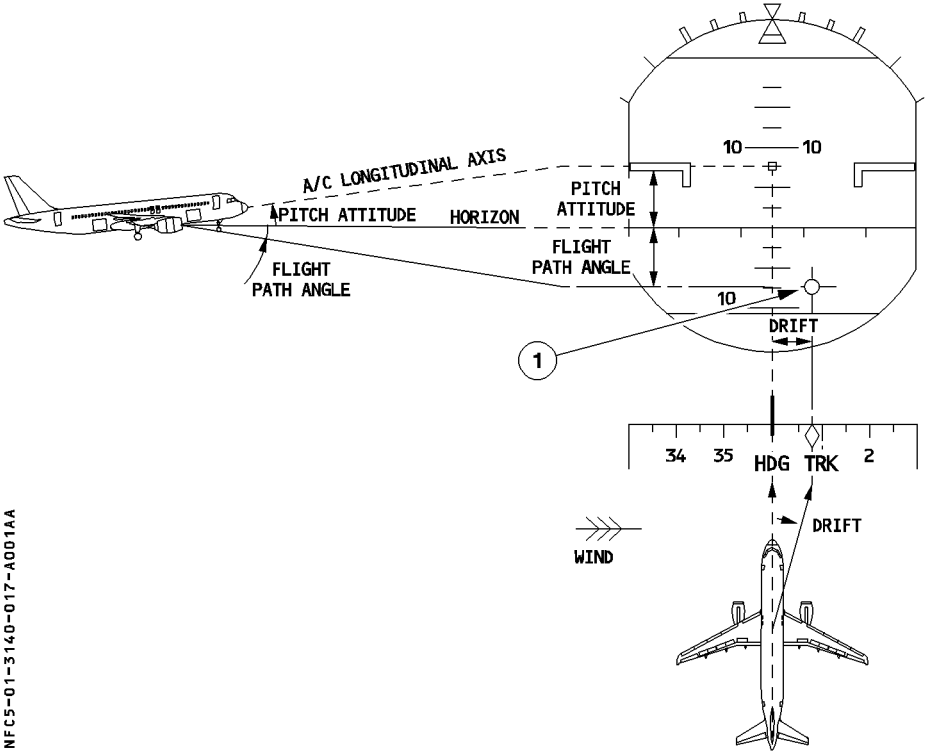
(2) Selected Heading or Track Index (blue)

The pointer indicates the heading or track displayed on the FCU HDG-TRK window.
The index is replaced by digits on the right, or on the left, side of the scale when the selected value is off the scale.
If the FD pushbutton is OFF, a second heading/track symbol appears on the horizon line and markers are displayed every 10°.

(3) Actual Track Symbol

This symbol is a small green diamond.

FLIGHT PATH VECTOR



(1) Flight Path Vector (FPV)

This symbol appears when the pilot selects TRK/FPA on the FCU.
The flight path vector represents the lateral and vertical trajectory of the aircraft with respect to the ground.

– On the lateral scale it indicates the aircraft's track.
– On the vertical scale it indicates the aircraft's flight path angle.

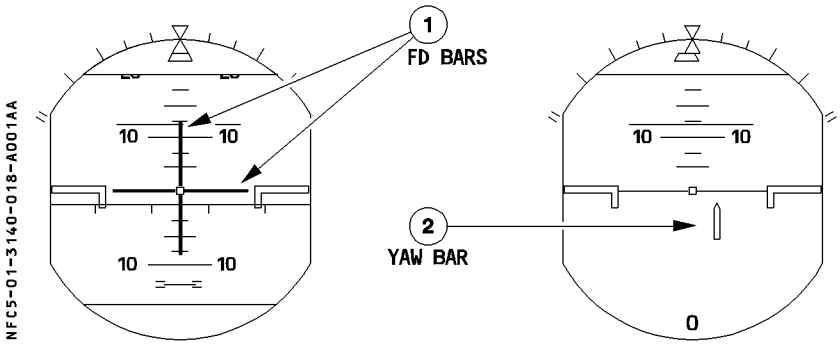
Example : The aircraft flies a track of 009 (heading 360°, wind from west) and descends with a flight path angle of – 7.5°.

GUIDANCE

Two completely different flight director modes are available, each with its own characteristic symbols. The symbol displayed corresponds to the basic operating reference the pilot has selected – either HDG V/S or TRK FPA.
In normal operation PFD1 displays FD1 orders.
If FD1 fails, PFD1 automatically displays FD2 orders, and on the PFD1 the FD2 indication in the right column of the FMA flashes for a few seconds.
The same applies for FD2 orders normally displayed on PFD2.

IF THE CREW HAS SELECTED HDG V/S TO BE THE BASIC REFERENCE :

The PFD displays pitch and roll bars in green. They automatically move out of view at touchdown in ROLL OUT mode.
They flash for 10 seconds and then remain steady in the following conditions :
– reversion to the HDG V/S basic mode (manual or automatic), or
– change of selected flight level when ALT CAPTURE mode is engaged, or
– loss of LOC or G/S in LAND mode or loss of LAND mode, or
– at the first AP or FD engagement.
The PFD displays a yaw bar in green below 30 feet radio altitude if a localizer signal is available:
– during takeoff (in RWY mode)
R – upon landing (in FLARE and ROLL OUT mode).



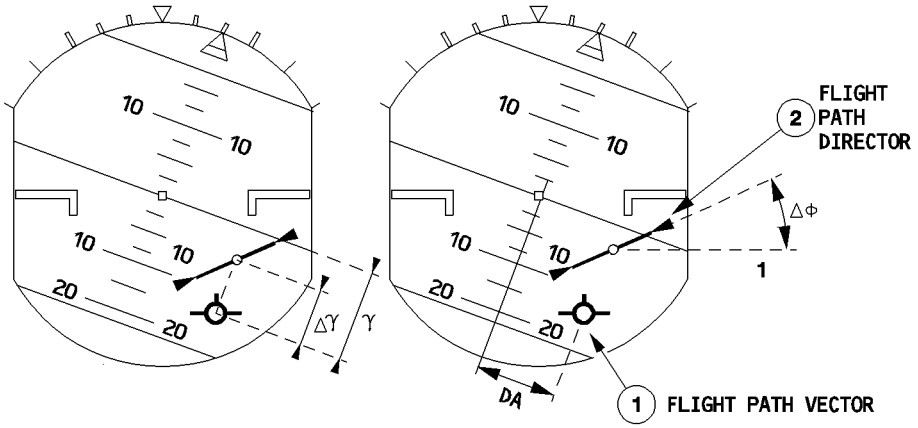
(1) FD Crossed Bars (green)

(2) Yaw Bar (green)

THE CREW HAS SELECTED TRK FPA AS THE BASIC REFERENCE :

An inertial flight path vector defines the aircraft's horizontal and vertical track, taking wind effect into account.
An associated flight path director symbol guides the flight crew onto the vertical and horizontal flight path targets.

R



NFCS-01-3140-019-A001AA

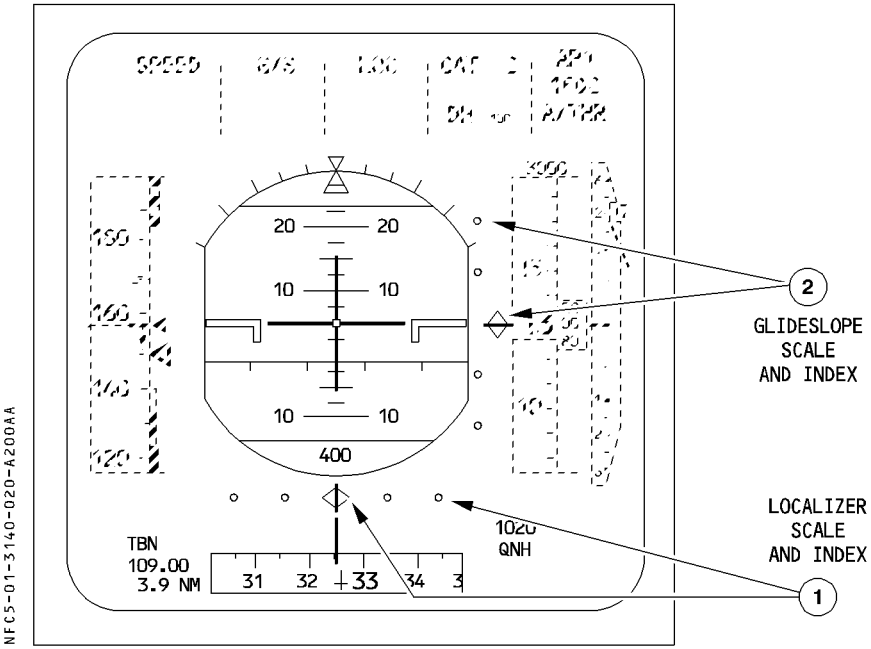
Υ REPRESENTS THE FLIGHT PATH ANGLE
DA REPRESENTS THE DRIFT ANGLE
ΔΥ REPRESENTS THE DIFFERENCE BETWEEN THE ORDERED FLIGHT PATH ANGLE AND THE ACTUAL ONE
Δφ REPRESENTS THE DIFFERENCE BETWEEN THE ORDERED ROLL ANGLE AND THE ACTUAL ONE

(1) Flight Path Vector (green)

(2) Flight Path Director (green)

TRAJECTORY DEVIATION

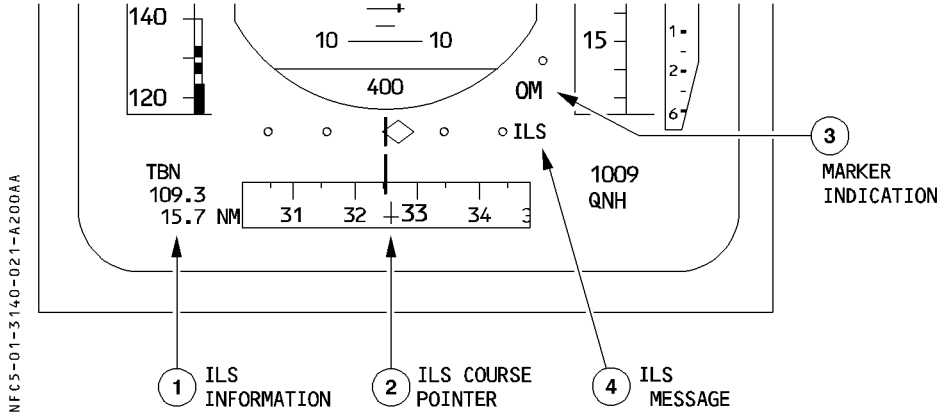
ILS APPROACH



(1) Localizer Deviation Scale and Index

(2) Glideslope Deviation Scale and Index

Deviation scales appear as soon as the flight crew pushes an LS pushbutton on the EFIS control panel. Deviation indexes appear, when the glideslope and localizer signals are valid, if deviation scales are displayed.
When a deviation index is out of the displayed range, only half a symbol appears at the end of the scale.
The LOC scale flashes and continues to flash, if the deviation exceeds 1/4 dot for two seconds (above 15 feet RA). The glide scale flashes and continues to flash, if the deviation exceeds one dot for two seconds (above 100 feet RA).
"LOC" and the glide scale half index symbols flash and continue to flash, when the deviation exceeds two dots for two seconds.
One dot represents a deviation of ± 0.8° on the localizer scale and ± 0.4° on the glideslope scale.



(1) ILS information (magenta)

The following information appears on the PFD, when the crew has selected an ILS frequency and course, and pushed the LS pushbutton :
· ILS identification, as decoded by the ILS receiver ;
· ILS frequency ;
· DME distance, if the ILS has a DME

(2) ILS course Pointer (magenta)

This pointer appears on the PFD, when the crew has selected an ILS frequency and course, and pushed the LS pushbutton.
It is a dagger-shaped symbol on the heading scale.
The ILS course pointer is replaced by digits on the right or left of the heading scale (in white box), when the ILS course value is outside the displayed portion of the heading scale.

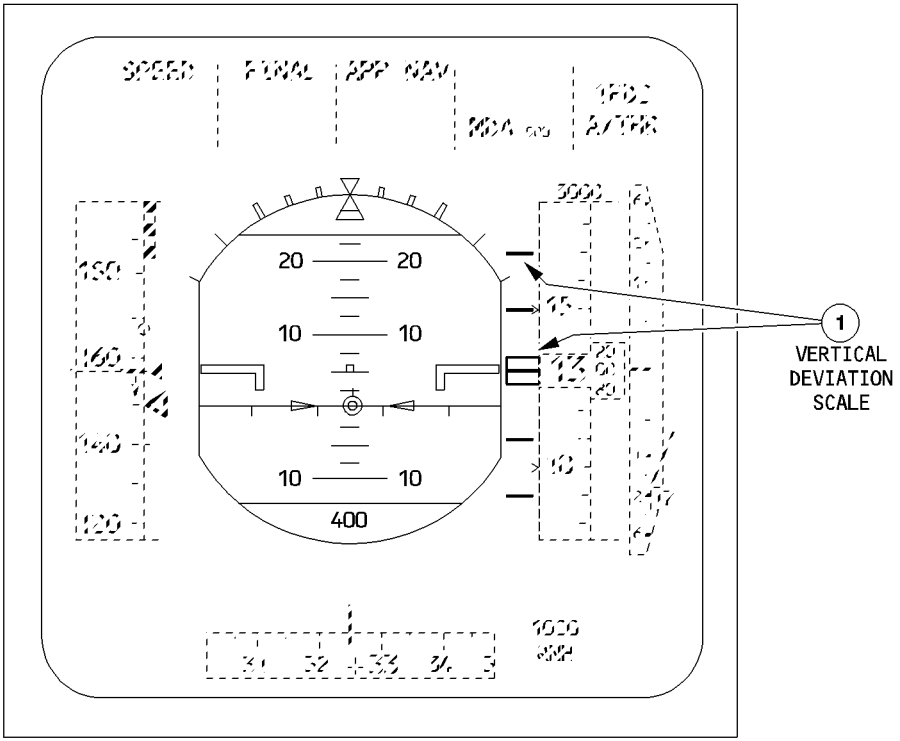
(3) Marker Indications

OM appears in blue, when the aircraft flies over the outer marker.
MM appears in amber, when it flies over the middle marker.
IM appears in white, when it flies over an airways marker beacon or the ILS inner marker.

(4) ILS Message

This flashes amber, when the APPR mode is armed and the ILS display is not selected.

NON PRECISION APPROACH

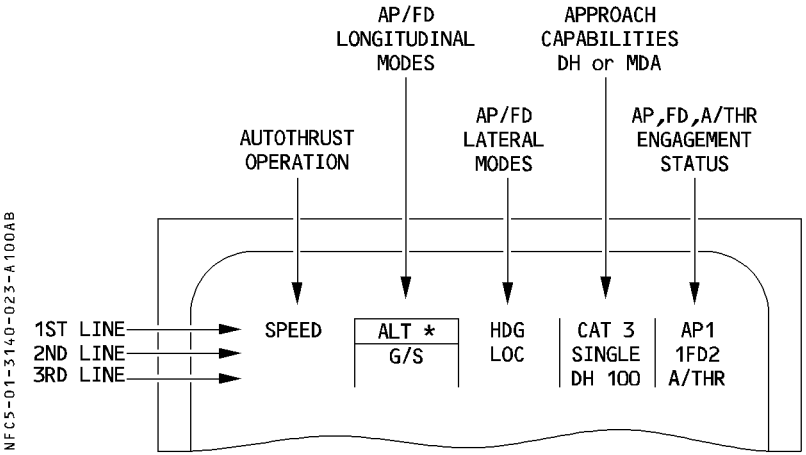


(1) Vertical Deviation Scale and Index

These symbols appear when in the approach phase and, when either FINAL is armed/engaged or a non-LS approach has been entered. They are displayed in the approach or go-around phase, until the MDA has been reached, or the MAP or the runway has been sequenced. They give the vertical deviation from the trajectory defined by the FMGC.
Each index scale graduation represents 100 feet. The range is ± 200 feet.

Note : · If the LS pushbutton is pressed, glide deviation has priority over vertical deviation information. As long as V/DEV display conditions are met, and the LS pushbutton is selected, an amber V/DEV message flashes above the glide scale.

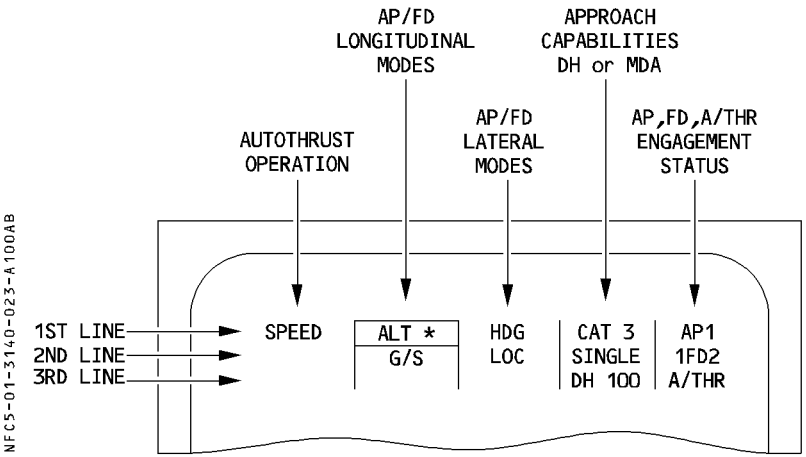
FLIGHT MODE ANNUNCIATOR



For a detailed discussion of legends and messages that may appear during FMGS operations, see FLIGHT GUIDANCE chapter (Refer to 1.22.30).

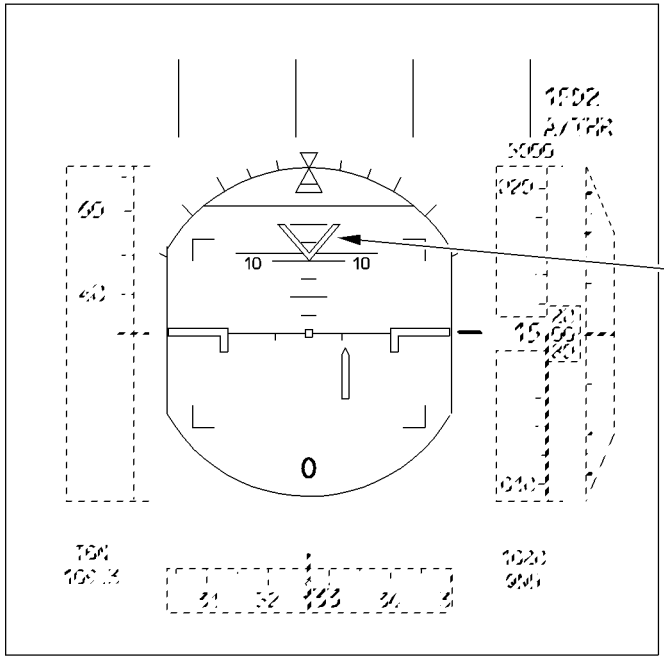
INTENTIONALLY LEFT BLANK

FLIGHT MODE ANNUNCIATOR



For a detailed discussion of legends and messages that may appear during FMGS operations, see FLIGHT GUIDANCE chapter (Refer to 1.22.30).

TAILSTRIKE PITCH LIMIT INDICATOR

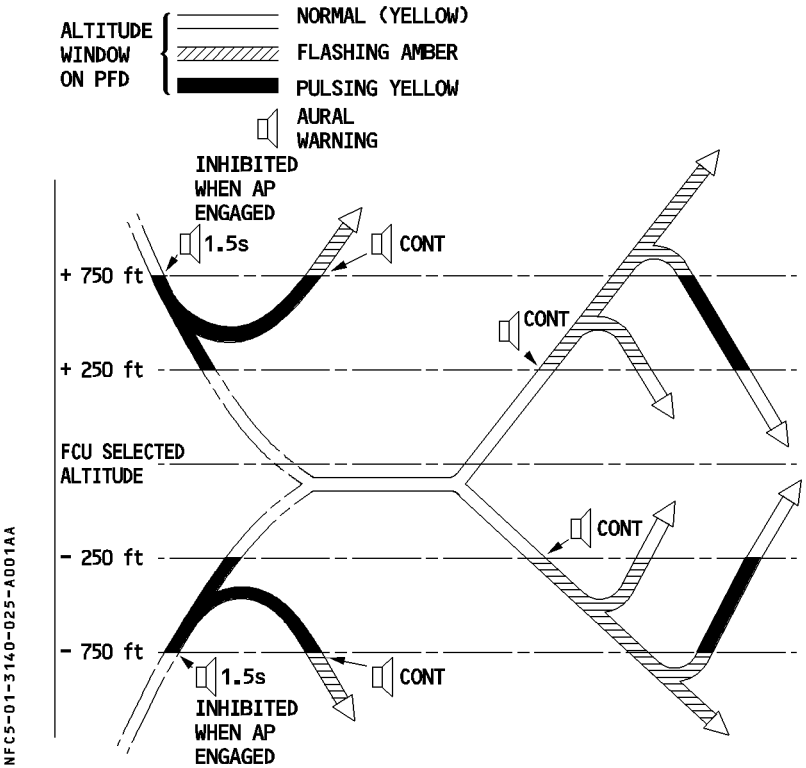


(1) Tailstrike Pitch Limit

The pitch limit indicates the maximum pitch attitude to avoid the tailstrike risk at landing. The indication is a fixed value corresponding to the main landing gear compressed. The indication appears at 400 feet radio height. The indication disappears, when there is no longer a risk of tailstrike.

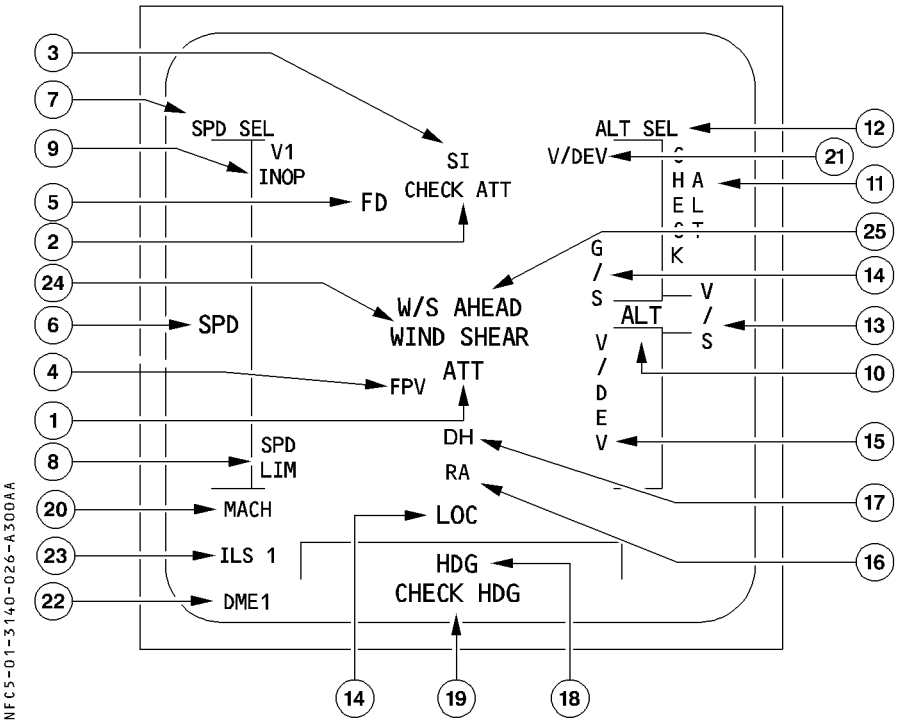
ALTITUDE ALERT

The FWC generates an altitude warning (C chord sound and altitude window of PFD pulsing yellow or flashing amber) when the aircraft approaches a preselected altitude or flight level or when it deviates from its selected altitude or flight level.
This warning results from a comparison between the altitude (ADIRS) and the preselected altitude displayed on FCU.



- The selection of a new altitude cancels the continuous C chord, as does the crew's pushing the EMER CANC pushbutton of the ECAM control panel or the pressing either MASTER WARN pushbutton.
- The selection of a new altitude stops the flashing of the altitude window.
- The altitude alert is inhibited :
  - when the slats are out with landing gear is selected down, or
  - in approach after the aircraft captures the glide slope, or
  - when the landing gear is locked down.

FLAGS AND MESSAGES DISPLAYED ON PFD



(1) ATT flag (red)

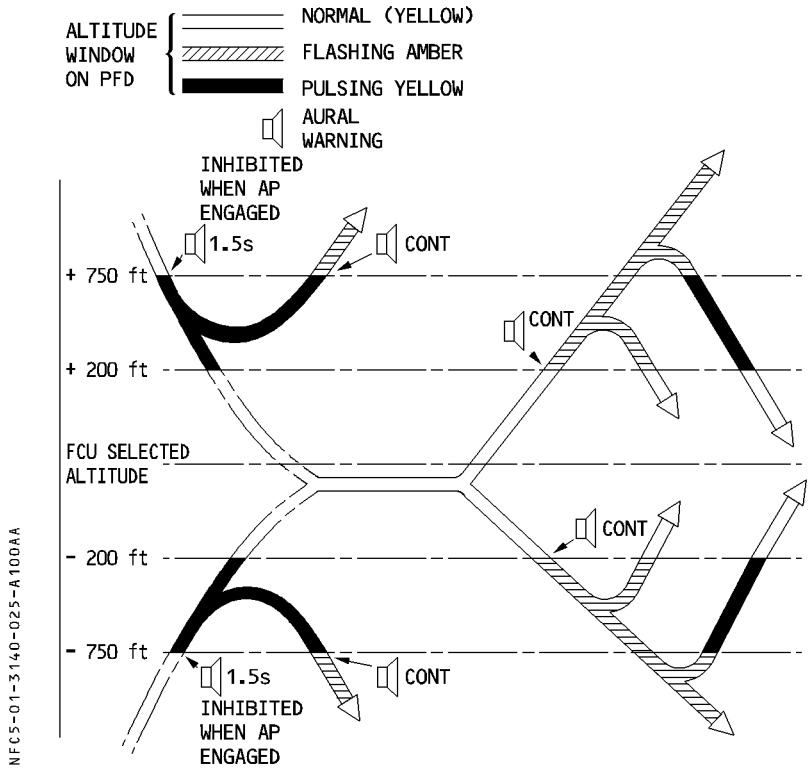
If the PFD loses all attitude data, its entire sphere is cleared to display the ATT flag.

(2) CHECK ATT (amber)

"CHECK ATT" appears, when there is a disagreement (of a least 5°) between the attitude information displayed by the two PFDs. The CHECK ATT flag appears on both PFDs, and a caution appears on the ECAM.

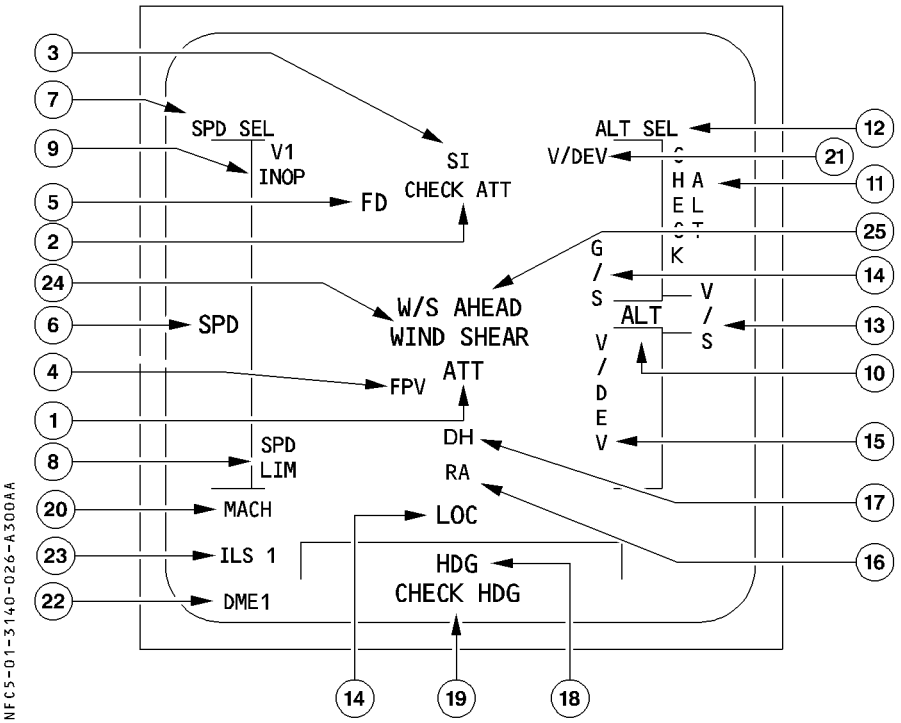
ALTITUDE ALERT

The FWC generates an altitude warning (C chord sound and PFD's altitude window pulses in yellow or flashes in amber), when the aircraft approaches a preselected altitude or flight level, or when it deviates from its selected altitude or flight level.
This warning results from a comparison between the altitude (ADIRS) and the preselected altitude displayed on FCU.



- Selecting a new altitude, or pushing the ECAM's EMER CANC pushbutton, or pressing either MASTER WARN pushbutton, cancels the continuous C chord.
- Selecting a new altitude stops the flashing of the altitude window.
- The altitude alert is inhibited :
  - When the slats are out, with the landing gear is selected down, or
  - In approach after the aircraft captures the glideslope, or
  - When the landing gear is locked down.

FLAGS AND MESSAGES DISPLAYED ON PFD



(1) ATT flag (red)

If the PFD loses all attitude data, its entire sphere is cleared to display the ATT flag.

(2) CHECK ATT (amber)

"CHECK ATT" appears, when there is a disagreement (of a least 5°) between the attitude information displayed by the two PFDs. The CHECK ATT flag appears on both PFDs, and a caution appears on the ECAM.

(3) SI flag (red)

If the sideslip information is lost or any reverse is deployed in flight, the index disappears and a red SI flag appears.

(4) FPV flag (red)

In the TRK FPA mode, when the drift angle or flight path angle is not valid, an FPV flag appears.

(5) FD flag (red)

If both FMGCs fail, or if both FDs are disengaged and the FD pushbutton is on and the attitude is valid, a red FD flag appears.

(6) SPD flag (red)

If the speed information fails, a SPD flag replaces the speed scale.

(7) SPD SEL flag (red)

If the selected speed information fails, a SPD SEL flag appears.

(8) SPD LIM flag (red)

This flag appears when both FACs are inoperative, or in case of SFCC dual flap/slat channel failure.
In this case, the following PFD information is lost : VLS, S, F, Green Dot, Vtrend, Vmax, VFE next, VSW.

(9) V1 INOP flag (red)

When the V1 signal is not valid, a V1 INOP flag replaces the digital value.

(10) ALT flag (red)

If the altitude information fails, the ALT flag replaces the altitude scale.

(11) CHECK ALT flag (amber)

The CHECK ALT flag appears, as does an ECAM caution, if the disagree between the two PFD altitude indications is greater than 250 feet when QNH is selected, or 500 feet when STD is selected.

R The caution and the flag disappear, when the Pilot's and the Co-pilot's barometer references disagree.

(12) ALT SEL flag (red)

If the selected altitude information fails, an ALT SEL flag appears.

(13) V/S flag (red)

If the vertical speed information fails, the V/S flag replaces the vertical speed scale.

(14) LOC and G/S flags (red)

If the localizer or glideslope receiver fails, a LOC or G/S flag appears on the deviation scale.

(15) V/DEV flag (red)

If the vertical deviation information fails, and the LS pushbutton is not pressed, a V/DEV flag replaces the V/DEV scale.

(16) RA flag (red)

If both radio altimeters fail, this flag appears in place of the radio height indication.

(17) DH flag (amber)

A DH flag appears, when the aircraft reaches the selected DH.

(18) HDG flag (red)

If the heading information fails, the HDG flag replaces the heading scale.

(19) CHECK HDG flag (amber)

The CHECK HDG flag appears, as does an ECAM caution, if there is a discrepancy (5°) between pilots's and copilot's heading indications.

(20) MACH flag (red)

This flag appears, if the Mach data fails.

(21) V/DEV (amber)

At the top of the glide scale, this message flashes when in approach phase and, when either the FINAL mode is armed/engaged or a non-LS approach has been selected, and the LS pushbutton is selected.

(22) DME 1 flag (red)

When the DME distance is not valid, a DME1 (on PFD1) or DME2 (on PFD2) flag replaces the DME distance indication.

(23) ILS1 flag (red)

If an ILS frequency fails, or if either the LOC or G/S signals fail, an ILS1 (on PFD1) or ILS2 (on PFD2) flag replaces the ILS frequency indication.

(24) WINDSHEAR (red)

This message is displayed, when windshear is detected (reactive windshear warning) by the FAC.

R Refer to 1.22.40.

(25) W/S AHEAD

This message is displayed, when the predictive windshear system has detected windshear ahead of the aircraft.
The message is in amber or red, depending on the alert level.
Refer to 1.34.60

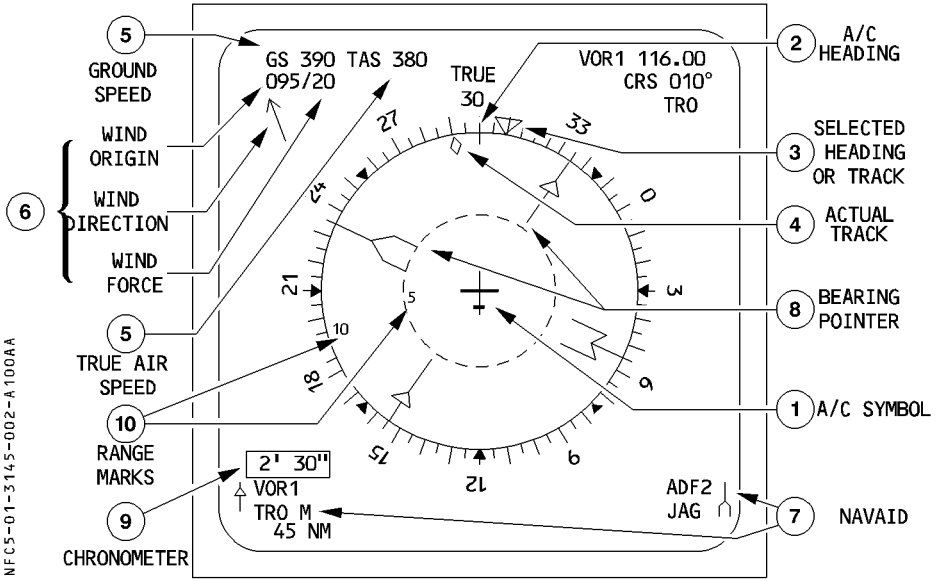
Note : 1. All flags, except V1 INOP which is steady, flash for 9 seconds, then remain steady.
2. For information on the TCAS flag, refer to 1.34.80.

GENERAL

There are five different displays (that display navigation information) :
- ROSE LS
- ROSE VOR
- ROSE NAV
- ARC
- PLAN

The Navigation Display (ND) can provide a weather radar image in all modes, except PLAN.

ROSE MODES



(1) Aircraft symbol (yellow)

Fixed and centered in the display, this symbol points to the yellow lubber line.

(2) Aircraft heading

The fixed yellow lubber line points to the aircraft magnetic heading on the moving white compass rose. Small white triangles are fixed at 45° intervals on the circumference of the compass rose.
"TRUE" appears at the top of the compass rose, when it is displaying true heading instead of magnetic heading (latitude above 73° North or 60° South).

(3) Selected heading or track (blue)

This pointer shows the heading or track indicated on the FCU's HDG TRK counter.

(4) Actual aircraft track (green)

This symbol is a small green diamond.

(5) Ground speed and true air speed (green)

ADIRS furnishes these speeds.

⑥ Wind direction and speed

R ADIRS provides the wind direction and speed. The digital direction and the analog
R direction (indicated by the green arrow) reflect both the true north reference. The green
R arrow only appears, if the wind speed is above two knots.
If the display does not receive either wind speed or direction, dashes replace the numbers on the display.

⑦ Navaids

When the ADF-OFF-VOR selector switch on either the pilot's or copilot's EFIS control panel is set to ADF or VOR, the onside ND displays the following characteristics of the corresponding navaid in white for VOR or in green for ADF (left side for receiver 1 and right side for receiver 2) :

- Type of navaid (ADF or VOR)
- Shape and color of the associated bearing pointer (if the bearing pointer is in view).
- Navaid identification (or frequency by default)
- DME distance if a DME is collocated with the selected VOR. ADF and DME distance are never displayed at the same time.
- Mode of tuning
  - M for a navaid tuned manually by the pilot through the MCDU (underlined and dimmed),
  - R for a navaid tuned from an RMP (Radio Management Panel) (underlined and dimmed),
  - Nothing for a navaid tuned automatically by the FMGC.

If reception fails, the ND stops displaying the associated data (except for the identification or frequency).

⑧ Bearing pointer (green for ADF, white for VOR)

This pointer appears when bearing data is available.
If the aircraft is not receiving the beacon or if a receiver fails, the associated bearing pointer disappears.

⑨ Chronometer Indication (white)

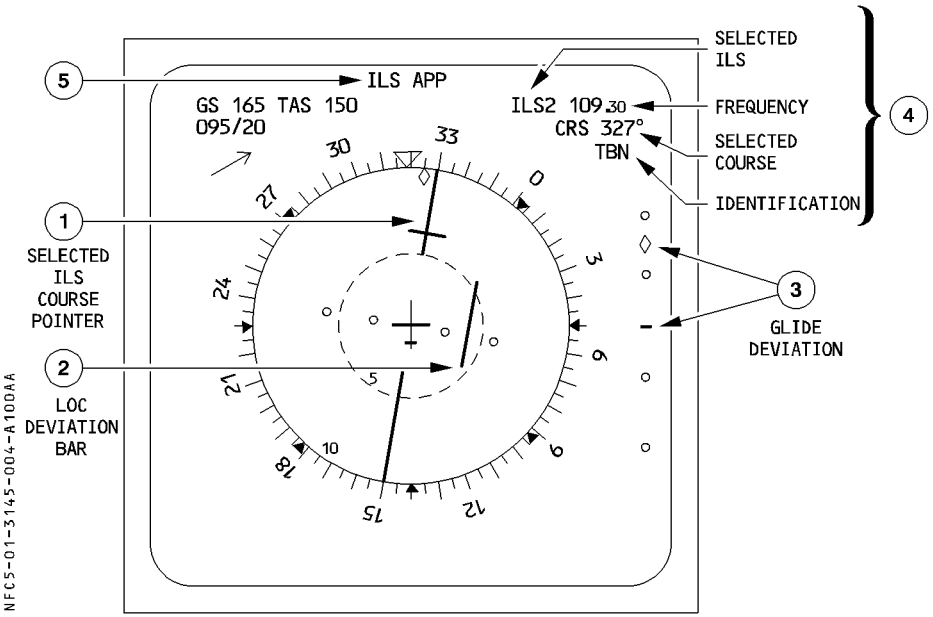
These numbers appear when the onside chronometer is started.
They display the elapsed time.
The indication is in minutes and seconds from 0 to 59' 59", and in hours and minutes from 1 H to 99 H 59'. (Seconds are not displayed beyond 59' 59").

⑩ Range marks

The range scale value selected on the EFIS control panel (10 to 320 NM) governs the scale of the ND.

R

ROSE LS MODE



(1) ILS course pointer (magenta)

This dagger-shaped symbol points to the selected ILS course.
The ILS is selected either by the FMGC (autotuned or manually) or through the RMP in backup mode. If no course has been entered, the value defaults to 360°.

(2) Localizer deviation bar (magenta)

This bar moves laterally with respect to the course pointer. Its scale consists of two dots on each side of zero deviation. Each dot represents a deviation of about ± 0.8°.
If the deviation becomes excessive (1/4 dot, 0.2°) above 15 feet RA, the bar and the scale pulse.

(3) Glide deviation (magenta)

This diamond moves on a vertical scale that has two white dots on each side of the yellow reference line. Each dot represents a deviation of approx. plus or minus 0.4 degrees.
If the deviation becomes greater than one dot above 100 feet RA, the scale and the diamond flash.

(4) Selected ILS information

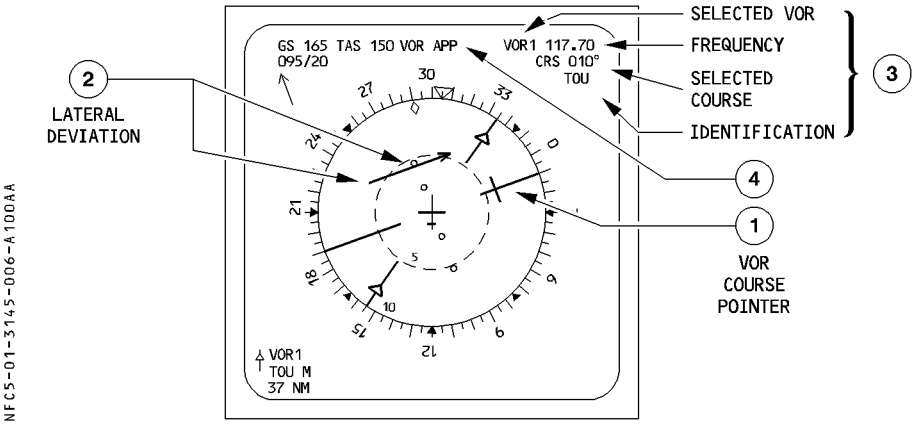
This display shows the ILS frequency (magenta), the selected course (blue), and the identification (magenta).

(5) ILS APP message (green)

This message appears :
- When the flight crew selects an ILS approach on the MCDU, and
- When the FMS flight phase is DES, APP or GA, or the FMS phase is CRZ and the along track distance to destination is less then 250 NM.

Note : ILS1 information appears on PFD1 and ND2.
ILS2 information appears on PFD2 and ND1.

R **ROSE VOR MODE**



(1) VOR course pointer (blue)

This dagger-shaped symbol points to the selected VOR course.
The VOR course is automatically selected by the FMGC or manually by the crew using
R the MCDU pages or the RMP backup mode.

(2) Lateral deviation bar (blue)

This bar shows the VOR deviation on a lateral scale.
Each dot represents 5°. When the lateral deviation exceeds 10°, the bar remains displayed on the outer dot.
R The arrow on the bar gives the TO/FROM indication.

(3) VOR information (white)

This area displays the frequency of the selected VOR and its identification (if decoded by the receiver), the selected course.

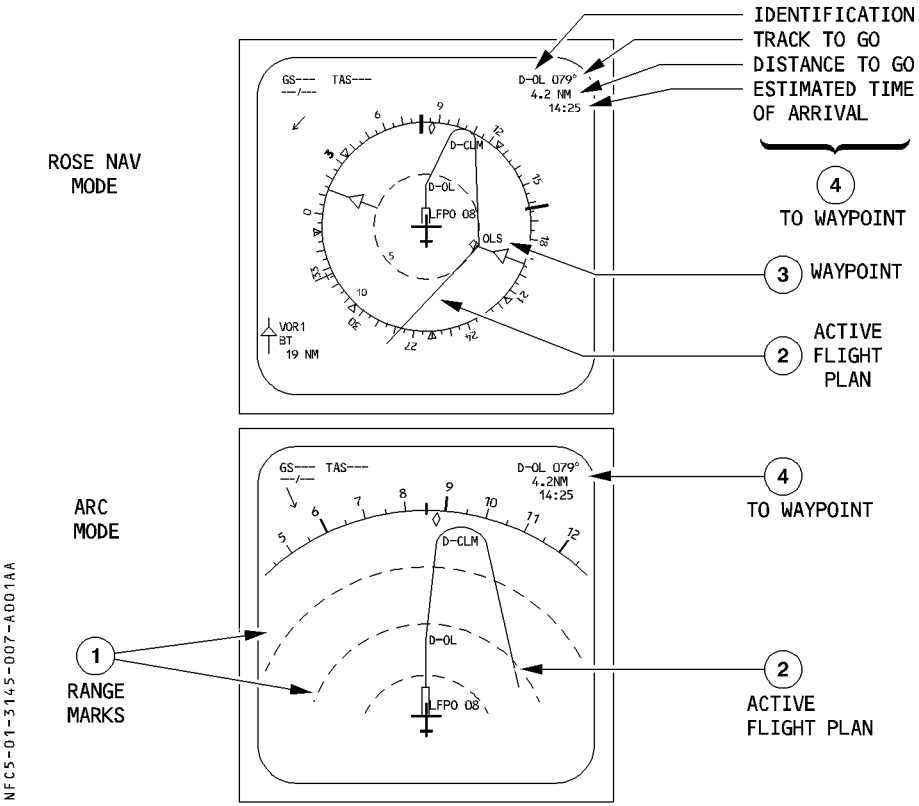
(4) VOR APP or GPS APP Messages (green)

VOR APPR appears when the flight crew has selected a VOR approach on the MCDU.
GPS APP appears when the crew has selected a GPS approach.

ROSE NAV MODE/ARC MODE

ROSE NAV and ARC modes give the pilot the same information, but ARC mode limits it to the forward 90° sector.

R



(1) Range Marks and Values

R The values displayed on the ND are :

In ROSE NAV mode 1/4 of the selected range for the inner circle.
1/2 of the selected range for the heading scale circle.

In ARC mode 1/4 of the selected range for the first inner arc.
1/2 of the selected range for the second inner arc.
3/4 of the selected range for the third inner arc.

(2) Flight Plan

The crew can use the MCDU to select various types of flight plan :

R · The active flight plan (the flight plan the aircraft is actually following when the NAV mode is engaged) is represented by a continuous green line. The ND shows only the part of the flight plan that is ahead of the aircraft, as well as the waypoints that are still to be overflown and the waypoint from which the aircraft is coming.
The ND does not show a SID or a STAR, except for the last waypoint of the SID and the first waypoint of the STAR, when the selected range is 160 or 320 NM.
If the primary flight plan is not active, it is represented by a dotted green line.

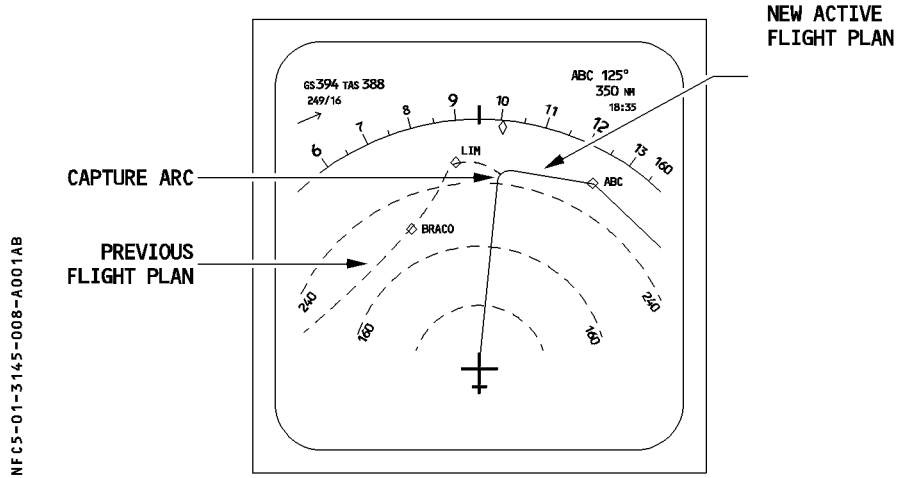
· A continuous blue line portrays the missed approach procedure, and a dashed blue line portrays the flight plan to the alternate.
The missed approach and the alternate flight plan are displayed when :
— In ARC or ROSE NAV mode, a missed approach waypoint or an alternate flight plan waypoint is displayed on the onside MCDU.
— In PLAN mode a missed approach or alternate waypoint is displayed in the 2L field of the onside MCDU.

· The secondary flight plan is represented by a continuous white line. The ND continues to display the active flight plan.

· Temporary flight plan
The revised portion of the flight plan is represented by a dotted yellow line.

· Flight plan capture

R When the aircraft is off the primary flight plan and is flying toward it in HDG mode with the NAV mode armed, the ND shows the new active flight plan as a continuous green line if the FMGC has computed the intercept path.
The part of the flight plan before the interception point shows as a dotted green line.



③ Waypoint

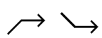
The ND can display various kinds of waypoints :

Flight plan waypoints

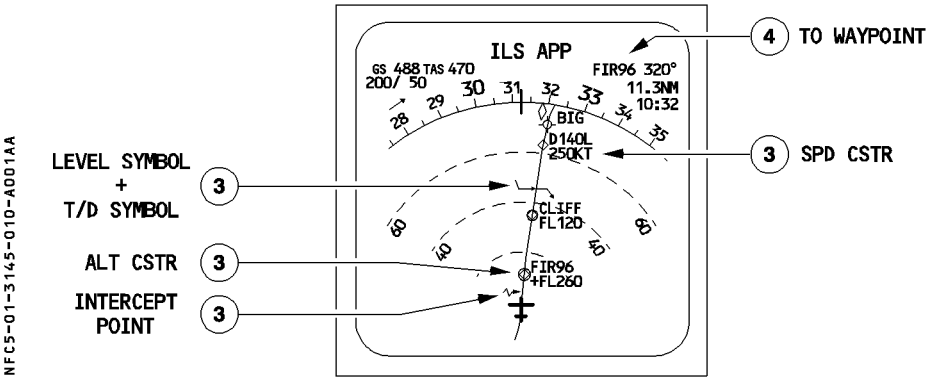
The ND displays these as green diamonds (white, for TO waypoints). When the flight crew selects the WPT option on his EFIS control panel, all waypoints other than flight plan waypoints are displayed in magenta.

Pseudo waypoint

Point of the flight path where the aircraft is predicted to reach a selected altitude or speed.

Pseudo waypoint	Definition
	Level symbol (top of climb or level-off position), when the aircraft reaches : · The FCU-selected altitude (blue arrow), or · The constrained altitude, if it is more restrictive than the FCU altitude, and if appropriate modes are engaged (magenta) · It does not appear when the aircraft is within 100 feet above, or below, the selected altitude.
	Top of descent symbol, or continue descent symbol : · White, if DES is not armed · Blue, if DES is armed.
	Start of CLIMB symbol : · White, if CLB is not armed · Blue, if CLB is armed.
	Intercept point symbol : · White, if only the NAV mode is engaged · Blue, if DES mode is engaged · Indicates the point at which the aircraft is predicted to intercept the descent path, if there is any vertical deviation while the aircraft is in DES mode.
	Speed change symbol (magenta) : · Indicates the point at which the aircraft will start an automatic acceleration or deceleration from the current speed to a new computed speed for SPD LIM, SPD CSTR, or HOLDING SPD.
	Decelerate point symbol : · Indicates the point at which the aircraft is predicted to decelerate for approach (and thus switch to the approach phase) · Magenta, if in managed speed and NAV or approach mode is engaged · White, if in selected speed or HDG/TRK mode · Automatic decelerations only occur when displayed in magenta.
	ALT CSTR symbol set around the constrained waypoint : · Magenta, when the ALT CSTR is predicted to be met · Amber, when the ALT CSTR is predicted to be missed · White, when the ALT CSTR is not taken into account by the FMGS, and NAV mode is engaged.
	Energy circle symbol (green arc) centered on the aircraft position and oriented to the current track line. Represents the Required Distance to Land. Only displayed if the lateral guidance mode is heading or track, and the current FMS flight phase is in cruise, descent or approach, and the aircraft is within 180 NM of the destination.

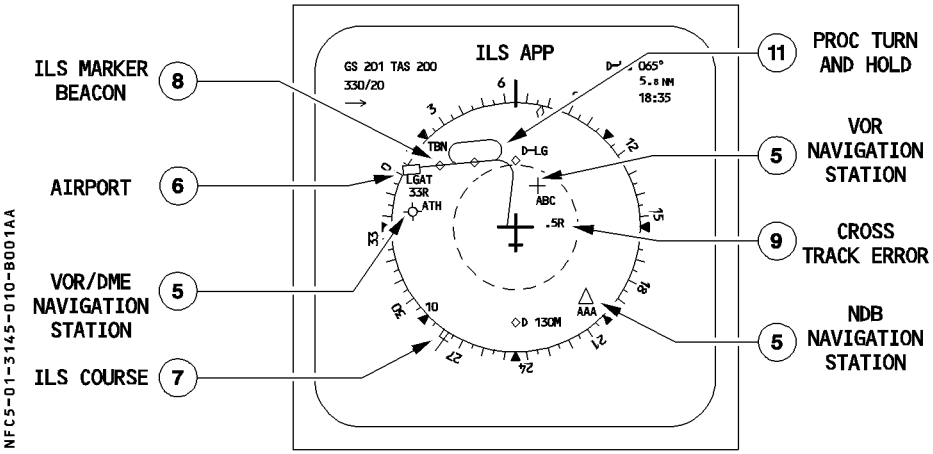
③ Waypoint (cont'd)



④ TO waypoint

This is the next waypoint to be overflown.
This area of the screen also shows :

- Waypoint identification (white).
- Track to go (green).
- Distance to go (green).
- Estimated time of arrival (green), assuming the aircraft will fly directly from its present position to the TO waypoint at the current ground speed.



(5) Navaids

The display uses specific symbols for navaids :
○ DME or TACAN
+ VOR
⊹ VOR/DME
△ NDB
The symbol appears :
· In green if the navaid is a current waypoint of the flight plan.
· In white if it is the TO waypoint.
· In blue when the navaid is tuned for display either automatically by the FMGC or manually through the MCDU.
· In magenta when the navaid is not part of the flight plan and is called for display as an option (corresponding option pushbutton pressed on the FCU EFIS control panel).

(6) Airport

Airport included in the flight plan :
· If the runway is not specified, the airport is represented by a star and the identification is displayed in white.
Example : * LSGG
· If the runway is specified, it is represented by an oriented runway symbol in white.

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LSGG
33R

The runway is drawn to scale (paved length) if the selected range is 10, 20 or 40 NM.

Optional airport information
The airports that are not displayed as part of the flight plan may be called for display (ARPT pushbutton on the EFIS control panel).
They are represented by a star and the identification in magenta.

(7) ILS Course (Magenta)

When the pilot pushes the LS pushbutton switch on the EFIS control panel, and if an ILS station has been selected, the display shows an ILS course symbol.

(8) ILS Marker Beacons

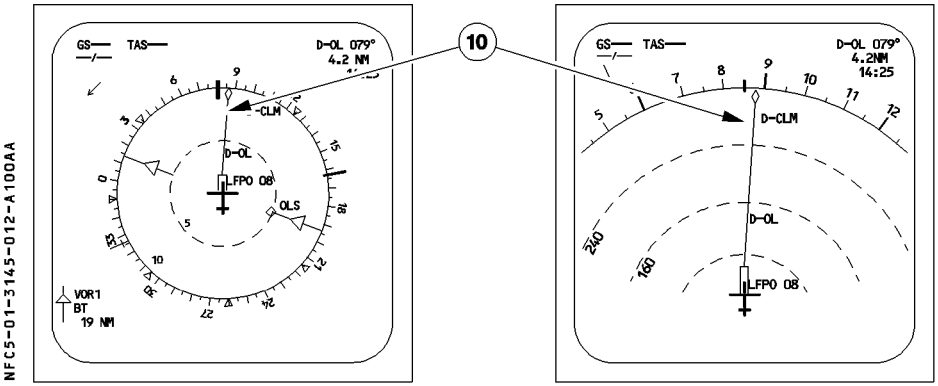
The screen shows these as waypoints (diamonds).
When the aircraft overflies a marker beacon, the corresponding symbol flashes :
Blue for the outer marker.
Amber for the middle marker.
White for the inner marker.

(9) Cross Track Error

This is the aircraft's lateral deviation from the active leg of the flight plan (related to the great circle route). It is indicated in nautical miles (NM), with the letter R (right) or L (left), according to the position of the aircraft with respect to the flight plan.

(10) Track line

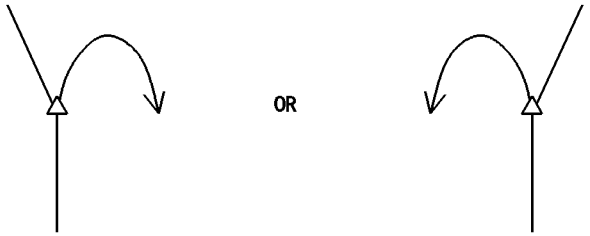
This line appears in green only in the ROSE NAV or ARC mode when HDG or TRK has been selected on the FCU.



(11) Procedure turns and holding patterns

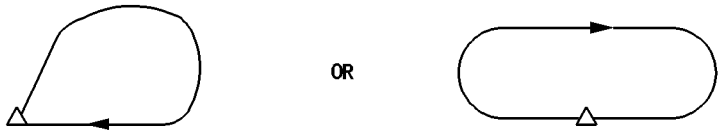
These appear only when they are part of the flight plan. For the 160 and 320 NM range scales, each one is represented by a white arrow that originates at the associated fix and indicates the direction of the turn.

NFC5-01-3145-013-A001AA



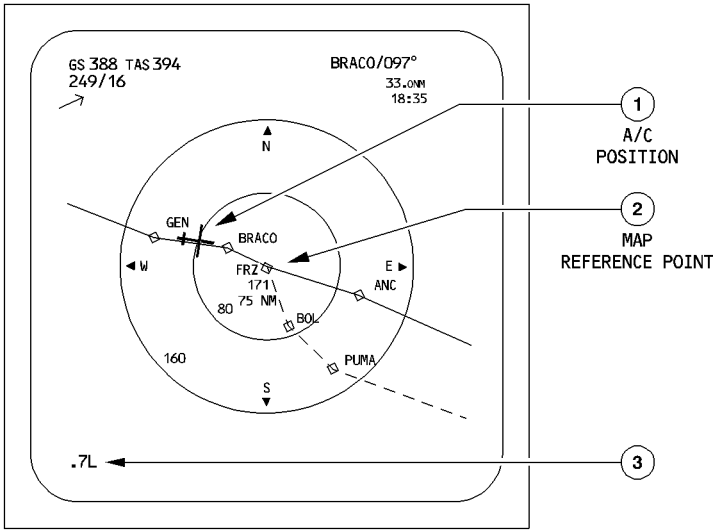
For shorter range scales and if the procedure turn or the holding pattern is in the next or the active leg, the display shows the full circuit or pattern.

NFC5-01-3145-013-B001AA



PLAN MODE

This mode statically displays the flight plan legs on a map oriented to true north. The map is centered on a map reference point, that the pilot selects by scrolling to it on his MCDU. The map reference point is the waypoint displayed on the second line of the MCDU's F-PLN page. It can either be the active waypoint (next waypoint to be overflown), or any other waypoint of the flight plan.
The pilot can scroll through the overall flight plan, and display it in PLAN mode.
The pilot chooses the scale of the map with the range selector (the diameter of the outer circle corresponds to the selected range).
Data on navaids and on their characteristics and associated bearing pointers are not available in this mode.



NFC5-01-3145-014-A100AA

(1) Aircraft Position and True Track

The orientation of the yellow aircraft symbol always indicates the true track of the aircraft. Its position represents the aircraft position given by the FMGS.

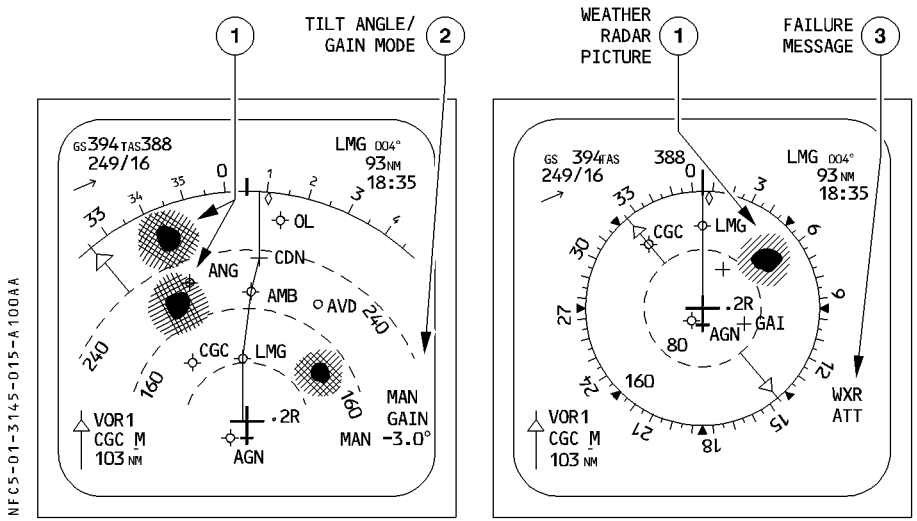
(2) Map Reference Point

If the CSTR option is not selected, the track and distance from the map reference point to the next F-PLN waypoint is displayed in magenta.

(3) Cross Track Error

Refer to the ROSE NAV MODE/ARC MODE chapter.

R **WEATHER RADAR**



R (1) Weather Radar Picture

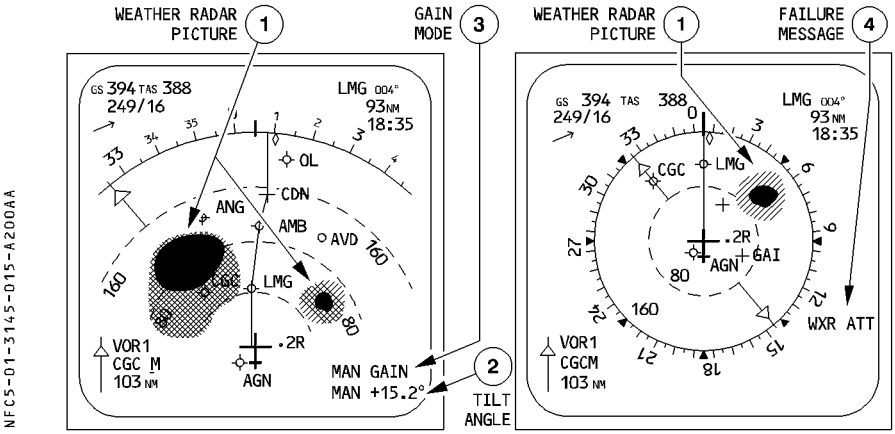
R – When the radar is operating, and when the ND is not in PLAN mode, the ND displays the weather radar picture.
R – The echoes appear in different colors, depending on the precipitation rates (black, green, yellow, red or magenta).
R – The selected ND range will determine how often the image is refreshed.

R (2) Tilt Angle and Gain Mode

R – The value of the tilt angle is in degrees, and quarters of a degree. It appears in blue in the lower right-hand corner of the screen along with MAN indication. This angle is the angle between the horizon and the radar beam axis.
R – "MAN GAIN" appears in white, when the manual gain mode is selected.

WEATHER RADAR

R



(1) Weather Radar Picture

- When the radar is operating, and when the ND is not in PLAN mode, the ND displays the weather radar picture.
- The echoes appear in different colors, depending on the precipitation rates (black, green, yellow, red or magenta).
- The selected ND range will determine how often the image is refreshed.

R (2) Tilt Angle

R – The auto-tilt function of the weather radar automatically sets the tilt angle to optimize
R weather radar detection.
R – The value of the tilt angle is in degrees, and quarters of a degree. It appears in the
R lower right corner of the screen :
R · In green, when the flight crew sets the TILT toggle switch to AUTO
R · In blue, next to the blue "MAN" indication, when the flight crew sets the TILT toggle
R switch to MAN.
R The tilt angle is the angle between the horizon and the radar beam axis.
R – When the auto-tilt function is lost, the tilt value is dashed, and the "NO AUTO TILT"
R message appears in amber on the ND, until the flight crew sets the TILT toggle switch
R to MAN.

R (3) Gain Mode

R – "MAN GAIN" appears in white, when the manual gain mode is selected.

R (3) Failure Messages

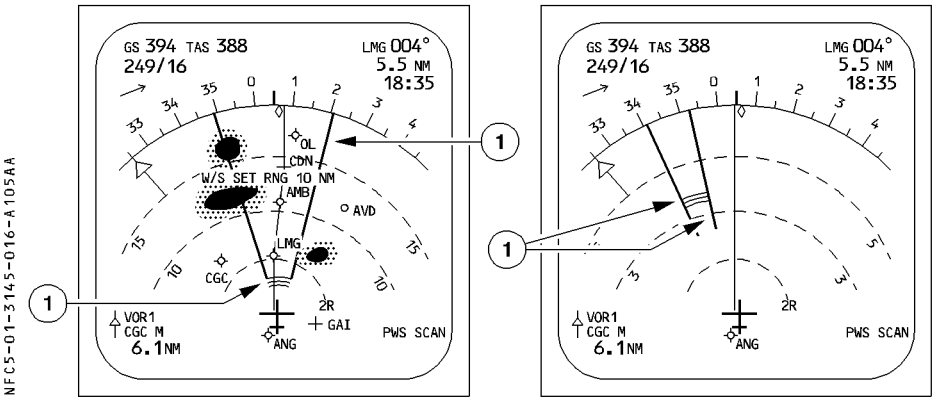
R The ND lists the detected failures.
R If the message is in "red", the ND does not display a radar image.
R If the message is in "amber", the image is not affected.
R WXR RT (red) : Radar transceiver failure.
R WXR ANT (red) : Radar antenna failure.
R WXR CTL (red) : Radar control unit failure.
R WXR RNG (red) : Range error.
R WXR WEAK (amber) : Calibration failure.
R WXR ATT (amber) : Attitude control failure.
R WXR STAB (amber) : Antenna stabilization failure.

R (4) Failure Messages

The ND lists the detected failures.
If the message is in "red", the ND does not display a radar image.
If the message is in "amber", the image is not affected.

WXR RT (red) : Radar transceiver failure.
WXR ANT (red) : Radar antenna failure.
WXR CTL (red) : Radar control unit failure.
WXR RNG (red) : Range error.
WXR WEAK (amber) : Calibration failure.
WXR ATT (amber) : Attitude control failure.
WXR STAB (amber) : Antenna stabilization failure.

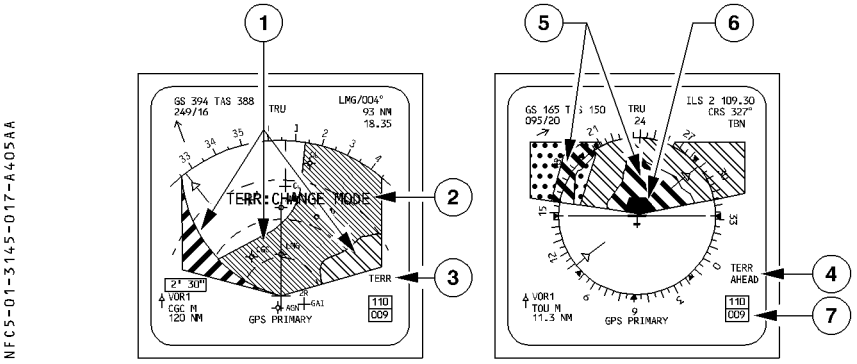
PREDICTIVE WINDSHEAR SYSTEM



(1) Predictive windshear area indication

A PWS SCAN message is displayed when the Predictive Windshear system is active on the ND.
The predicted windshear area is indicated by a red and black icon and two yellow radial lines. Windshear information is available in ARC and ROSE ND modes.
When the ND range is set above 10 NM, a W/S SET RNG 10 NM (Windshear, set range 10 NM) message appears, requesting the crew to adjust the ND range. It is displayed even if the weather radar is switched off, provided the WINDSHEAR switch on the weather radar panel is set to AUTO.
Depending on the windshear alert level, ND indication may be completed with a PFD message (Refer to 1.31.40).

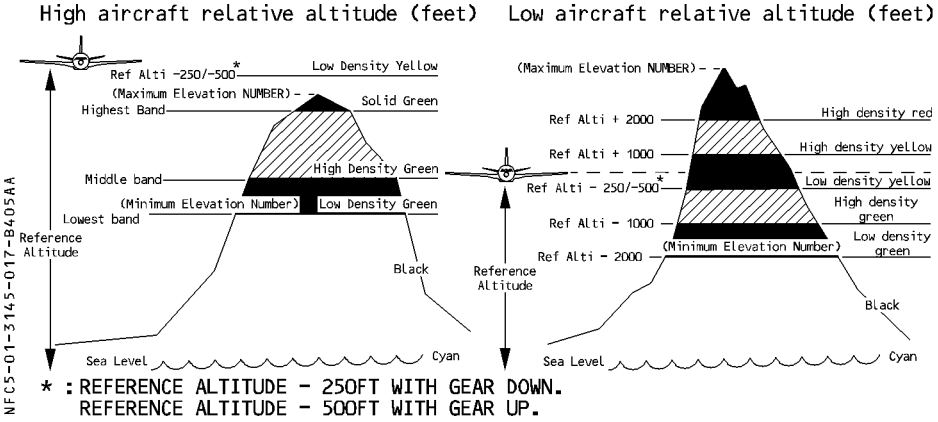
R **EGPWS**



NFCS-01-3145-017-A405AA

(1) EGPWS terrain picture

The ND displays the EGPWS terrain picture, when the TERR ON ND switch is selected ON, and the ND is not in PLAN mode. The terrain picture replaces the weather radar image. Terrain data is displayed independently of the aircraft relative altitude. The terrain appears in different colors and densities, according to its relative height :



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Note : — *Areas without available terrain data in the EGPWS database appear in magenta.*

— *The reference altitude is computed based on the current aircraft altitude or, if descending more than 1000 ft/min, the altitude expected in 30 seconds.*

— *In case of flight above the maximum elevation number, the relief between the minimum and maximum displayed elevations is displayed by using three different green levels.*

R (2) Center Part Messages

R – The "TERR CHANGE MODE" indication is displayed in red (or amber), in the case of
R a Terrain Awareness Display (TAD) warning (or caution) alert, if the current selected
R display mode is PLAN.
R – The "TERR REDUCE RANGE" indication is displayed in red (or amber), in the case of
R a Terrain Awareness Display (TAD) warning (or caution) alert, if the selected range is
R 160 NM or 320 NM.

(3) TERR indication

To differentiate between the terrain and weather display, the weather radar TILT is replaced by a blue TERR, and the terrain display sweeps from the center outward to both NDs.

(4) Warning and caution messages

TERR AHEAD or OBST AHEAD (amber) : For a caution.
TERR AHEAD or OBST AHEAD (red) : For a warning.
When triggered, these messages flash for 9 seconds, then remain steady until the caution or warning alert condition disappears.
TERR RNG (red) : For a RANGE error warning.
TERR TST (amber) : Appears during the EGPWS test, when the terrain pattern is displayed, and there is no failure.

(5) Terrain or obstacle caution alert

Generated when a conflict exists between the terrain caution envelope, ahead of the aircraft, and database-stored terrain/obstacles. The conflict area is displayed in solid yellow.

(6) Terrain or obstacle warning alert

Generated when a conflict exists between the terrain warning envelope, ahead of the aircraft, and terrain/obstacles data stored in the database. The conflict area is displayed in solid red.

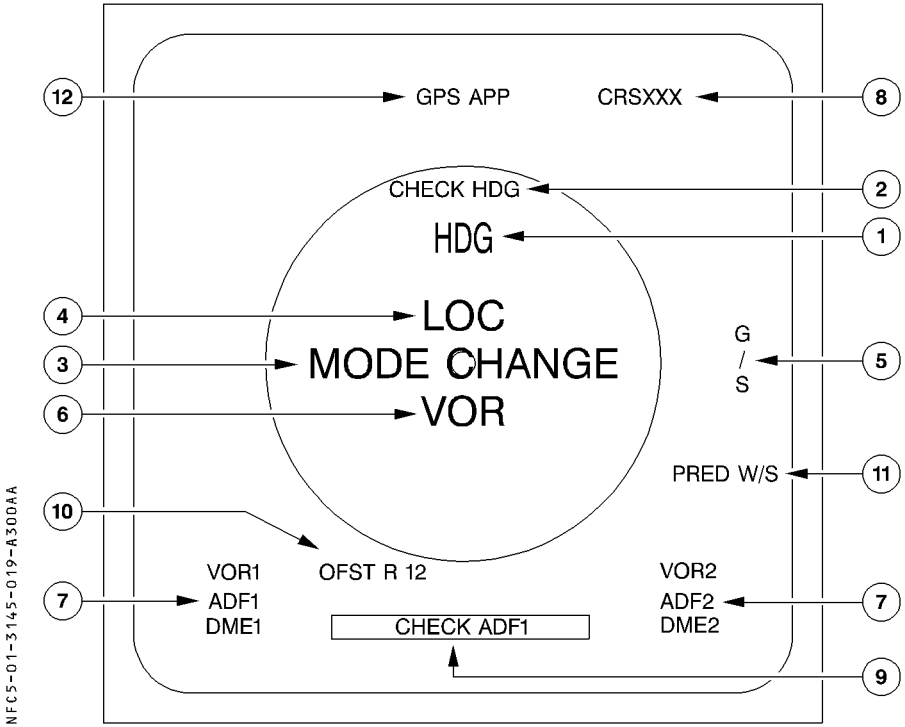
Note : When an alert is generated (either caution or warning) and TERR ON ND is not selected, the terrain is automatically displayed and the TERR ON ND pushbutton ON light comes on.

(7) Lowest and highest elevations

Minimum and maximum elevations encountered within the selected range, are respectively displayed in this square, using the color code of paragraph 1.

Note : The elevations shown on the ND correspond to the terrain included in the selected ND range, ahead of the aircraft. In ARC mode, the elevations are linked with the terrain displayed on the ND. In ROSE mode, the elevations may not represent the lowest and highest terrain currently displayed on the ND.

FLAGS AND MESSAGES DISPLAYED ON ND



(1) HDG Flag (red)

If the heading data fails, the rose, arc and associated symbols disappear.
A HDG flag flashes for 9 seconds, then remains steady in the upper part of the ND.

(2) CHECK HDG Flag (amber)

When the flight warning computer detects a disagree (5°) between sides 1 and 2, a CHECK HDG flag flashes for 9 seconds, then remains steady on both NDs, and a caution appears on the ECAM.

③ Center Part Messages

- The screen displays a MODE CHANGE message in green if there is a discrepancy between the selected mode on the EFIS control panel and the mode sent from the onside FMGC, or while the DMC is preparing a new page for display.
- The screen displays a RANGE CHANGE message in green if there is a discrepancy between the range selected on the EFIS control panel and the range sent from the onside FMGC. A MODE CHANGE message has priority over a RANGE CHANGE message.
- The screen displays a MAP NOT AVAIL message in red for several reasons :
  · The MODE CHANGE or RANGE CHANGE message has been displayed more than six seconds or
  · The FMGC has failed or
  · The FMGC has delivered an invalid aircraft position.
- The screen displays a W/S SET RNG 10 NM message if a predictive windshear alert is triggered and the range is above 10 NM.
  The message is displayed in the color corresponding to the windshear alert : red for a warning, amber for a caution.
- The screen displays a W/S CHANGE MODE message if a predictive windshear alert is triggered and the ND is not in ARC or ROSE mode. The message appears in red for a warning, or amber for a caution.

④ LOC Flag (red)

If LOC data fails, this flag flashes for nine seconds, then remains steady.

⑤ G/S Flag (red)

If G/S data fails, this flag flashes for nine seconds, then remains steady.

⑥ VOR Flag (red)

In ROSE VOR mode, when the VOR bearing is not valid, this flag flashes for nine seconds, then remains steady.

⑦ VOR1(2) or ADF1(2) or DME1 Flag (red)

If a navigation receiver fails, the appropriate one of these flags flashes for nine seconds, then remains steady.

⑧ VOR Course Flag

If the VOR course fails, a red CRSXXX flag appears.
If there is non-computed data (NCD), a blue CRS - - - flag appears.

⑨ Other messages

MAP PARTLY DISPLAYED (amber) : In case of incomplete data transmission between the FMGC (priority criteria) and the DMC, or if the DMC cannot draw the complete MAP.
This message is also displayed when a very long leg exists in the flight plan. A leg is considered as "very long" when the starting point (or endpoint) is located at more than 45° from the aircraft location (45° of longitude or latitude).
This DMC limitation results from a compromise between accurate drawing precision and maximum leg length that can be displayed.

NAV ACCUR UPGRAD, or (white)
NAV ACCUR DOWNGRAD (amber) : Signals a change in navigation accuracy.

SPECIFIC VOR/D UNAVAIL (amber) : If the navaid, that is tuned for the selected approach or departure, is not available.

SET OFFSIDE RNG/MODE (amber) : Displayed on ND1(2), in case of an FMGC1(2) failure when the two ND ranges or modes selected on the EFIS control panels are different.

GPS PRIMARY (white, boxed white) : This message appears when GPS PRIMARY mode is available, or has been recovered. The pilot can clear this message by pressing the CLR key on the MCDU.

GPS PRIMARY LOST (amber, boxed white) : This message appears when GPS PRIMARY is not available, and not clearable by pilot action.

↓ (green) : Overflow arrow, displayed when more than one of the following messages are present at the same time :
- NAV ACCUR DOWNGRAD
- NAV ACCUR UPGRAD
- SPECIF VOR/D UNAVAIL
- MAP PARTLY DISPLAYED
- SET OFFSIDE RNG/MODE
- GPS PRIMARY
- GPS PRIMARY LOST

Note : For information about the TCAS messages, refer to 1.34.80.

(10) OFST R(L) XX message (yellow)

The screen displays this message, when a temporary or an offset flight plan is entered. The offset value is given in NM.

Note : For information about the TCAS messages, refer to 1.34.80.

(11) PRED W/S flag (amber)

The WINDSHEAR switch on the weather radar panel is set to AUTO, and a Predictive Windshear System fault is detected. This message appears on ground, or when flaps and slats are extended.
It is associated with a single chime. The radar image remains available, provided that the fault does not affect the radar mode.

(12) GPS APP (green)

This message is displayed, when a GPS approach has been selected.

⑨ Other messages

MAP PARTLY DISPLAYED (amber) : In case of incomplete data transmission between the FMGC (priority criteria) and the DMC, or if the DMC cannot draw the complete MAP.
This message is also displayed when a very long leg exists in the flight plan. A leg is considered as "very long" when the starting point (or endpoint) is located at more than 45° from the aircraft location (45° of longitude or latitude).
This DMC limitation results from a compromise between accurate drawing precision and maximum leg length that can be displayed.

NAV ACCUR UPGRAD, or (white)
NAV ACCUR DOWNGRAD (amber) : Signals a change in navigation accuracy.

SPECIFIC VOR/D UNAVAIL (amber) : If the navaid, that is tuned for the selected approach or departure, is not available.

SET OFFSIDE RNG/MODE (amber) : Displayed on ND1(2), in case of an FMGC1(2) failure when the two ND ranges or modes selected on the EFIS control panels are different.

OFFSIDE FM CONTROL (amber) : If the offside FM supplies the onside ND.

GPS PRIMARY (white, boxed white) : This message appears when GPS PRIMARY mode is available, or has been recovered. The pilot can clear this message by pressing the CLR key on the MCDU.

GPS PRIMARY LOST (amber, boxed white) : This message appears when GPS PRIMARY is not available, and not clearable by pilot action.

↓ (green) : Overflow arrow, displayed when more than one of the following messages are present at the same time :
- NAV ACCUR DOWNGRAD
- NAV ACCUR UPGRAD
- SPECIF VOR/D UNAVAIL
- MAP PARTLY DISPLAYED
- SET OFFSIDE RNG/MODE
- GPS PRIMARY
- GPS PRIMARY LOST

Note : For information about the TCAS messages, refer to 1.34.80.

(10) OFST R(L) XX message (yellow)

The screen displays this message, when a temporary or an offset flight plan is entered. The offset value is given in NM.

Note : For information about the TCAS messages, refer to 1.34.80.

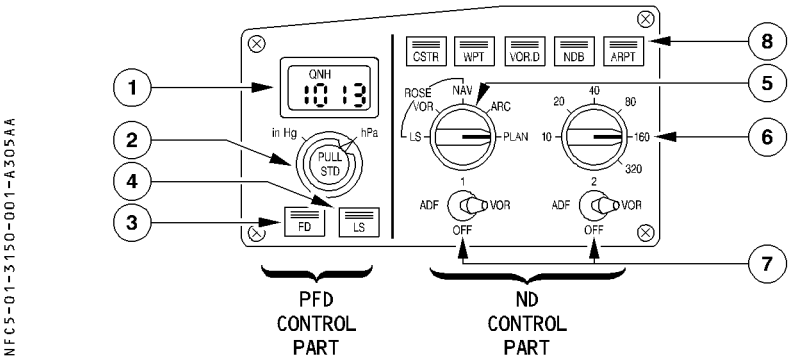
(11) PRED W/S flag (amber)

The WINDSHEAR switch on the weather radar panel is set to AUTO, and a Predictive Windshear System fault is detected. This message appears on ground, or when flaps and slats are extended.
It is associated with a single chime. The radar image remains available, provided that the fault does not affect the radar mode.

(12) GPS APP (green)

This message is displayed, when a GPS approach has been selected.

EFIS CONTROL PANEL



(1) Barometer Reference Display Window

Range : 745 hPa to 1100 hPa.

(2) Barometer Reference Selector

a) Outer ring : For selection of the units for the barometer reference, either hectoPascals (hPa) or inches of mercury (in Hg).

Note : The selected unit does not appear on the PFD.

b) Inner knob : For selection of the reference value displayed in the barometer reference display window and on the PFD below the altitude scale.
At FCU initialization, the window displays 1013 or 29.92, depending on the selected unit.
- Pulling the knob selects the standard baro reference setting. The PFD then displays "STD." (Rotating the knob has no effect.)
- Pushing the knob from the STD position makes the last selected QFE or QNH baro setting available.
- Pushing the knob again changes from QNH to QFE or vice versa.
The window displays "QNH" or "QFE" according to the flight crew's selection.

Note : QFE option is a pin program installed on the FMGC. The FMGC operates using the selected pin program (QNH or QFE), independently of the baro reference setting selected on the EFIS CTL panel.

(3) FD Pushbutton

Pushing this button removes the FD bars from the associated PFD (or removes the flight path director symbol if the TRK FPA reference is selected).
The pushbutton light goes out.
Pushing it again restores the FD bars (or the FPD symbol) and the green pushbutton light comes on.

R (4) LS Pushbutton

Pushing this button displays the localizer and glide slope scales on the PFD.
Deviation symbols appear if there is a valid ILS signal.
The green pushbutton light comes on.

(5) Mode Select Switch

This switch selects a navigation display for the onside ND.

(6) Range Select Switch

This switch selects a range scale for the onside ND.

Note : If the mode or the range data fails, the default selection is the ROSE NAV mode and 80 NM range.

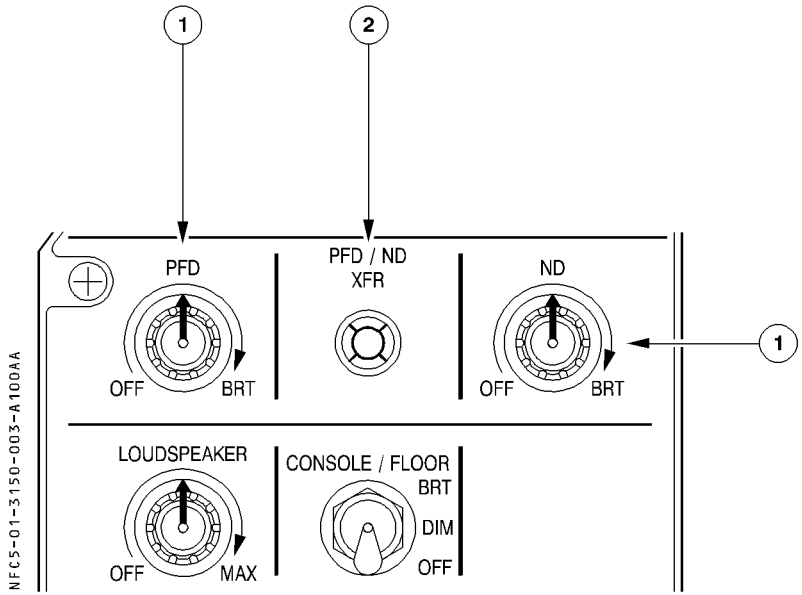
(7) ADF-VOR Select Switches

These switches select ADF or VOR bearing pointers and DME distance on the onside ND, as well as the corresponding navaid data characteristics in any mode except PLAN mode.

(8) Optional Data Display Pushbutton

Pushing this button displays optional data in addition to the data permanently displayed in PLAN, ARC, or ROSE NAV modes. The green pushbutton light comes on.
Only one option can be activated at a time.

OTHER EFIS CONTROLS



(1) OFF/BRT knobs

· These knobs turn the PFD and ND display units on and off, and control their brightness.
· The display brightness automatically adjusts for changing light conditions. It may also be adjusted manually.

PFD Brightness Control Knob

Rotating this knob all the way counterclockwise switches off the PFD. In this case, the PFD image is automatically displayed on the NDU, but the pilot may recover the ND by means of the PFD-ND XFR pushbutton.

ND Brightness Control Knob

R The outer knob controls the brightness of both the weather radar image and the EGPWS
R terrain display.

The inner knob controls the general brightness of the ND symbols.

Rotating this knob all the way counterclockwise switches off the NDU.

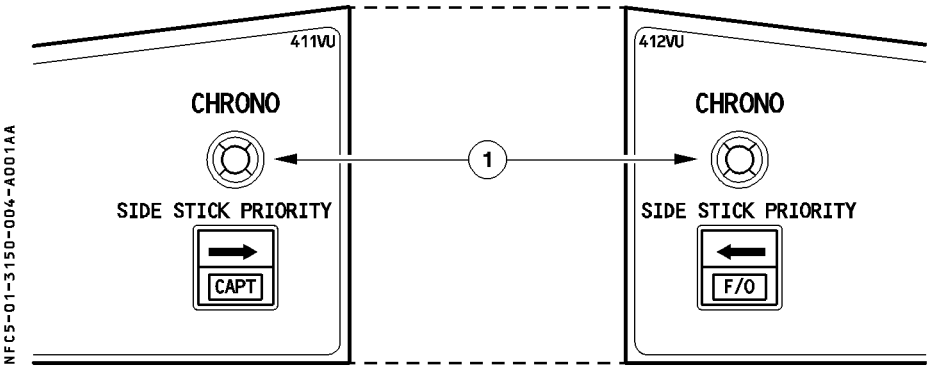
(2) PFD/ND XFR Pushbutton

Pushing this button interchanges the PFD and the ND.

If the PFDU fails, the PFD automatically transfers to the NDU.

R

CHRONOMETER



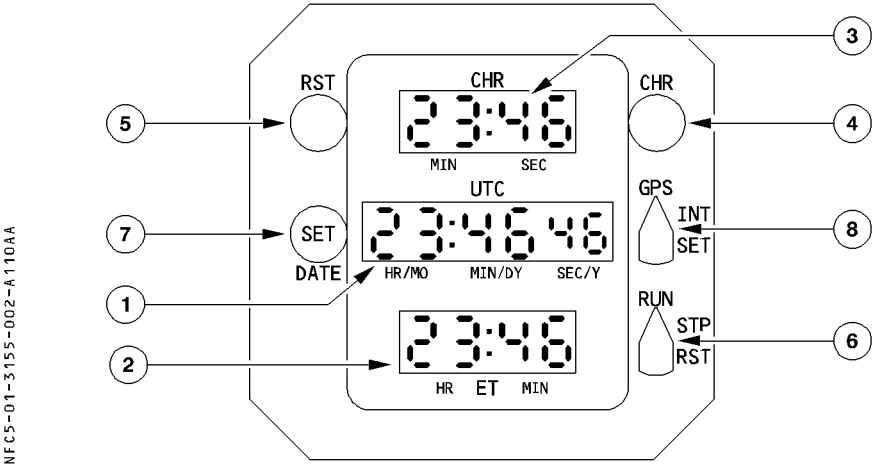
(1) CHRONO Pushbutton

Pushing this button displays chronometer time on the onside ND.
Pushing it again freezes the displayed value.
Pushing it a third time resets the chronometer, and the chronometer time disappears from the display.

GENERAL

R A fully independent clock is on the right side of the control panel.
It sends time to the centralized fault data interface unit, the flight data interface unit, and the flight management and guidance computer.
The clock has two electrical supplies, one of which is a direct connection to the aircraft battery hot bus.
The clock performs four functions :
- It displays "UTC" (GMT) time in hours, minutes and seconds on the center counter.
- It displays elapsed time (ET) (from engine startup) in hours and minutes on the lower counter.
- It drives the chronometer (CHR), which measures a time interval (from the pushing of the CHRONO button) in minutes and seconds.
- It can replace the UTC with the date.

CONTROLS AND INDICATORS



(1) UTC (GMT) counter

This counter displays the present time in 24-hour format from 0 to 23 hours 59 minutes 59 seconds.

(2) Elapsed Time (ET) counter

This counter registers the aircraft's flight time from 0 to 99 hours 59 minutes.

(3) Chrono (CHR) counter

This counter registers elapsed time from 0 to 99 minutes 59 seconds. It is controlled by the CHR pushbutton.

④ CHR pushbutton

First push : starts the CHR counter
Second push : stops the CHR counter, keeps the display at its last indication.

⑤ Reset (RST) pushbutton

When pressed, the CHR counter restarts from 0 if the chrono is running.

⑥ ET selector

"RUN" : the ET counter starts
"STP" : the ET counter stops counting
spring loaded "RST": the ET counter is blanked. The selector returns to its STP position when the selector is released.

Note : A cumulative elapsed time can be realized by alternatively setting this switch in "RUN" and "STP" position.

⑦ DATE/SET button

First push : sets the clock to date mode. The UTC time display is replaced by the date (day month year).
Second push : sets the clock to time mode. The date display disappears.

Note : in order to select the date mode, the UTC selector must be set on "GPS" or "INT" position.

(8) UTC selector

"GPS": Time (or date, if selected) is displayed, and this data is synchronized on GPS information.

Note : – *If the signal between the GPS and the clock is not detected, dashes are displayed. Only the "INT" and "SET" positions are then available.*
– *If the signal is detected, but GPS data is invalid, the clock automatically runs on its internal time.*
R – *The clock will automatically resynchronize on the GPS information, as soon as*
R *the GPS data becomes available.*

"INT": Internal time (or date, if selected) is displayed.

R *Note :* – *The clock's internal time is always synchronized with the latest valid GPS*
R *information.*
R – *If there is no valid GPS information at power up, the internal time will be*
R *00:00:00, until the clock is initialized, or until valid GPS information is present.*

R "SET": Allows the internal time and date to be initialized.

R INTERNAL TIME AND DATE INITIALIZATION

Set the UTC selector on "SET". The minute digits flash, and the seconds' digits are blank.
To increase data, turn the DATE/SET button clockwise.
To decrease data, turn the DATE/SET button counterclockwise.
– First, push on DATE/SET : To set the hour.
– Second, push on DATE/SET : To set the year.
– Third, push on DATE/SET : To set the month.
– Fourth, push on DATE/SET : To set the day.
Switch the UTC selector to the "INT" position, and the clock starts with the seconds' digits at 00.

Note : This process must be completed in less than one minute. Otherwise, it will be necessary to reset the CFDS in order to synchronize the lower ECAM time display with the cockpit clock display. Resetting the CFDS is a maintenance operation.

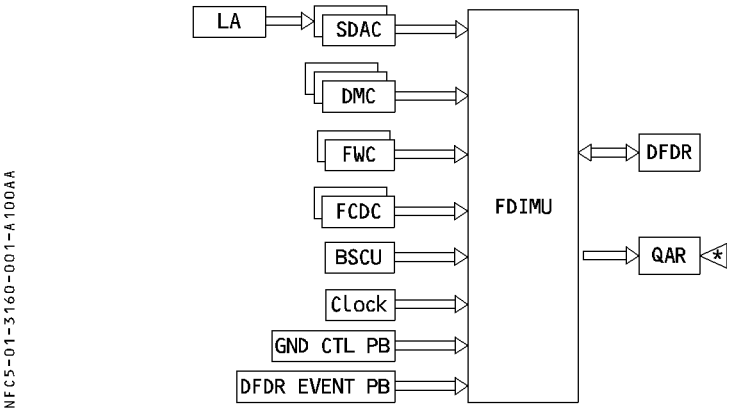
FLIGHT DATA RECORDING SYSTEM

DESCRIPTION

The Flight Data Recording System, which records the mandatory parameters, consists of the following components :

- A Flight Data Interface and Management Unit (FDIMU)
- A Digital Flight Data Recorder (DFDR)
- A three-axis Linear Accelerometer (LA)

The FDIMU collects and processes parameters from the SDACs, DMCs, FWCs, FCDCs, BSCU, the DFDR event pushbutton, the GND CTL pushbutton and the Clock.
It stores the mandatory flight parameters in the DFDR.
The DFDR can store the last 25 hours, at least. It stores this data on a fireproof and shockproof device. An underwater locator beacon is attached to the DFDR.
The linear accelerometer measures the acceleration of the aircraft along each of the three axes.
The QAR is an optional recorder that stores the same data as the DFDR. However the QAR is more accessible for the maintenance crew.



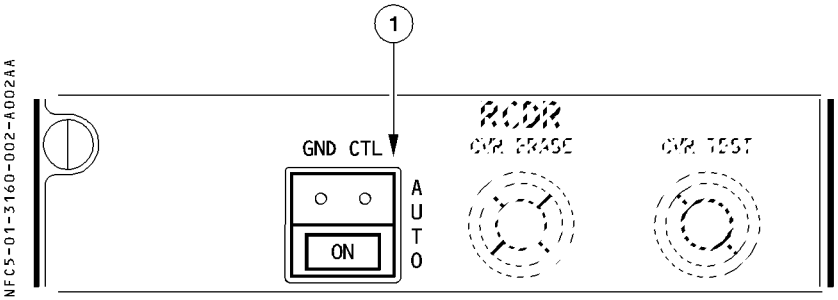
The recording system is automatically active :

- On the ground, during the first five minutes after the aircraft electric network is energized.
- On the ground, after the first engine start.
- In flight (whether the engines are running or not).

On the ground, the recording system stops automatically five minutes after the second engine shuts down.
On the ground, the crew can start the recording system manually by pressing the GND CTL pushbutton.

R **CONTROLS AND INDICATORS**

OVERHEAD PANEL



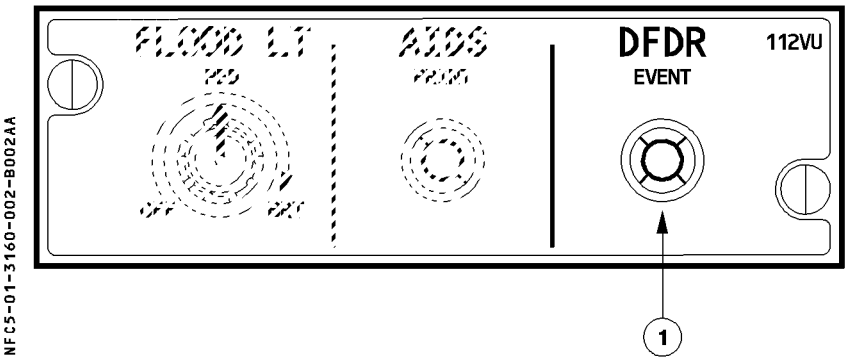
(1) GND CTL pushbutton (springloaded)

R – ON The Cockpit Voice Recorder (CVR) and the Flight Data Recorders are active. The ON light is on.

R – AUTO The Cockpit Voice Recorder (CVR) and the Flight Data Recorders are active, according to the logic.

The system automatically switches from ON to AUTO at the first engine start, and also in case of an electrical transient.

PEDESTAL



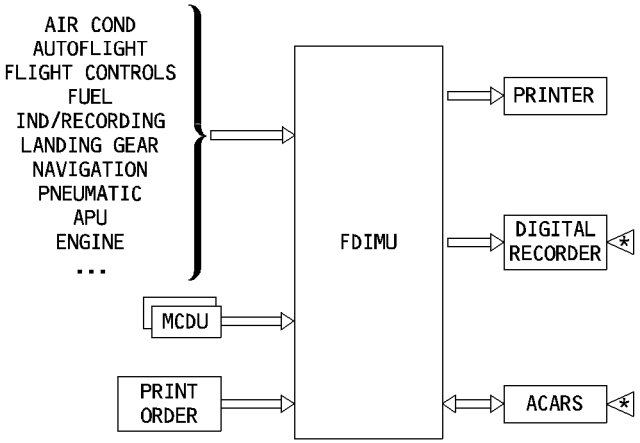
(1) DFDR EVENT pushbutton

R – Pressing this button (briefly) sets an event mark on the Flight Data records.

AIRCRAFT INTEGRATED DATA SYSTEM (AIDS)

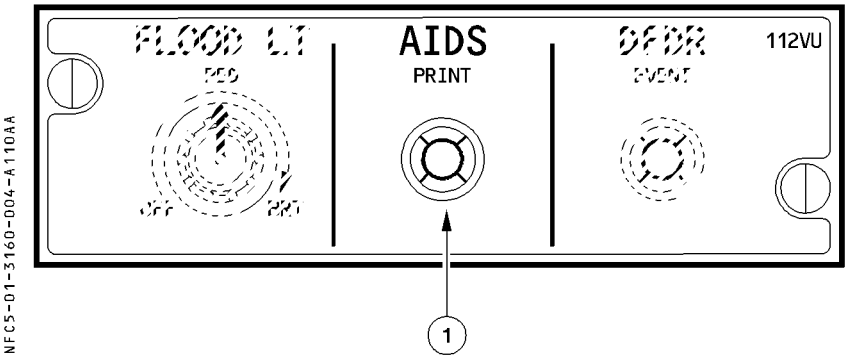
DESCRIPTION

The AIDS is used to monitor various aircraft system parameters in order to make maintenance easier and to allow formulating operational recommendations.
The AIDS can generate system reports. The Airbus Standard Reports are preprogrammed reports available at aircraft delivery. The operator can create its own reports.
The AIDS uses the Flight Data Interface and Management Unit (FDIMU) to acquire the relevant aircraft system parameters. The FDIMU is connected to the rest of the AIDS as shown below.
The system may be programmed using the MCDUs. The crew can select any report to be displayed on the MCDUs
The Printer prints the flihgt phase programmed reports or any report selected on the MCDU. This printing may be automatic or in response to the AIDS PRINT pushbutton.
The AIDS may send automatic reports via ACARS (◁).
An optional Digital Recorder may be installed to extend the recording capacity.



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CONTROLS ON PEDESTAL



(1) AIDS PRINT pushbutton

Pushing this pushbutton causes the immediate printing of a specific report, depending on the flight phase. The crew may then use the MCDU to select another report for immediate printing.

DESCRIPTION

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INTENTIONALLY LEFT BLANK

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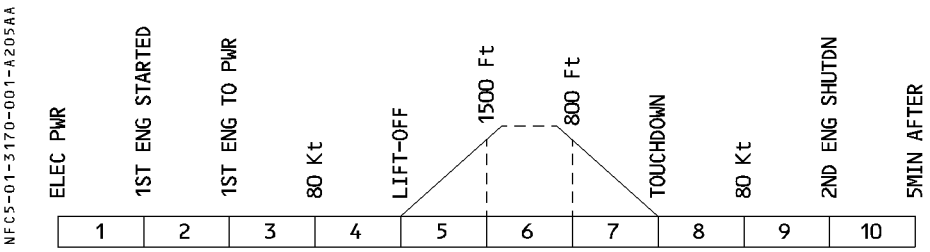
GENERAL

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GENERAL

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WARNINGS AND CAUTIONS



E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNINGS	FLT PHASE INHIB
SDAC 1 + 2 FAULT	SINGLE CHIME	MASTER CAUT	NIL	NIL	4, 5, 7, 8
DMC 1 (2) FAULT					
DMC 3 FAULT					
SDAC 1 (2) FAULT	NIL	NIL			3, 4, 5, 7, 8
FWC 1 (2) FAULT					
FWC 1 + 2 FAULT					NIL
DFDR FAULT					3, 4, 5, 7, 8
RECORDER SYS FAULT					
OEB/FWC DISCREPANCY FWC1 and FWC2 do not have the same OEBs listed in their OEB reminder database.	SINGLE CHIME	MASTER CAUT			3 to 8

BUS EQUIPMENT LIST

R

		NORM		EMER ELEC		
		AC	DC	AC ESS	DC ESS	HOT
DU	CAPT PFD			X		
	CAPT ND			SHED		
	F/O PFD	AC2				
	F/O ND	AC2				
	UPPER ECAM DU			X		
	LOWER ECAM DU	AC2				
DMC	DMC 1			X		
	DMC 2	AC2				
	DMC 3	AC1		X *		
FWC	FWC 1			X		
	FWC 2	AC2				
SDAC	SDAC 1			X		
	SDAC 2	AC2				
ECP	ECP				X	
FDIU/QAR ◁		AC2				
CLOCK					X	X

* in case of EIS DMC switching to CAPT/3, with AC BUS 1 failed.

32.00 CONTENTS

32.10 LANDING GEAR AND DOORS
– DESCRIPTION 1
– LANDING GEAR SYSTEM/INTERFACE 5
– INTERACTIONS BETWEEN LANDING GEAR AND AIRCRAFT SYSTEMS 8
– CONTROLS AND INDICATORS 18
– WARNINGS AND CAUTIONS 23

32.20 NOSE WHEEL STEERING
– DESCRIPTION 1
– CONTROLS AND INDICATORS 3
– WARNINGS AND CAUTIONS 5

32.30 BRAKES AND ANTISKID
– DESCRIPTION 1
– CONTROLS AND INDICATORS 7
– WARNINGS AND CAUTIONS 13

32.40 TIRE PRESSURE INDICATING SYSTEM ◁
– DESCRIPTION 1
– CONTROLS AND INDICATORS 2
– WARNINGS AND CAUTIONS 3

32.50 ELECTRICAL SUPPLY

DESCRIPTION

GENERAL

The landing gear consists of :
– two main gear that retract inboard,
– a nose gear that retracts forward.

Doors enclose the landing gear bays. Gear and doors are electrically controlled and hydraulically operated.

The doors, which are fitted to the landing gear struts, are operated mechanically by the
R gear and close at the end of gear retraction.

All gear doors open while the gear is retracting or extending.

Two Landing Gear Control and Interface Units (LGCIUs) control the extension and retraction of the gear and the operation of the doors. They also supply information about the landing gear to ECAM for display, and send signals indicating whether the aircraft is in flight or on the ground to other aircraft systems.

A hand crank on the center pedestal allows the flight crew to extend the landing gear if the aircraft loses hydraulic systems or electrical power.

MAIN GEAR

Each main gear has twin wheels and an oleopneumatic shock absorber.

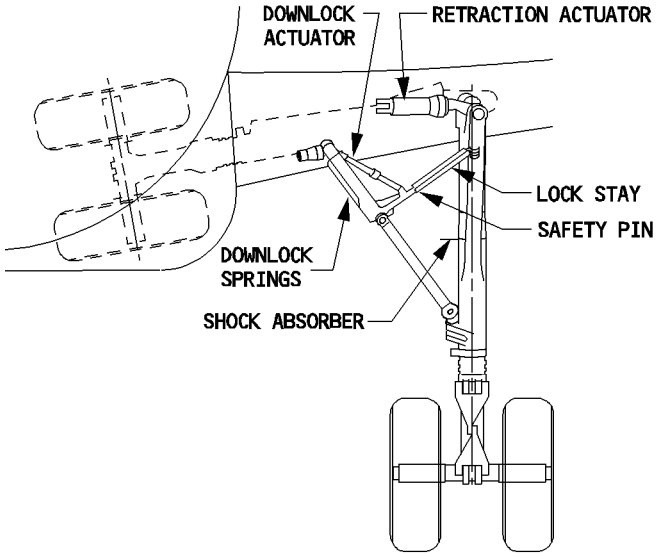
Each main wheel has an antiskid brake.

NOSE GEAR

The two-wheeled nose gear has an oleopneumatic shock strut and a nose wheel steering system.

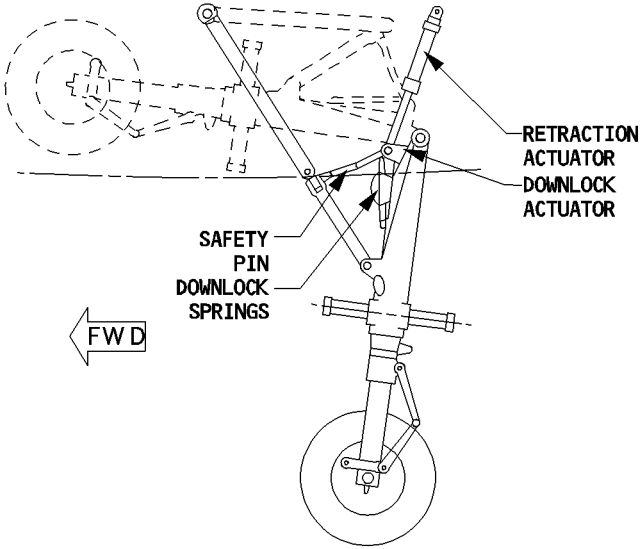
DRAWINGS

MAIN LANDING GEAR



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NOSE GEAR



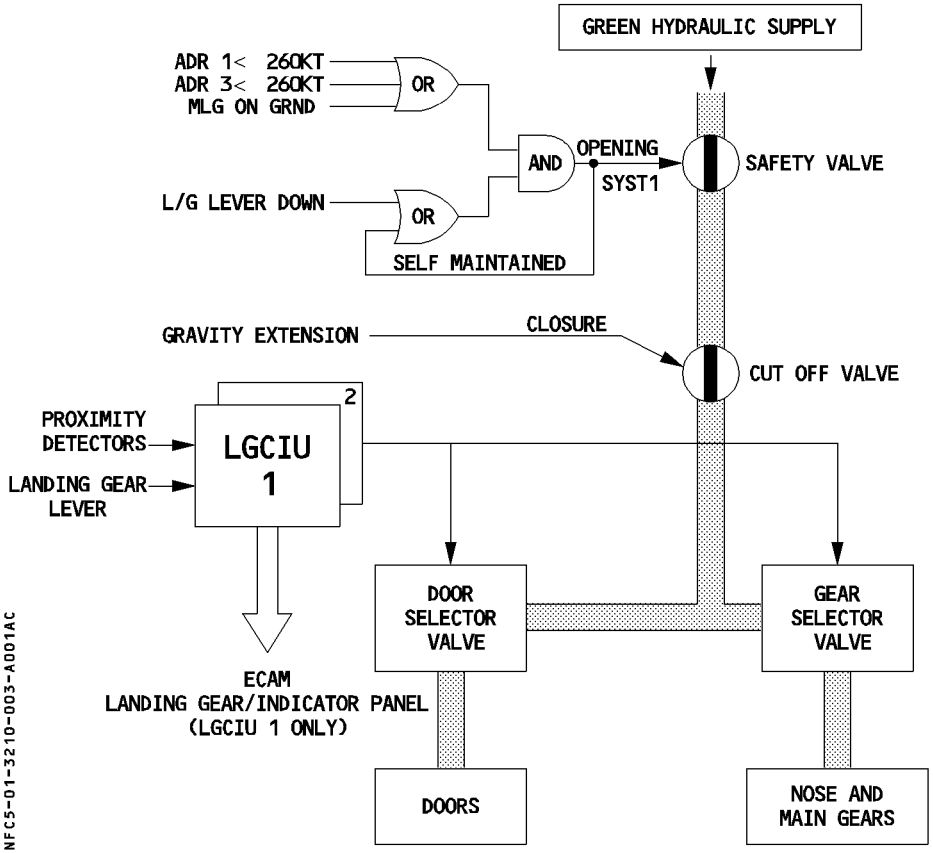
NFC5-01-32-10-002-B001AA

OPERATION OF GEAR AND DOORS

NORMAL OPERATION

The flight crew normally operates the landing gear by means of the lever on the center instrument panel.
The LGCIUs control the sequencing of gear and doors electrically. One LGCIU controls one complete gear cycle, then switches over automatically to the other LGCIU at the completion of the retraction cycle. It also switches over in case of failure.
The green hydraulic system actuates all gear and doors. When the aircraft is flying faster than 260 kt, a safety valve automatically cuts off hydraulic supply to the landing gear system. Below 260 kt, the hydraulic supply remains cut off as long as the landing gear lever is up.

FOR INFO



EMERGENCY EXTENSION

If the normal system fails to extend the gear hydraulically, the flight crew can use a crank to extend it mechanically.

When a crew member turns the crank, it :

– isolates the landing gear hydraulics from the green hydraulic system,
– unlocks the landing gear doors and the main and nose main gear,
– allows gravity to drop the gear into the extended position.

Locking springs help the crew to crank the main gear into the locked condition, and aerodynamic forces assist in the locking of the nose gear.

The gear doors remain open.

The flight crew can reset the emergency extension system in flight after using it for training (if green hydraulic pressure is available).

LANDING GEAR SYSTEM INTERFACE

LGCIUs

The LGCIUs receive position information from the landing gear, cargo door, and landing flap systems.

LANDING GEAR

The LGCIUs receive the following information about the landing gear from proximity detectors :
- gear locked down or up,
- shock absorbers compressed or extended,
- landing gear door open or closed.

Failure of a proximity detector :
- The LGCIU detects any electrical failure in a proximity detector, and signals the associated output to the flight position (shock absorber not compressed or landing gear uplocked).
  The other LGCIU then automatically takes over control of the landing gear operation.
- In case of mechanical failure, the LGCIU does not modify the associated output. The effect that such a failure has on the system depends upon which condition is signalled incorrectly.

Electrical failure of an LGCIU :
- The other (healthy) LGCIU takes control of the landing gear.
- The system does not force the outputs of the failed LGCIU to the safe (flight) condition.
  · Some users will see “flight” condition.
  · Some users will see “ground” condition.

CARGO DOORS

Sensors send to the LGCIUs the position of the following components :
- manuel selector valves,
- locking shaft,
- locking handle,
- safety shaft,
- door sills .◁

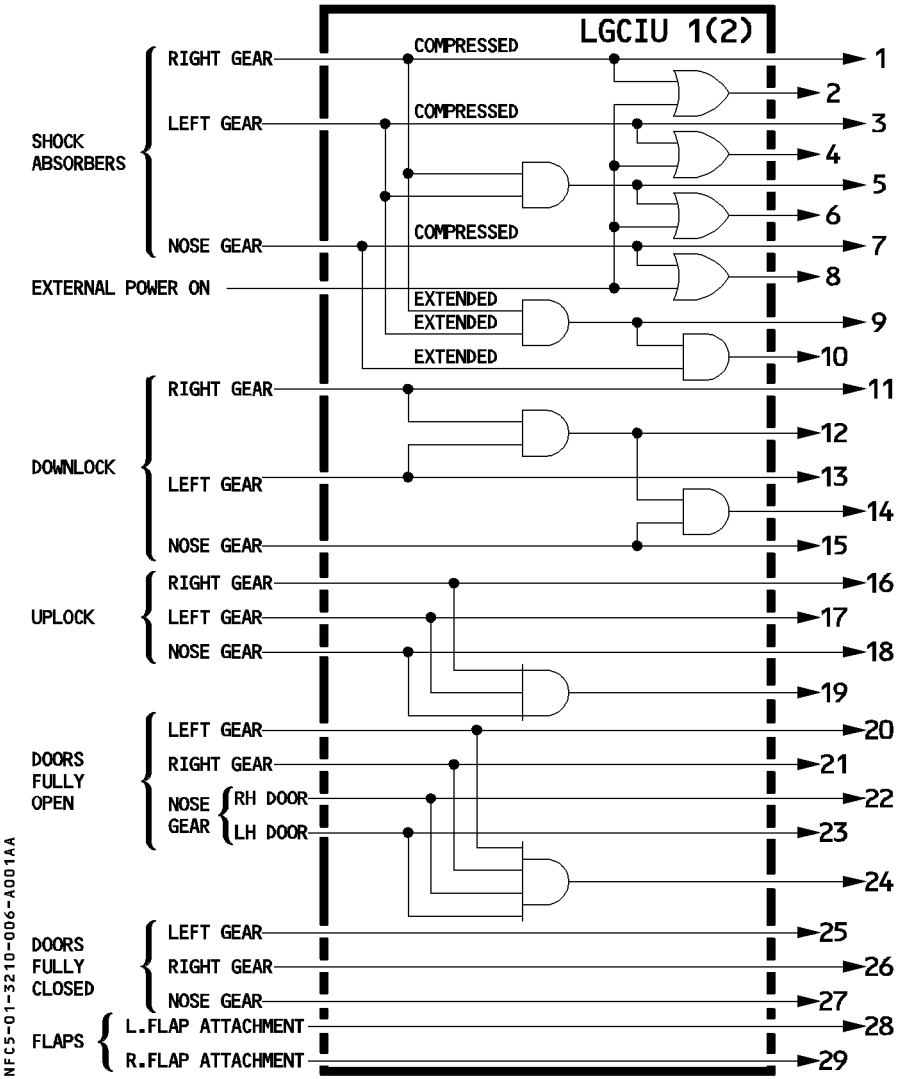
The LGCIUs detect electrical failures only in certain proximity switches in the cargo door system :
- locking shaft,
- locking handle,
- safety shaft.

When an LGCIU makes such a detection, it indicates the NON LOCKED condition for that component.

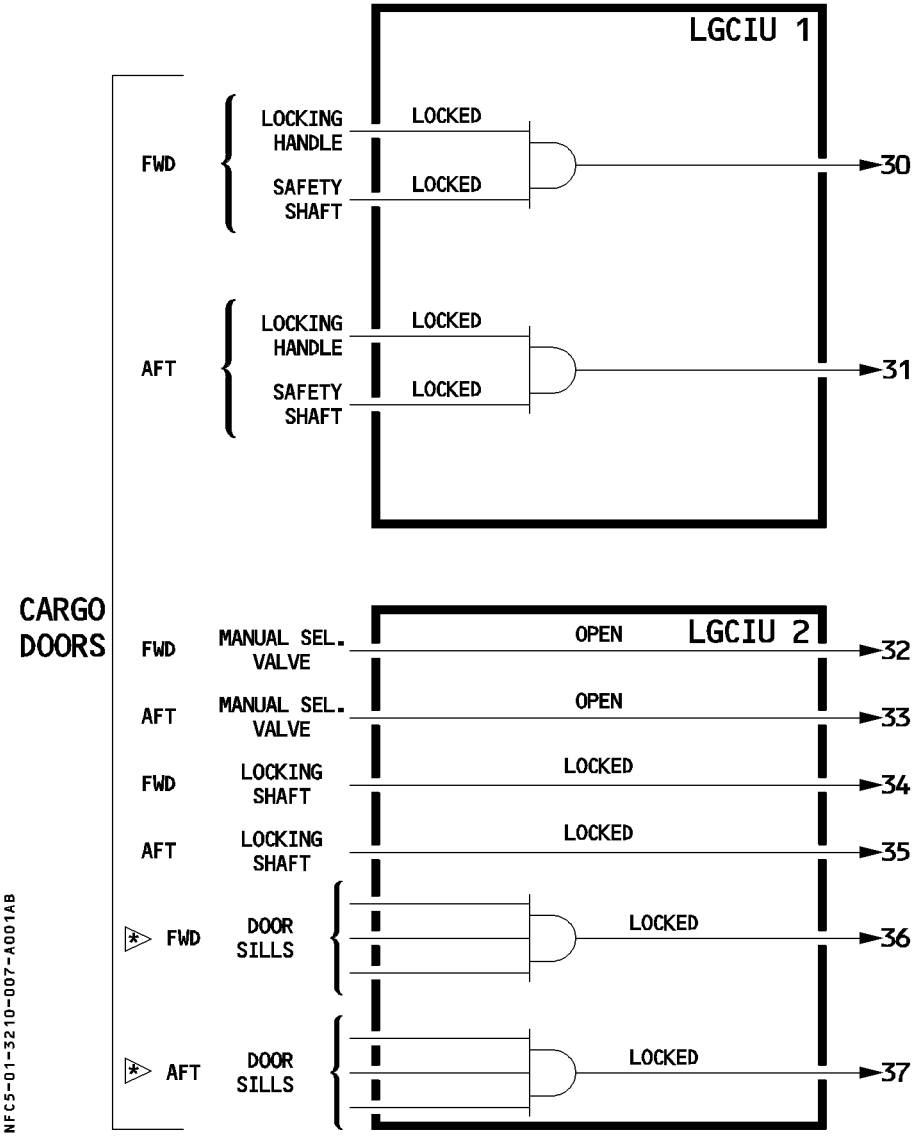
FLAPS

The LGCIUs process the signals from four flap disconnect proximity switches, then send them to the Slat/Flap Control Computers (SFCCs).
The LGCIUs do not monitor failures in the SFCC system.

PROXIMITY DETECTOR OUTPUT SIGNALS



PROXIMITY DETECTOR OUTPUT SIGNALS (CONT'D)



INTERACTIONS BETWEEN LANDING GEAR AND AIRCRAFT SYSTEMS

The following tables present the operational effects of the proximity detectors on aircraft systems.
How to read the tables :

R

SYSTEM	LGCIU 1	LGCIU 2	A/C IN FLT	A/C ON GROUND
SERVICE INTERPHONE	**6**	**6**	.....	.....
SFCC 1(2)	**5**	**(5)**	.....	.....

The above lines mean that the service interphone receives the output n° 6 from both LGCIUs, while SFCC 1 receive the output 5 from LGCIU 1 and SFCC 2 the output 5 from LGCIU 2.
The two additional colums give the system functioning when the aircraft is in flight and on the ground.

PROXIMITY DETECTORS ON SHOCK ABSORBERS

	SYSTEM	LGCIU 1 OUTPUT	LGCIU 2 OUTPUT	A/C IN FLT	A/C ON GRND
GENERAL	STROBE lts		5	On when AUTO selected	Off when AUTO selected
	LOGO lts		5	Off when flaps retracted	On
	AIRSTAIRS (if installed)	3	1	Control inhibited (1)	Control not inhibited (2)
	CARGO DOOR (5)		5	normal control not available	normal control available
	WATER FILLING		5	Preselect water servicing inhibited	Preselect water servicing available
AIR COND	AVNCS COOLING	5	5	. Skin temp. < 35° C : The system is in closed conf. (1) . Skin temp. > 35° C : The system is in intermediate conf. (1)	. Skin temp. < 5° C : The system is in closed conf. (2) . Skin temp. > 5° C : The system is in open conf. (2)
	GRND COOLING (if installed)	1 3	1 3	Inhibited (1)	Not inhibited (2)
	FWD CARGO VENT		5	Extract fan stopped when $\triangle P > 1$ psi	Extract fan on
	CAB PRESS	5	5	– Climb mode active (4)	– Prepressurization active before TO (3) –Depressurization active after LDG (3)
	PACK 1 (2) TEMP CONTROL		3 (1)	Pack air inlet flaps opened.	Pack air inlet flap fully closed at T.O and LDG

(1) When either LGCIU indicates flight
(2) When both LGCIU indicate ground
(3) When either LGCIU indicates ground
(4) When both LGCIU indicate flight
(5) Valid from MSN 44.

PROXIMITY DETECTORS ON SHOCK ABSORBERS

R

	SYSTEM	LGCIU 1 OUTPUT	LGCIU 2 OUTPUT	A/C IN FLT	A/C ON GRND
APU	APU AUTO SHUTDOWN	5		– In case of oil low press, automatic shutdown is delayed by 15.5 seconds	– In case of oil low press, the automatic shutdown is delayed by : · 15.5 seconds if the oil temp < – 4°C · 0.05 seconds if oil temp > – 4°C
	APU SPEED CONTROL			– Speed is controlled at 101 %	– Speed is controlled at 99 % (101 % for eng start or when ambient temp ≥ 30° C)
COMMUNICATIONS	SERVICE INTERPHONE	6	6	Inhibited (1)	Available (2)
	PUBLIC ADDRESS	1 3	1 3	P.A. increased level (1)	P.A. low level (2)
	ADIRU and AVIONICS ground warning	1 3	1 3	External horn and light inhibited (1)	External horn and light not inhibited (2)
	FLT INTERPHONE	9		Communication with ground mechanic inhibited	Communication with ground mechanic available
	COCKPIT CALL LIGHT	9		Inhibited	Not inhibited
	ACARS (ACARS MU or ATSU)	7		Available	Available
	CVR	1 3 7	1 3	Runs (1)	Runs : (2) · during the first 5 minutes following energization · with at least one engine running Stops : (2) 5 minutes after second engine shutdown
	CVR		5	· ERASE function inhibited · No low frequency signal in the loudspeakers if test performed	· ERASE function not inhibited · Low frequency signal in the loudspeakers if test performed

(1) When either output indicates flight.
(2) When all outputs indicate ground.

PROXIMITY DETECTORS ON SHOCK ABSORBERS

	SYSTEM	LGCIU 1 OUTPUT	LGCIU 2 OUTPUT	A/C IN FLT	A/C ON GRND
ELEC	DC generation	5		APU start on batteries only, is delayed by 45 seconds	No APU start delay when on batteries only
	GALLEY supply		5	Main galley not supplied when APU GEN only is supplying	Main galley supplied when APU GEN only is supplying
EIS	EIS	5		Display test inhibited when ANN LT TEST is selected	Display test not inhibited
FIRE	APU	5		No APU fire automatic extinguishing	Automatic extinguishing not inhibited
FLT CTL	SFCC 1(2)	5	(5)	· For SFCC 1(2) : Slats alpha/speed lock function active · For SFCC (2) : No flaps movement inhibition if the cargo door is opened	· For SFCC 1(2) : Slats alpha/speed lock function active if speed > 60 kt · For SFCC (2) : Flaps movement inhibition if cargo door is opened
FLT INST	· DFDR · QAR (If installed)	1 3 7	1 3	Runs (1)	Runs : (2) · during the first 5 minutes following energization · with one engine running Stops : (2) 5 minutes after second engine shut down
FUEL	FQI	5		FQI uses flight attitude correction due to wing bending	FQI uses ground attitude correction

(1) When either output indicates flight
(2) When all outputs indicate ground

PROXIMITY DETECTORS ON SHOCK ABSORBERS

R

	SYSTEM	LGCIU 1 OUTPUT	LGCIU 2 OUTPUT	A/C IN FLT	A/C ON GRND
HYD	BLUE and GREEN pumps	**1** **3**		Blue or green pump "FAULT" light not inhibited when related pump is stopped (1)	Blue or green pump "FAULT" light inhibited when related pump is stopped (4)
	BLUE pump	**7**		Runs when electrical power is available	Runs when at least one engine is running
	BLUE and YELLOW pumps		**1** **3**	Blue or yellow pump "FAULT" light not inhibited when related pump is stopped (1)	Blue or yellow pump "FAULT" light inhibited when related pump is stopped (2)
	PTU		**7**	PTU runs if green/yellow diff. press > 500 psi	PTU runs if green/yellow diff. press > 500 psi and · both MASTER LEVERS are at OFF or · both MASTER LEVERS are at ON or · nose wheel steering is not in towing position with parking brake released. PTU is inhibited during the use of the cargo door hand pump and for 40 seconds after its use.
ICE RAIN PROT	CAPT, (F/O), (STBY) probes and CAPT, (F/O) windows heating	**4,** **(2)** **((8))**	**4,** **(2)** **((8))**	. CAPT, (F/O), ((STBY)) pitots and CAPT, (F/O) windows : high heating level applied . All other probes and windows are heated (1)	. With engines stopped :no heating (2) . With at least one engine running : . CAPT, (F/O), ((STBY)) pitots and CAPT, (F/O) windows are heated at low level (2)
	WING ANTI ICE	**3**	**1**	Wing anti ice valves open when the WING ANTI ICE pb is at ON (1)	Wing anti ice valves open for 30 seconds when the WING ANTI ICE pb is at ON (2)
	RAIN REPELLENT	**1** **3**	**1** **3**	Not inhibited (1)	Inhibited if engines are stopped (4)
	DRAIN MAST (5)		**9**	High heating level is applied	Low heating level is applied

(1) When either outputs indicates flight
(2) When both outputs indicate ground
(3) One valid output is sufficient
(4) When all outputs indicate ground
(5) Valid from MSN 22

PROXIMITY DETECTORS ON SHOCK ABSORBERS

	SYSTEM	LGCIU 1 OUTPUT	LGCIU 2 OUTPUT	A/C IN FLT	A/C ON GRND
LANDING GEAR	L/G SAFETY VALVE	6		Safety valve closes if aircraft speed > 260 kt	Safety valve opened
	L/G control	10	10	Retraction not inhibited (1)	Retraction inhibited (1)
	TIRE PRESS ◁		5	"TYRE LO PRESS" warning threshold set to its flight level	"TYRE LO PRESS" warning threshold set to its ground level
NAVIGATION	STAND BY ALTI	5		VIBRATION function active	Vibration function inhibited
	ATC 1(2)	3	(1)	ATC 1(2) available in AUTO mode	ATC 1(2) inhibited in AUTO mode
	ADIRU 1 (2)	7		No external horn when ADIRU supplied from batteries only	External horn not inhibited

(1) One valid output is sufficient
(2) Valid from MSN 22

PROXIMITY DETECTORS ON SHOCK ABSORBERS

	SYSTEM	LGCIU 1 OUTPUT	LGCIU 2 OUTPUT	A/C IN FLT	A/C ON GRND
POWER PLANT	FADEC 1(2)	1 3	(1) (3)	On Eng 1(2) : (1) · Reverse inhibited · No automatic start abort · FADEC always supplied · FLEX not available · If installed, BUMP not selectable	On Eng 1(2) : (2) · Reverse available · Automatic start abort available · 5 minutes after eng-shut down FADEC 1(2) no more supplied · FLEX available · If installed, BUMP selectable
		1 3 8	(1) (3) (8)	Modulated idle and approach idle are available (1)	Modulated idle only available (3)

(1) When either output indicates flight
(2) When both outputs indicate ground
(3) When all outputs indicate ground

PROXIMITY DETECTORS ON UPLOCKS

	SYSTEM	LGCIU 1 OUTPUT	LGCIU 2 OUTPUT	L/G UPLOCKED	L/G NOT UPLOCKED
LANDING GEAR	L/G control	19	19	. If UP selected : (1) L/G doors will close	. If UP selected : (1) L/G doors will not close
	ECAM WHEEL page	16 17 18	16 17 18	. If UP selected : (2) L/G uplocked indications	. If UP selected : (2) L/G in transit indications
	L/G indicator panel	16 17 18		. If UP selected : (2) no indication	. If UP selected : (2) "UNLK" red indications

DOORS PROX DET

	SYSTEM	LGCIU 1 OUTPUT	LGCIU 2 OUTPUT	DOORS FULLY OPENED	DOORS CLOSED
LANDING GEAR	L/G control	24	24	L/G extension or retraction possible (1)	L/G extension or retraction inhibited (1)
	ECAM WHEEL PAGE	20 21 22 23	20 21 22 23	Doors fully opened indication	Doors closed indication

(1) One valid output is sufficient.
(2) When all outputs indicate the same position.

PROXIMITY DETECTORS ON DOWNLOCKS

R

	SYSTEM	LGCIU 1 OUTPUT	LGCIU 2 OUTPUT	L/G DOWNLOCKED	L/G NOT DOWNLOCKED
GEN	TAXI/T.O lights		**15**	lights not inhibited	lights inhibited
COMM.	SIGNS	**12**	**12**	"NO SMOKING" and "EXIT" signs on when AUTO selected (1)	"NO SMOKING" and "EXIT" signs inhibited when AUTO selected (2)
FLT. INST.	WBS ◁	**15**	**15**	active (3)	inhibited (4)
FMGS	FAC 1(2)	**12**	**12**	VLE indication displayed on PFD 1(2)	no VLE indication
LANDING GEAR	L/G control	**14**	**14**	If DOWN selected : (5) L/G doors will close	If DOWN selected : (5) L/G doors will not close
	ECAM WHEEL page	**11** **13** **15**	**11** **13** **15**	If DOWN selected : (6) L/G down indications	If DOWN selected : (6) L/G in transit indications
	L/G INDIC panel	**11** **13** **15**		If DOWN selected : (6) L/G down indications	If DOWN selected : (6) L/G in transit indications
	BRAKING STEERING	**15**	**15**	BSCU test operative (1)	BSCU test inhibited (1)
	BRAKES COOLING ◁		**13**	Cooling available when ON selected	Cooling inhibited when ON selected
NAV	GPWS	**13**		"TOO LOW-FLAPS" or "TOO LOW TERRAIN" warning operative	"TOO LOW-GEAR" or "TOO LOW TERRAIN" warning operative

(1) When either output indicates DOWNLOCK.
(2) When both outputs indicate NOT DOWNLOCK.
(3) When both outputs indicate DOWNLOCK.
(4) When either output indicates NOT DOWNLOCK.
(5) One valid output is sufficient.
(6) When all outputs indicate the same position.

PROXIMITY DETECTORS ON CARGO DOORS

LOCKING HANDLE OR SHAFT, DOOR SILLS

	SYSTEM	LGCIU 1 OUTPUT	LGCIU 2 OUTPUT	LOCKED	UNLOCKED
CRG DOORS	ECAM DOOR PAGE	**30 (31)**		Forward (aft) door symbol appears green	Forward (aft) door symbol appears amber, associated with "CARGO" amber.
	CARGO DOOR OPERATION		**34 (35)**	Forward (aft) door normal opening inhibition	Forward (aft) door normal opening possible
			36 ◁ (37) ◁	Forward (aft) door normal operation possible	Forward (aft) door normal operation inhibited

MANUAL SELECTOR VALVE

	SYSTEM	LGCIU 1 OUTPUT	LGCIU 2 OUTPUT	CLOSE	OPEN
CRG DOORS	CARGO DOOR OPERATION		**32 (33)**	Forward (aft) door normal opening inhibition	Forward (aft) door normal opening possible

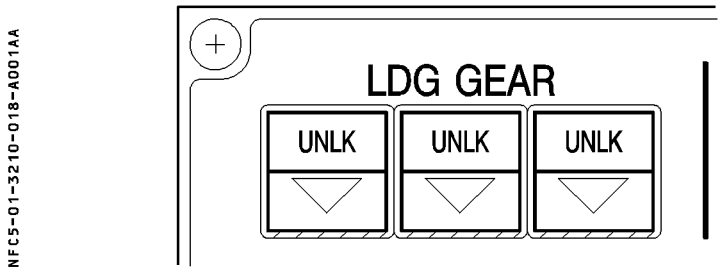
PROXIMITY DETECTORS ON FLAP ATTACHMENTS

	SYSTEM	LGCIU 1 OUTPUT	LGCIU 2 OUTPUT	FLAP ATTACHMENT	FLAP ATTACHMENT FAILURE
FLT CTL	SFCC	**28 (29)**	**28 (29)**	L(R) FLAPS normal operation (1)	"FLAPS LOCKED" warning (2)

(1) When at least one SFCC detects normal operation
(2) When both SFCCs detect attachment failure

CONTROLS AND INDICATORS

LANDING GEAR INDICATOR PANEL

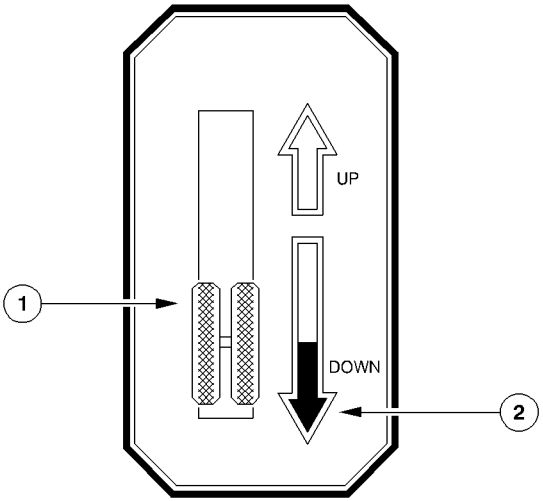


This panel is connected to LGCIU1, which receives signals from proximity detectors.
UNLK : come on red if the gear is not locked in the selected position.
▽ : come on green if the gear is locked down.

R *Note : The lights on the LDG GEAR indicator panel come on as long as the LGCIU1 is*
R *electrically supplied.*

LANDING GEAR SELECTOR LEVER

A two-position selector lever sends electrical signals to the two LGCIUs. These control the green hydraulic supply to the landing gear system by means of selector valves.
When the flight crew selects UP or DOWN (and if the airspeed is below 260 knots) :
– All landing gear doors open.
– Each landing gear moves to the selected position.
– All landing gear doors close.



NFCS-01-3210-019-A100AA

① L/G LEVER

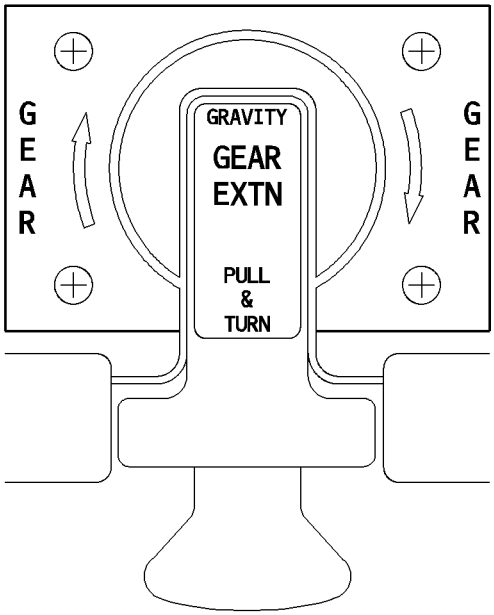
UP : This position selects landing gear retraction.
While the landing gear doors are opening, the normal brake system brakes the wheels of the main gear automatically.

DOWN : This position selects landing gear extension.
An interlock mechanism prevents anyone from accidentally retracting the gear while the aircraft is on the ground. It does so by locking the lever in DOWN position when the shock absorber on either main gear is compressed (aircraft on ground) or the nose wheel steering is not centered.
The landing gear hydraulic system remains pressurized as long as the landing gear is extended (if green hydraulic pressure is available).

② RED ARROW

This red arrow lights up if the landing gear is not locked down when the aircraft is in the landing configuration, and a red warning appears on ECAM.

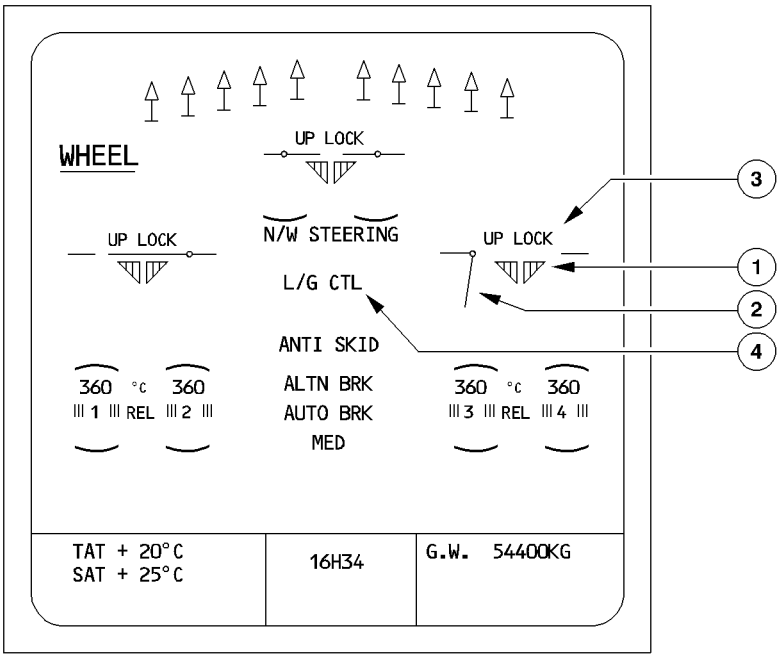
EMERGENCY EXTENSION



NFCS-01-3210-020-A001AA

To put the landing gear down by gravity, the flight crew must pull the gear crank out, then turn it clockwise for 3 turns.
When the flight crew operates the crank handle, the cutout valve shuts off hydraulic pressure to the landing gear system and depressurizes it.

ECAM WHEEL PAGE

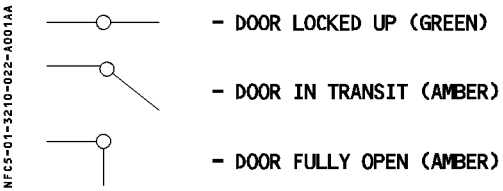


NFC5-01-3210-021-A105AA

(1) Landing gear position indication

The landing gear positions are indicated by 2 triangles for each gear.
Each triangle is controlled by one LGCIU :
- a green triangle indicates that one LGCIU detects a landing gear downlocked,
- a red triangle indicates that one LGCIU detects a landing gear in transit,
- no triangle indicates that one LGCIU detects a landing gear uplocked,
- amber crosses indicates that one LGCIU is failed.

(2) Landing gear door position indication



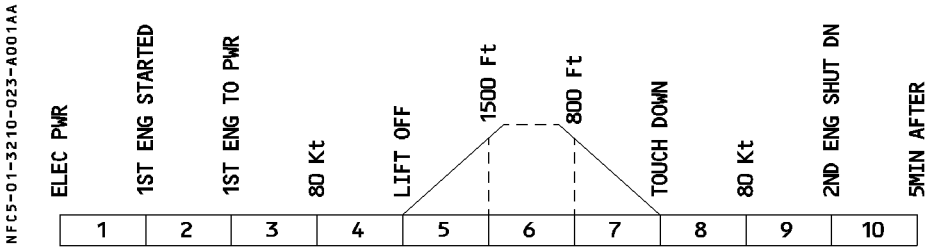
(3) UP LOCK

This legend appears amber along with a caution on the ECAM if the landing gear uplock is engaged when the landing gear is down locked.

(4) L/G CTL

This legend appears amber along with an ECAM caution if the landing gear lever and the landing gear position do not agree.

WARNINGS AND CAUTIONS



E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
GEAR NOT DOWNLOCKED One gear not downlocked and L/G selected down	CRC	MASTER WARN	WHEEL	UNLK lt on	3, 4, 5
GEAR NOT DOWN 1. L/G not downlocked and radio height lower than 750 ft and both engines N1 lower than 75 % (or if engine shut down N 1 of remaining engine lower than 97 %) or 2. L/G not downlocked and radio height lower than 750 ft and both engines not at T.O. power and flaps at 3 or FULL or 3. L/G not downlocked and flaps at 3 or FULL and both radio altimeters failed NOTE : In the cases 2 and 3 above, the aural warning can only be cancelled by the emergency cancel pushbutton.			NIL	DOWN ARROW lt on LDG GEAR panel	
SHOCK ABSORBER FAULT One shock absorber not extended when airborne or not compressed after landing	SINGLE CHIME	MASTER CAUT		NIL	1, 3, 4
DOORS NOT CLOSED One gear door is not uplocked			WHEEL		1, 3, 4, 5, 8, 9, 10
GEAR NOT UPLOCKED One gear not uplocked and L/G not selected down				UNLK lt on LDG GEAR panel	3, 4, 7, 8, 9, 10
GEAR UPLOCK FAULT One gear uplock engaged with corresponding gear downlocked					4
LGCIU 1 (2) FAULT	NIL	NIL		NIL	4, 5, 7, 8
SYS DISAGREE Disagree between L/G positions detected by the two LGCIU's					3, 4, 5, 7, 8

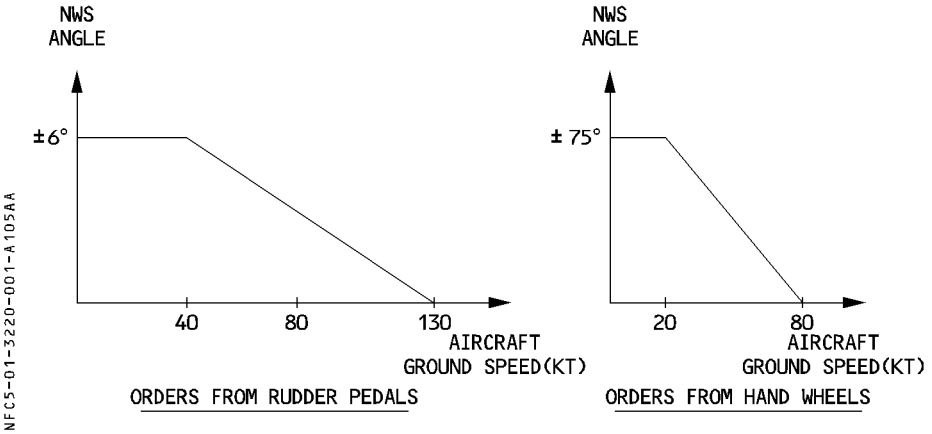
DESCRIPTION

A hydraulic actuating cylinder steers the nose wheel. The green hydraulic system supplies pressure to the cylinder, and electric signals from the Brake and Steering Control Unit (BSCU) control it.

The BSCU receives orders from :

- the Captain's and the First Officer's steering hand wheels (orders added algebraically),
- the rudder pedals,
- the autopilot.

The BSCU transforms these orders into nose wheel steering angle. That angle has the following limits, which depend on ground speed and the origin of the orders.



The steering system receives actuating hydraulic pressure when :

- the A/SKID & N/W STRG switch is on and,
- the towing control lever is in normal position and,
- at least one engine is running and,
- the aircraft is on ground.

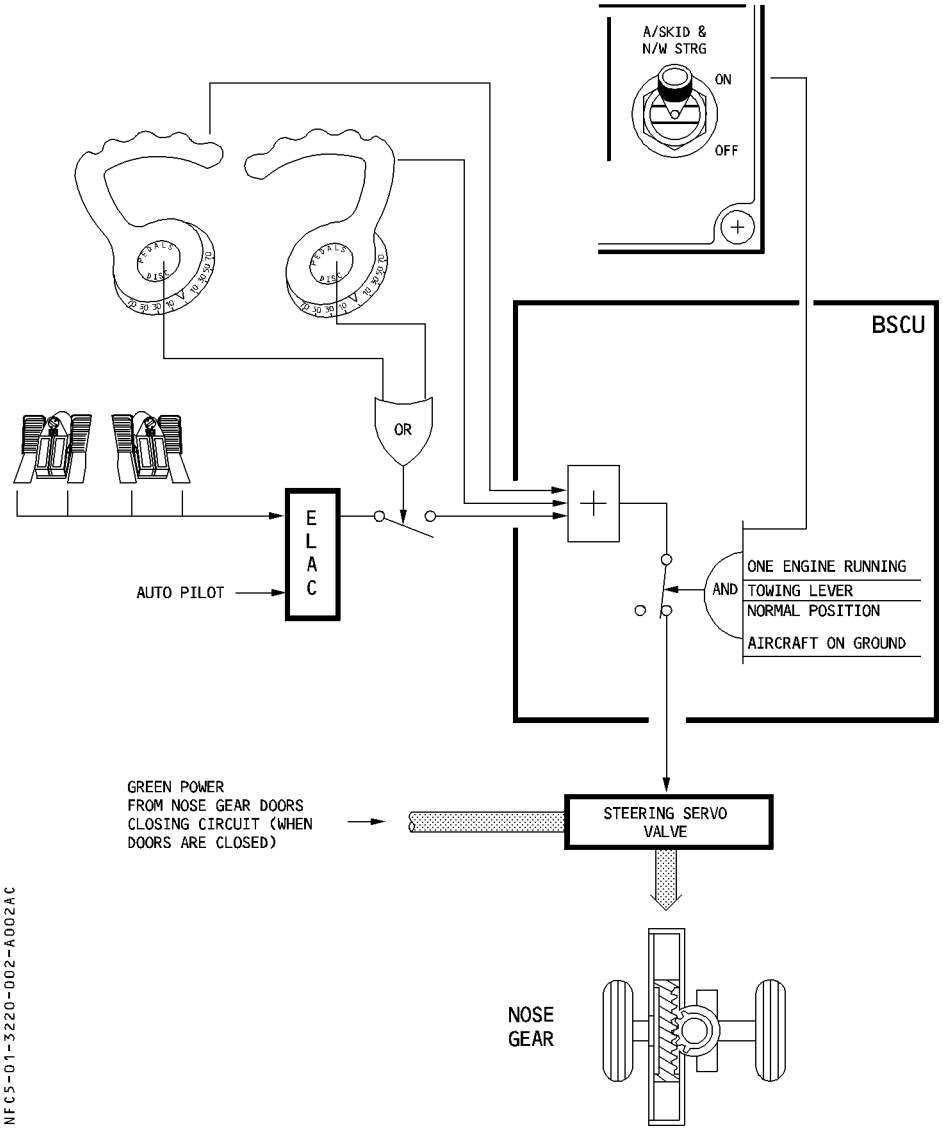
The nose landing gear doors must be closed in order for the green hydraulic system to apply pressure to the actuating cylinder.

The handwheel can turn the nose wheel up to 75° in either direction. A lever on the towing electrical box (on nose landing gear) allows ground crew to deactivate the steering system for towing. This then allows the wheel to be turned 95° in either direction.

The pilots can use a pushbutton on either steering handwheel to prevent rudder pedal orders or autopilot orders from going to the BSCU.

An internal cam mechanism returns the nose wheel to the centered position after takeoff.

R


A/SKID &
N/W STRG
ON
OFF
BSCU
OR
E
L
A
C
AUTO PILOT
ONE ENGINE RUNNING
AND TOWING LEVER
NORMAL POSITION
AIRCRAFT ON GROUND
GREEN POWER
FROM NOSE GEAR DOORS
CLOSING CIRCUIT (WHEN
DOORS ARE CLOSED)
STEERING SERVO
VALVE
NOSE
GEAR
NFC5-01-3220-002-A002AC

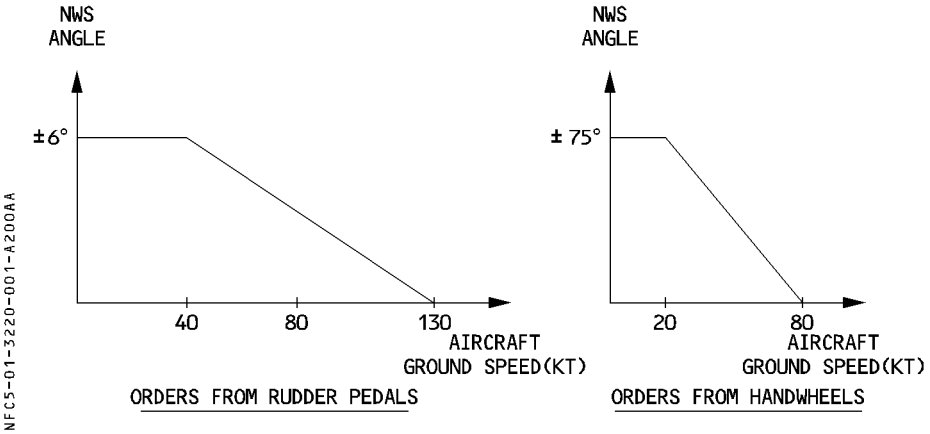
DESCRIPTION

A hydraulic actuating cylinder steers the nosewheel. The yellow hydraulic system supplies pressure to the cylinder, and electric signals from the Brake and Steering Control Unit (BSCU) control it.

The BSCU receives orders from the :

- Captain and First Officer's steering handwheels (orders added algebraically)
- Rudder pedals
- Autopilot.

The BSCU transforms these orders into the nosewheel steering angle. This angle has the following limits, that depend on ground speed and the origin of the orders.



The steering system receives actuating hydraulic pressure, when :

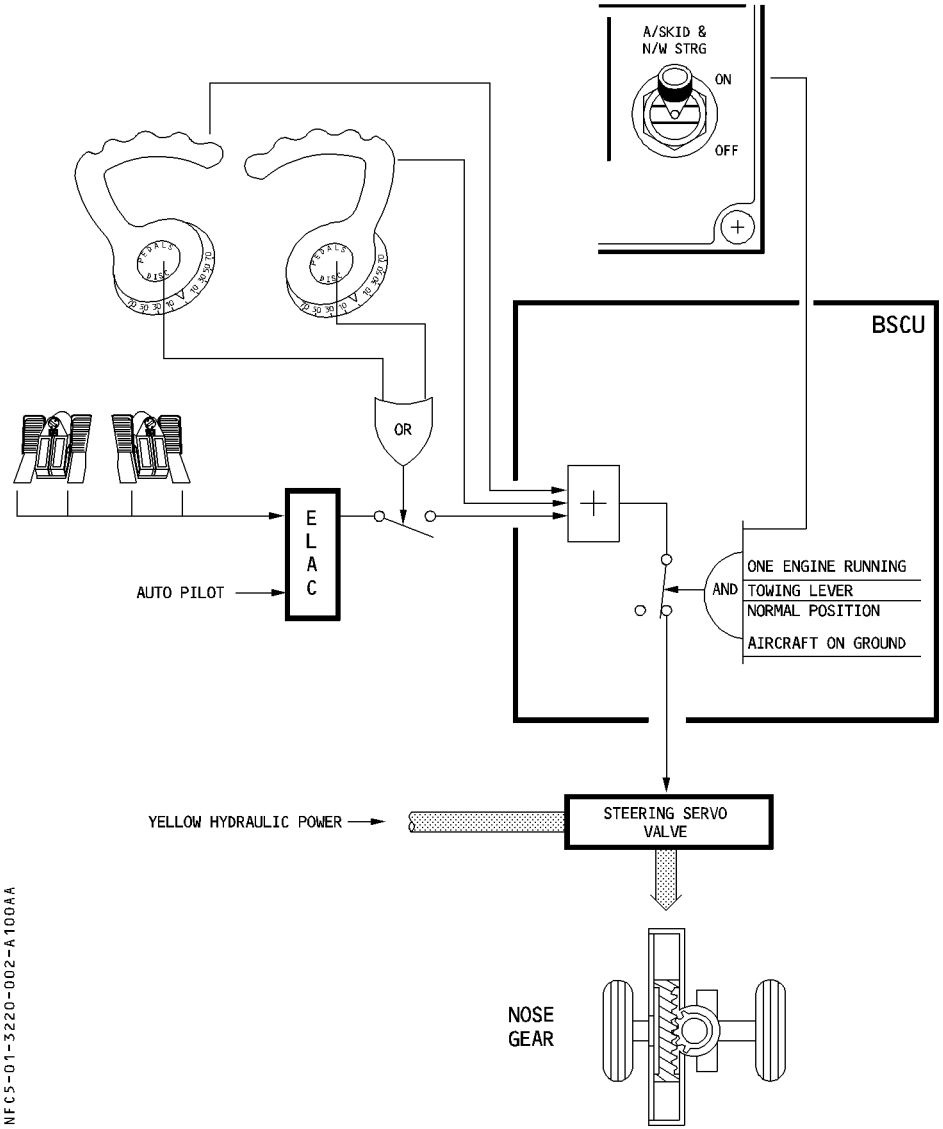
- The A/SKID & N/W STRG switch is on
- The towing control lever is in the normal position
- At least one engine is running, and
- The aircraft is on ground.

R The handwheel can turn the nosewheel up to 75° in either direction. A lever, on the towing electrical box (on nose landing gear), enables the ground crew to deactivate the steering system for towing. Then the wheel can be turned 95° in either direction.

To prevent rudder pedal orders, or autopilot orders, from going to the BSCU, the pilots can use the pushbutton on either steering handwheel.

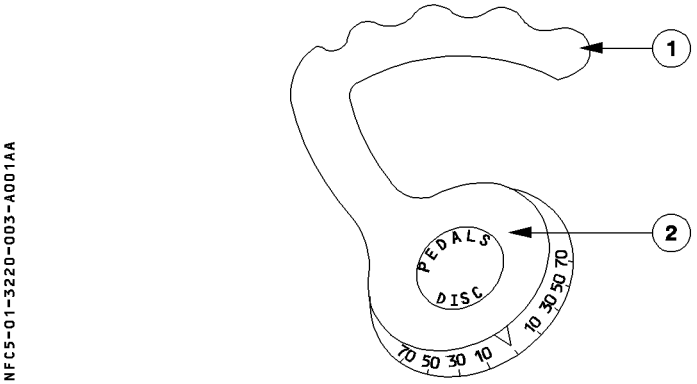
An internal cam mechanism returns the nosewheel to the centered position after takeoff.

R


A/SKID &
N/W STRG
ON
OFF
BSCU
OR
E
L
A
C
AUTO PILOT
ONE ENGINE RUNNING
AND TOWING LEVER
NORMAL POSITION
AIRCRAFT ON GROUND
YELLOW HYDRAULIC POWER
STEERING SERVO
VALVE
NOSE
GEAR
NFC5-01-3220-002-A100AA

CONTROLS AND INDICATORS

SIDE CONSOLES



NFC5-01-3220-003-A001AA

(1) Steering handwheels

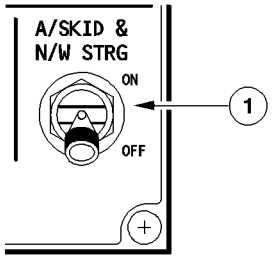
The steering handwheels, which are interconnected, can steer the nose wheel up to 75° in either direction.

Note : The steering system centers the nose wheel automatically after liftoff.

(2) Rudder PEDAL DISC pb

Pressing this button on either handwheel removes control of nose wheel steering from the rudder pedals until the button is released.

CENTER INSTRUMENT PANEL

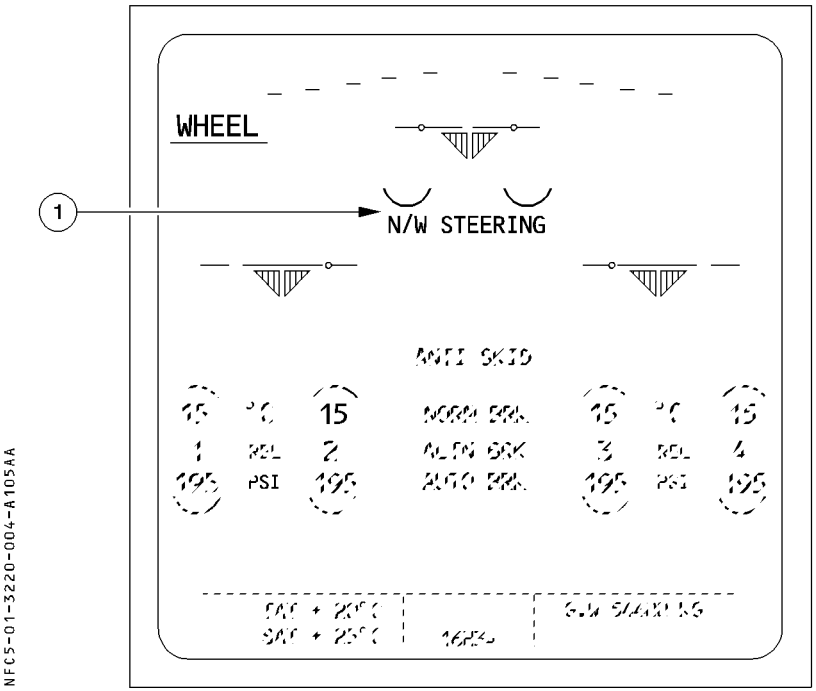


NFC5-01-3220-003-B001AA

(1) A/SKID & N/W STRG sw

This ON/OFF switch activates or deactivates the nose wheel steering and anti-skid. (Refer to 1.32.30, BRAKES AND ANTI-SKID).

ECAM WHEEL PAGE

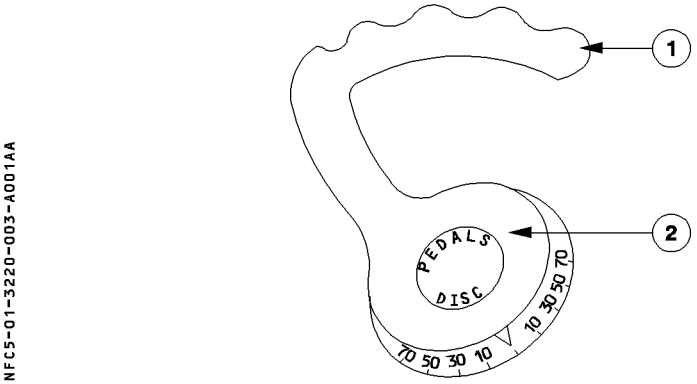


(1) N/W STEERING label

It appears in amber, when nosewheel steering is lost, due to failure of the nosewheel steering system, or of both BSCU channels, or when the A/SKID & N/W STRG switch is OFF.

CONTROLS AND INDICATORS

SIDE CONSOLES



NFC5-01-3220-003-A001AA

(1) Steering handwheels

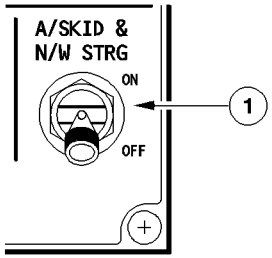
The steering handwheels, which are interconnected, can steer the nose wheel up to 75° in either direction.

Note : The steering system centers the nose wheel automatically after liftoff.

(2) Rudder PEDAL DISC pb

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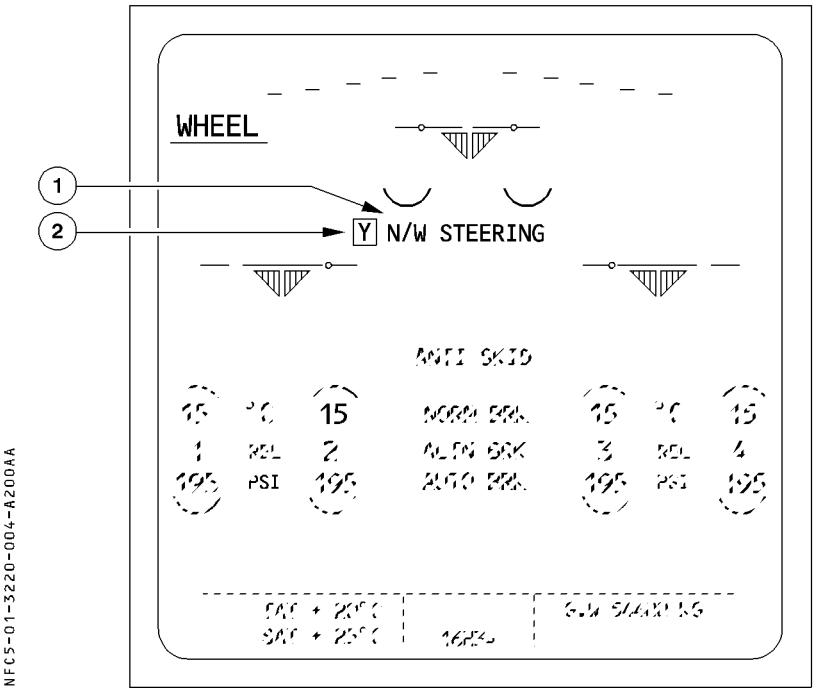


NFC5-01-3220-003-B001AA

(1) A/SKID & N/W STRG sw

This ON/OFF switch activates or deactivates the nose wheel steering and anti-skid. (Refer to 1.32.30, BRAKES AND ANTI-SKID).

ECAM WHEEL PAGE



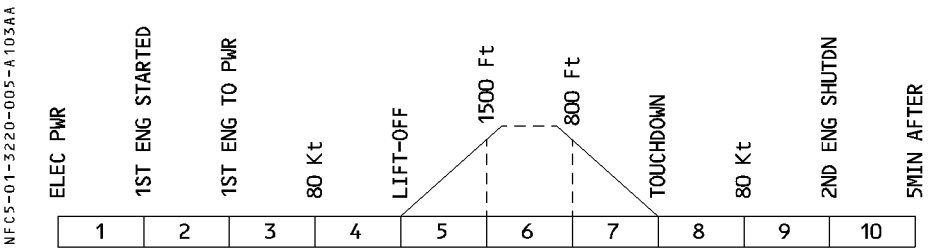
(1) N/W STEERING label

It appears in amber, when nosewheel steering is lost, due to failure of the nosewheel steering system, or of both BSCU channels, or in case of a yellow hydraulic system low
R pressure, or if the A/SKID & N/W STRG switch is OFF.

R (2) N/W STEERING hydraulic supply indication :

R Only when the N/W STEERING label is displayed :
R – Y is displayed in green in case the yellow hydraulic system is not failed.
R – Y is displayed in amber in case of yellow hydraulic system low pressure.

WARNINGS AND CAUTIONS



E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
N/W STRG FAULT detected by BSCU	SINGLE CHIME	MASTER CAUT	WHEEL	NIL	3, 4, 5, 8

MEMO DISPLAY

When the nosewheel steering selector is in the towing position, "NW STRG DISC" is displayed in green. The legend is in amber, if one engine is running.

DESCRIPTION

GENERAL

The main wheels have multidisc brakes that can be actuated by either of two independent brake systems.
The normal system uses green hydraulic pressure : the alternate system uses the yellow hydraulic system backed up by a hydraulic accumulator.
An anti-skid system and autobraking work through the brake system.
Braking commands come from either the brake pedals (pilot action) or the autobrake system (deceleration rate selected by the crew).
Two units on each main gear monitor the temperature of the brakes.
All braking functions (normal and alternate braking control, anti-skid control, autobraking, brake temperature indication) are controlled by a two-channel Brake and Steering Control Unit (BSCU).
The main wheels have fusible plugs that prevent the tires from bursting if they overheat.
The main wheels may also have brake cooling fans. ◁

ANTI-SKID SYSTEM

The anti-skid system produces maximum braking efficiency by maintaining the wheels just short of an impending skid.
When a wheel is on the verge of locking, the system sends brake release orders to the normal and alternate servovalves — and to the ECAM, which displays the released brakes.
The anti-skid deactivates when ground speed is less than 20 knots.
An ON/OFF switch turns the anti-skid system and nose wheel steering on and off.

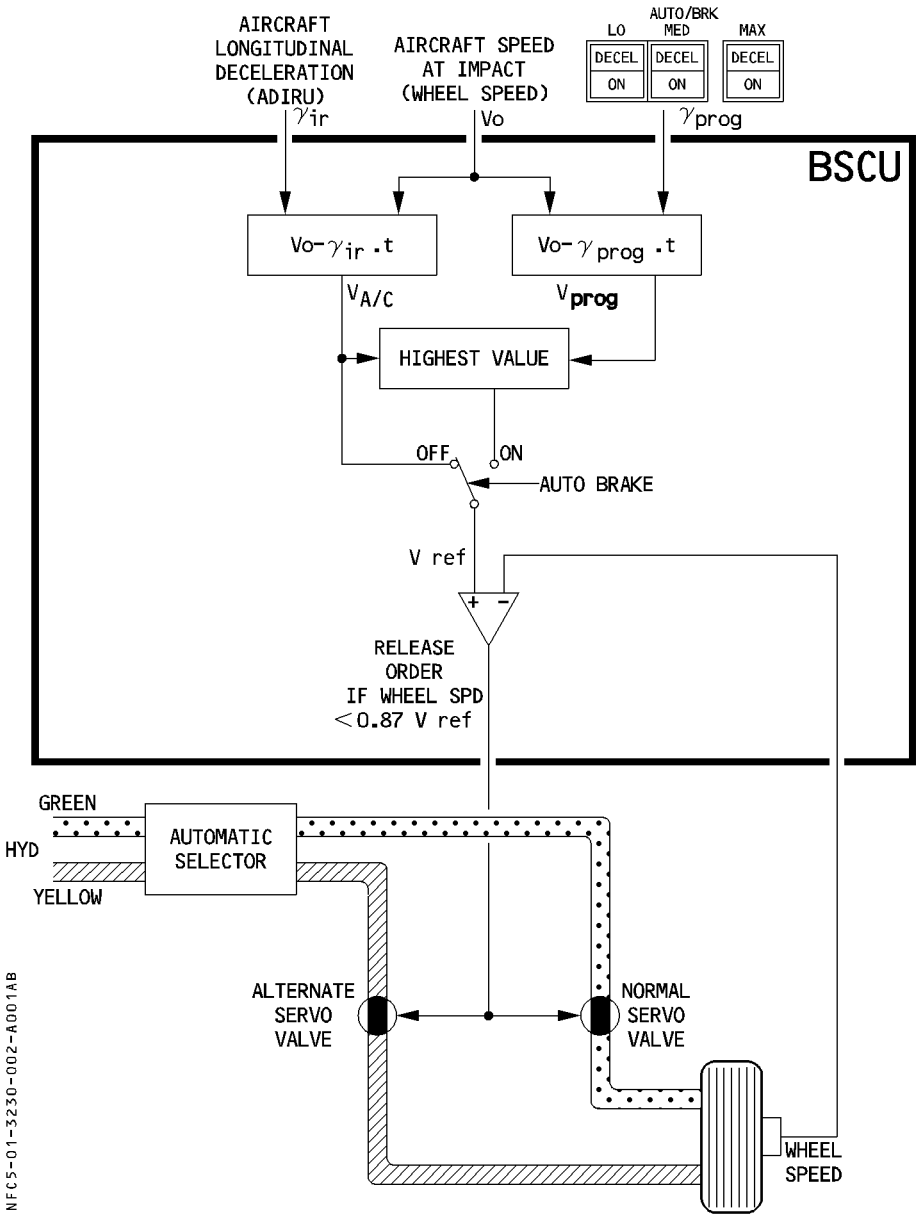
PRINCIPLE

The system compares the speed of each main gear wheel (given by a tachometer) with the speed of the aircraft (reference speed). When the speed of a wheel drops below 0.87 times the reference speed, the system orders brake releasing in order to maintain the brake slip at that value (best braking efficiency).
In normal operation, the BSCU determines the reference speed from the horizontal acceleration furnished by ADIRU1, ADIRU2, or ADIRU3.
If all three ADIRUs fail, reference speed equals the greater of either main landing gear wheel speed. Deceleration is limited to 1.7 meters/second^2 (5.6 feet/second^2)

ANTI-SKID PRINCIPLE

FOR INFO

R



DESCRIPTION

GENERAL

R The main wheels are equipped with carbon multidisc brakes, which can be actuated by either of two independent brake systems.
The normal system uses green hydraulic pressure, whereas the alternate system uses the yellow hydraulic system (backed up by the hydraulic accumulator).
An antiskid and autobrake system is also provided.
Braking commands come from either the brake pedals (pilot action), or the autobrake system (deceleration rate selected by the crew).
In normal operation, a dual channel Brake and Steering Control Unit (BSCU) controls normal braking and antiskid.
Depending on the failure, braking may revert to :
- Alternate braking with antiskid. This braking mode is controlled by the Alternate Braking Control Unit (ABCU). The antiskid is controlled by the BSCU.
- Alternate braking without antiskid. This braking mode is fully-controlled by the ABCU.
- Alternate braking without antiskid on accumulator. This braking mode is fully-controlled by the ABCU.

All the normal and alternate braking components are fully-monitored. Any detected failure is signaled to the crew via ECAM warnings.
The BSCU performs the following secondary functions :
- It checks the residual pressure in the brakes,
- It monitors the brake temperature,
- It provides discrete wheel speed information to other aircraft systems.

A changeover between the two BSCU channels takes place at each DOWN landing gear lever selection, or in case one channel fails.
The main gear wheels are fitted with fusible plugs which protect against tire burst, in the event of overheat.
Main gear wheels are also equipped with brake cooling fans ◁, which permit a high speed cooling of brakes.

ANTISKID SYSTEM

The antiskid system provides maximum braking efficiency by maintaining the wheels at the limit of an impending skid.
At skid onset, brake release orders are sent to the normal and alternate servovalves, as well as to the ECAM system which displays the released brakes.
Full braking performance is achieved only with brake pedals at full deflection.
The antiskid system is deactivated below 20 knots (ground speed).
An ON/OFF switch activates, or deactivates, the antiskid and nosewheel steering systems.

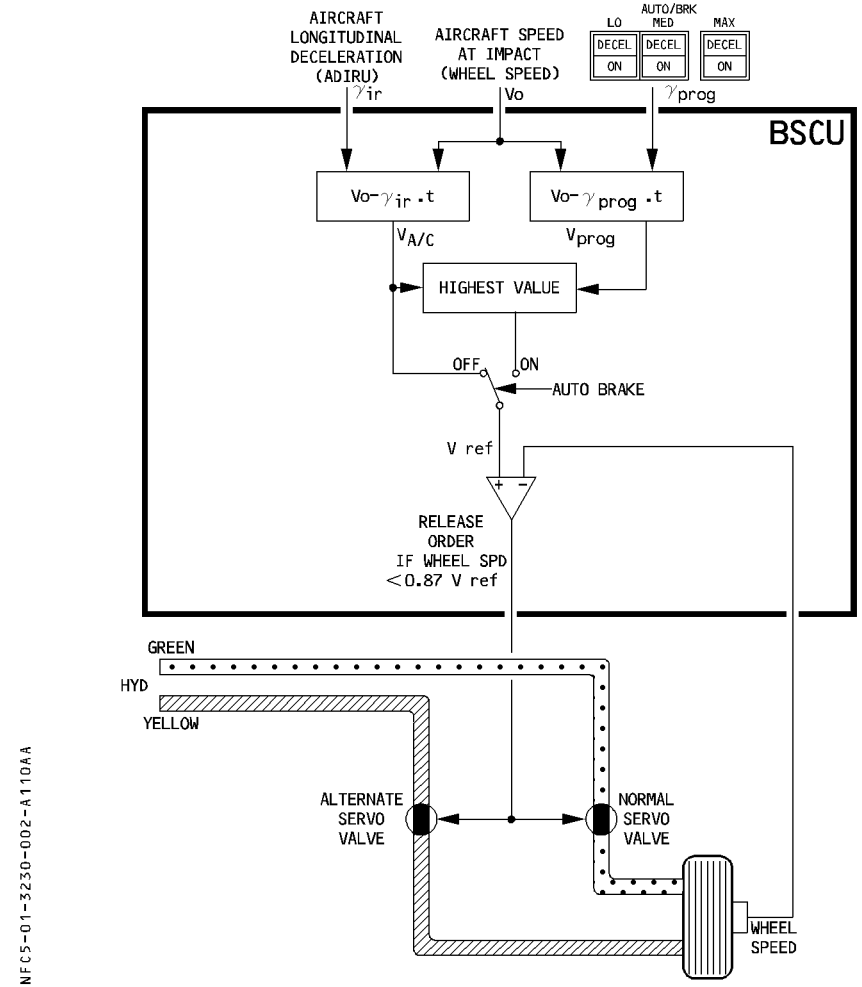
ANTISKID PRINCIPLE

The speed of each main gear wheel (given by a tachometer) is compared to the aircraft speed (reference speed). When the speed of a wheel decreases below approximately 0.87 times (depending on conditions) reference speed, brake release orders are given to maintain the wheel slip at that value (best braking efficiency).

In normal operation, the reference speed is determined by the BSCU from the horizontal acceleration of ADIRU 1, 2 or 3.

R In case all ADIRUs fail, reference speed equals the maximum of either main landing gear wheel speeds. Deceleration is limited to a default value of 1.7 m/s² (5.6 ft/s²).

FOR INFO



AUTO BRAKE

The purposes of this system are :
- to reduce the braking distance in case of an aborted takeoff
- to establish and maintain a selected deceleration rate during landing, thereby improving passenger comfort and reducing crew workload.

R SYSTEM ARMING

The system arms when the crew presses the LO, MED, or MAX pushbutton switch if :
- Green pressure is available.
- The anti-skid system has electric power.
- There is no failure in the braking system.
- At least one ADIRS is functioning.

Note : 1. Auto brake may be armed with the parking brake on.
2. MAX autobrake mode cannot be armed in flight.

R SYSTEM ACTIVATION

R Automatic braking activates :
R — when the ground spoilers extend (Refer to 1.27.10), for LO and MED mode.
R — when the ground spoilers extend and the aircraft speed is greater than 40 knots, for R MAX mode.
R Therefore, if the aircraft makes an acceleration stop and begins to decelerate when its R speed is under 72 knots, the automatic braking will not activate because the ground spoilers will not extend.
For autobrake to activate, at least two SEC's must be operative.

R SYSTEM DEACTIVATION

R The system deactivates :
R — When it is disarmed (see below).
R — When the ground spoilers retract. In this case it remains armed.

R SYSTEM DISARMING

The system disarms when :
- Flight crew presses the pushbutton switch or,
- One or more arming conditions is lost or,

R — Flight crew applies enough deflection to at least one brake pedal when autobrake is active in MAX, MED or LO mode.
R — After take-off/touch and go.

OPERATION

There are four modes of operation :
– Normal braking,
– Alternate braking with anti-skid,
– Alternate braking without anti-skid,
– Parking brake.

NORMAL BRAKING

Braking is normal when :
– Green hydraulic pressure is available.
– The A/SKID & N/W STRG switch is ON.
During normal braking, anti-skid operates and autobrake is available.
Braking is controlled electrically through the BSCU :
– from the pilot's pedals or,
– automatically
  · on the ground by the autobrake system,
  · in flight when the landing gear lever is up.
The anti-skid system is controlled by the BSCU via the normal servo valves.
There is no indication of brake pressure in the cockpit.

ALTERNATE BRAKING WITH ANTI-SKID

Braking uses this mode when green hydraulic pressure is insufficient and :
– Yellow hydraulic pressure is available.
– The A/SKID & N/W STRG switch is ON.
– The parking brake is not ON.
An automatic hydraulic selector changes from the green to the yellow system.
The pedals brake through the auxiliary low-pressure hydraulic distribution line acting on the dual valves. The BSCU controls the anti-skid system via the alternate servo valves.
A triple indicator on the center instrument panel shows the pressure delivered to the left and right brakes, as well as the accumulator pressure.
Autobrake is inoperative.

AUTO BRAKE

The purposes of this system are :
- to reduce the braking distance in case of an aborted takeoff
- to establish and maintain a selected deceleration rate during landing, thereby improving passenger comfort and reducing crew workload.

R SYSTEM ARMING

The system arms when the crew presses the LO, MED, or MAX pushbutton switch if :
- Green pressure is available.
- The anti-skid system has electric power.
- There is no failure in the braking system.
- At least one ADIRS is functioning.

Note : 1. Auto brake may be armed with the parking brake on.
2. MAX autobrake mode cannot be armed in flight.

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R Therefore, if the aircraft makes an acceleration stop and begins to decelerate when its R speed is under 72 knots, the automatic braking will not activate because the ground spoilers will not extend.
For autobrake to activate, at least two SEC's must be operative.

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R — When it is disarmed (see below).
R — When the ground spoilers retract. In this case it remains armed.

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The system disarms when :
- Flight crew presses the pushbutton switch or,
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R — After take-off/touch and go.

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There are four modes of operation :
– Normal braking,
– Alternate braking with antiskid,
– Alternate braking without antiskid,
– Parking brake.

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Braking is normal when :
– Green hydraulic pressure is available.
– The A/SKID & N/W STRG switch is ON.
During normal braking, antiskid operates and autobrake is available.
Braking is electrically-controlled through the BSCU :
– From the pilot's pedals, or
– Automatically :
  · On ground by the autobrake system,
  · In flight when the landing gear lever is up.
The antiskid system is controlled by the BSCU via the normal servovalves.
There is no brake pressure indication in the cockpit.

ALTERNATE BRAKING WITH ANTISKID

Autobrake is inoperative.
Braking uses this mode when green hydraulic pressure is insufficient, and :
– Yellow hydraulic pressure is available.
– The A/SKID & N/W STRG switch is ON.
– The parking brake is not ON.
Braking inputs are made by the brake pedals and sent to the ABCU. Then, taking into account the brake pedal input, the ABCU :
– Energizes the alternate brake selector valve to pressurize the yellow hydraulic circuit,
– Electrically controls the Alternate Servo Valve to obtain the correct pressure for the related brakes.
Antiskid is controlled by the BSCU.
Brake pressure, as well as accumulator pressure, are indicated on a triple indicator located on the center instrument panel.

ALTERNATE BRAKING WITHOUT ANTI-SKID

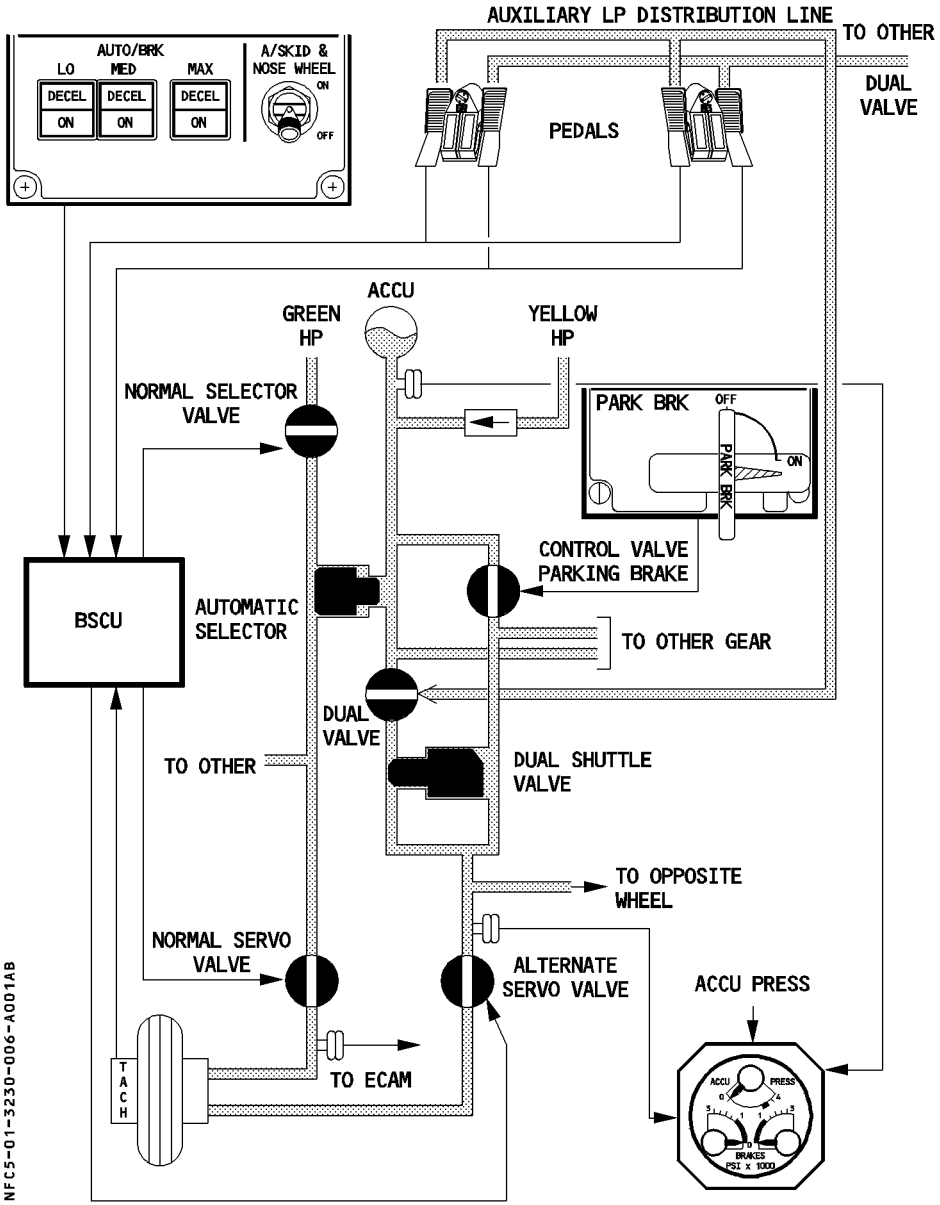
The anti-skid system can be deactivated :
- electrically (A/SKID & N/W STRG switch OFF, or power failure or BSCU failure),
- hydraulically (low pressure in both green and yellow systems, brakes being supplied by the brake accumulator only).

The pilot controls the braking with the pedals (acting on the dual valves).
Alternate servo valves are fully open.
The pilot must refer to the triple indicator to limit brake pressure in order to avoid locking a wheel.
The accumulator can supply at least 7 full brake applications.
Autobrake is inoperative.

PARKING BRAKE

Brakes are supplied by yellow hydraulic system or accumulator via the dual shuttle valves.
Alternate servo valves open allowing full pressure application.
The accumulator maintains the parking pressure for at least 12 hours.
If the parking brake is activated and no yellow hydraulic or accumulator brake pressure is available, then the normal braking system can be applied via the brake pedals.
Yellow accumulators can be pressurized by pressing the yellow electrical pump switch.
Brake pressure indications are available on the triple indicator.

BRAKING SCHEMATIC



ALTERNATE BRAKING WITHOUT ANTISKID

Autobrake and antiskid are inoperative.
The antiskid system is either deactivated :
- Electrically (A/SKID & N/W STRG switch OFF, or power supply failure, or BSCU failure), or
- Hydraulically (Y + G system low pressure, the brakes are supplied by the brake accumulator only).

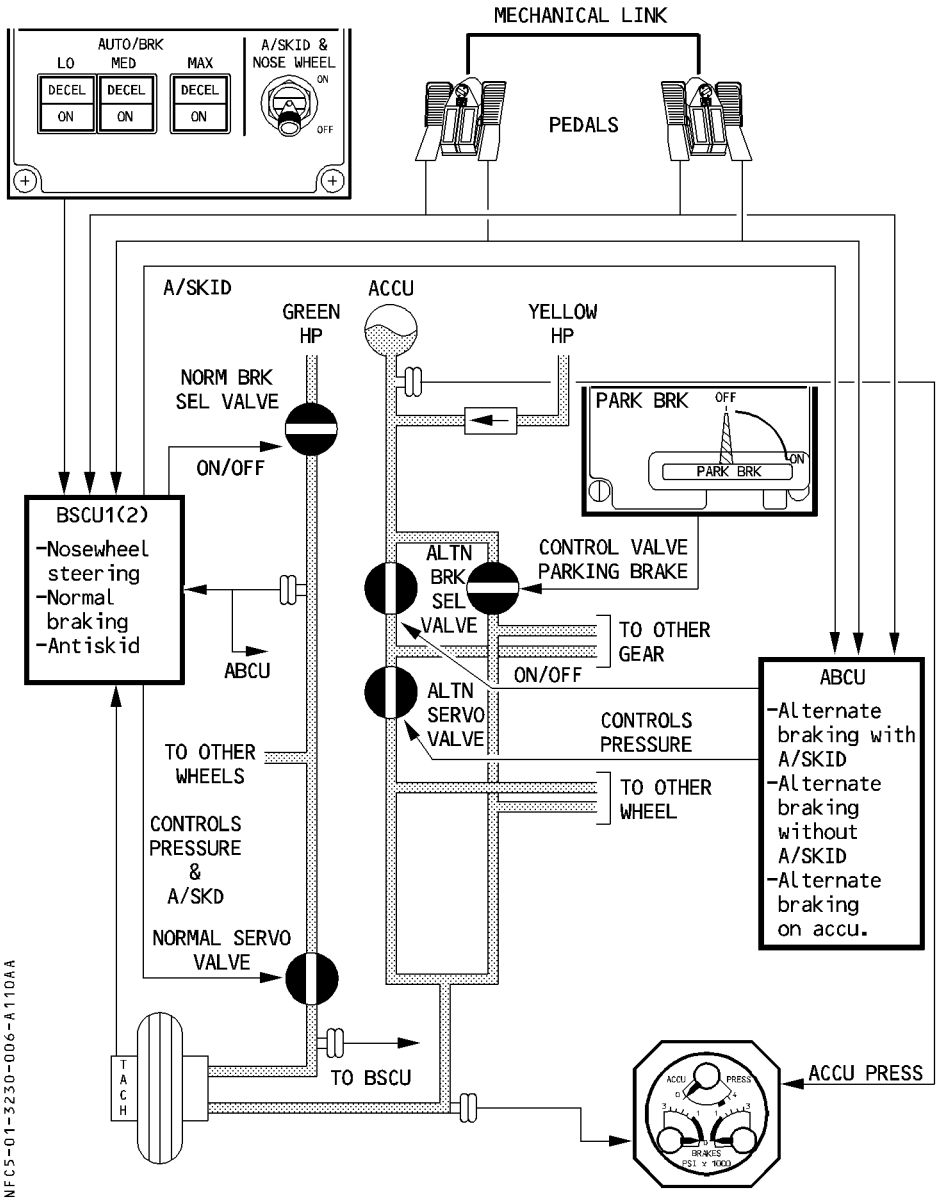
Depending on the brake pedals' demand, the ABCU controls the alternate brake selector and the alternate servovalves.
Brake pressure and accumulator pressure are indicated on a triple indicator, located on the center instrument panel.
To avoid wheel locking and limit the risk of tire burst, brake pressure is automatically limited to 1000 psi.
Accumulators are designed to supply at least seven full brake applications.

PARKING BRAKE

Brakes are supplied by the yellow hydraulic system, or by accumulator pressure via the parking brake control valve, which opens allowing full pressure application on the main gear wheel brakes.
The accumulator maintains the parking pressure for at least 12 hours.
If the parking brake is activated, and no yellow hydraulic or accumulator brake pressure is available, then the normal braking system can be applied via the brake pedals.
Yellow accumulators can be pressurized by pressing the yellow electrical pump switch.
Brake pressure and accumulator pressure are indicated on a triple indicator, located on the center instrument panel.

R

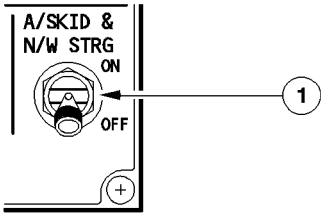
BRAKING SCHEMATIC



CONTROLS AND INDICATORS

CENTER INSTRUMENT PANEL

NFC5-01-3230-007-A001AA



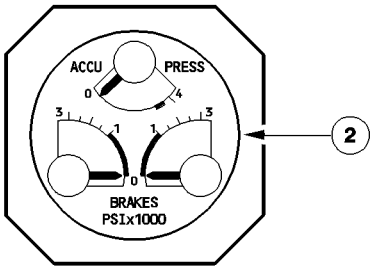
(1) A/SKID & N/W STRG sw

ON : If green hydraulic pressure is available :
- Anti-skid is available.
- Nose wheel steering is available.

If green hydraulic pressure is lost :
- Yellow hydraulic pressure takes over automatically to supply the brakes.
- Anti-skid remains available.
- Nose wheel steering is lost.
- The triple indicator shows yellow system brake pressure.

OFF : Yellow hydraulic system supplies pressure to the brakes.
- Anti-skid is deactivated. The pilot must refer to the triple indicator to limit brake pressure and avoid locking a wheel.
- Nose wheel steering is lost.
- Differential braking remains available through the pedals.
- The triple indicator displays yellow system brake pressure.

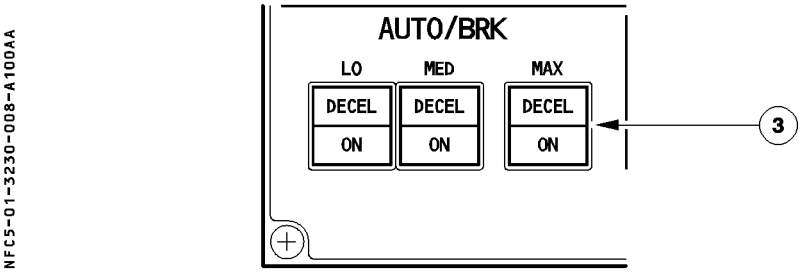
NFC5-01-3230-007-B001AA



(2) BRAKES and ACCU PRESS indicator

ACCU PRESS : Indicates the pressure in the yellow brake accumulators.
BRAKES : Indicates the yellow pressure delivered to the left and right brakes, as measured upstream of the alternate servo valves.

AUTO BRK panel



(3) AUTO/BRK panel

The springloaded MAX, MED, and LO pushbutton switches arm the appropriate deceleration rate.

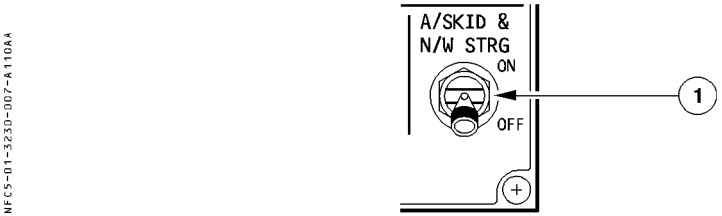
- MAX mode is normally selected for takeoff.
  In the case of an aborted takeoff, maximum pressure goes to the brakes, as soon as the system generates the ground spoiler deployment order.
- MED or LO mode is normally selected for landing.
  - LO mode sends progressive pressure to the brakes 4 seconds after the ground spoilers deploy, in order to decelerate the aircraft at 1.7 meters/second^2 (5.6 feet/second^2).
  - MED mode sends progressive pressure to the brakes 2 seconds after the ground spoilers deploy, in order to decelerate the aircraft at 3 meters/second^2 (9.8 feet/second^2).
- Lights:
  - The blue ON light comes on to indicate positive arming.
  - The green DECEL light comes on when the actual deceleration is 80% of the selected rate.

Note : On slippery runways, the predetermined deceleration may not be reached due to antiskid operation. In this case, the DECEL light will not come on. This does not mean that autobrake is not working.

R · Off : The corresponding autobrake mode is not armed.

CONTROLS AND INDICATORS

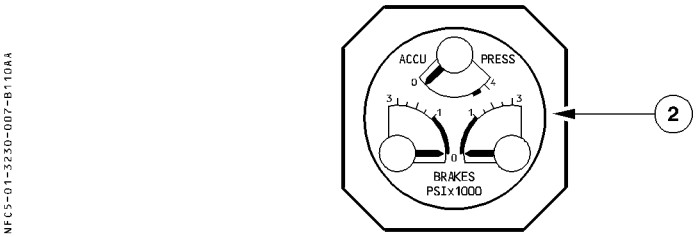
CENTER INSTRUMENT PANEL



(1) A/SKID & N/W STRG switch

ON : If green hydraulic pressure is available, then antiskid is available.
If green hydraulic pressure is lost, then :
– Yellow hydraulic pressure automatically takes over to supply the brakes,
– Antiskid and nosewheel steering remain available.
– The triple indicator shows yellow system brake pressure.

OFF : The yellow hydraulic system supplies pressure to the brakes.
– Antiskid is deactivated. The pilot must refer to the triple indicator to limit brake pressure and avoid locking a wheel.
– Nosewheel steering is lost.
– Differential braking remains available through the pedals.
– The triple indicator displays yellow system brake pressure.

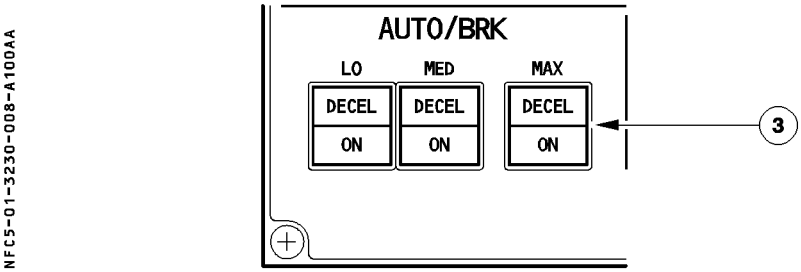


(2) BRAKES and ACCU PRESS indicator

Brake pressure is only indicated when the yellow hydraulic system controls the brake pressure, which means when the :
– Alternate braking system is activated, or
– Parking brake is applied.

ACCU PRESS : Indicates the pressure in the yellow brake accumulator.
BRAKES : Indicates the yellow pressure delivered to the left and right brakes, as measured downstream of the alternate servovalves.

AUTO BRK panel



(3) AUTO/BRK panel

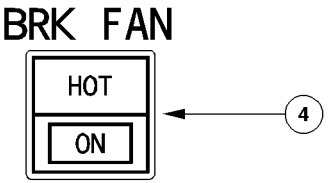
The springloaded MAX, MED, and LO pushbutton switches arm the appropriate deceleration rate.

- MAX mode is normally selected for takeoff.
  In the case of an aborted takeoff, maximum pressure goes to the brakes, as soon as the system generates the ground spoiler deployment order.
- MED or LO mode is normally selected for landing.
  - LO mode sends progressive pressure to the brakes 4 seconds after the ground spoilers deploy, in order to decelerate the aircraft at 1.7 meters/second^2 (5.6 feet/second^2).
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- Lights:
  - The blue ON light comes on to indicate positive arming.
  - The green DECEL light comes on when the actual deceleration is 80% of the selected rate.

Note : On slippery runways, the predetermined deceleration may not be reached due to antiskid operation. In this case, the DECEL light will not come on. This does not mean that autobrake is not working.

R · Off : The corresponding autobrake mode is not armed.

NFC5-01-3230-009-A100AA

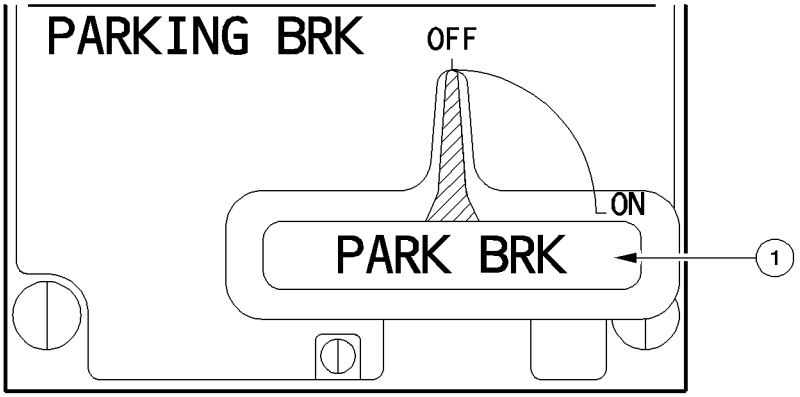


(4) BRK FAN pb sw ◁

ON : The brake fans run if the lefthand main landing gear is down and locked.
OFF : The brake fans stop.
HOT lt : This amber light comes on when the brakes get too hot. (A caution appears on ECAM, also).

PEDESTAL

NFC5-01-3230-009-B100AA



(1) PARKING BRK handle

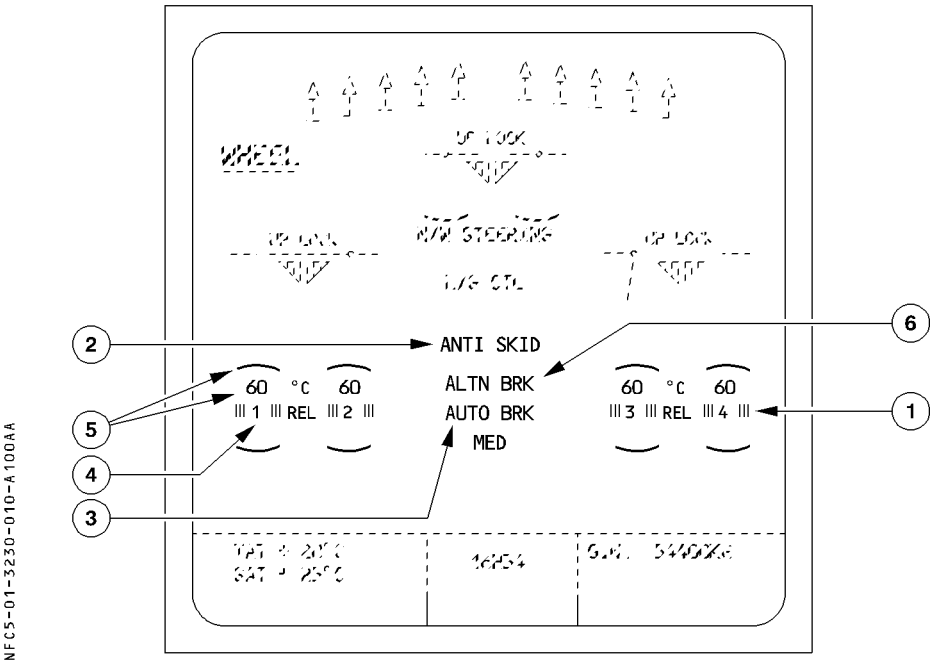
Flight crew pulls this handle, then turns it clockwise, to apply the parking brake.
The ECAM memo page displays "PARK BRK".

CAUTION

If the pointer is not at ON, the parking brake is not on.

R

ECAM WHEEL PAGE



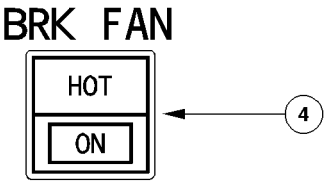
(1) Release indicators

III These green lines appear temporarily after the landing gear has been lowered to indicate that the anti-skid function is ready.
They reappear after touchdown when the anti-skid is active.

(2) ANTI SKID

This appears in amber, along with an ECAM caution, in case of a total BSCU failure, or when the A/SKID & N/W STRG switch is OFF, or if the BSCU detects an ANTI-SKID failure.

NFC5-01-3230-009-A100AA

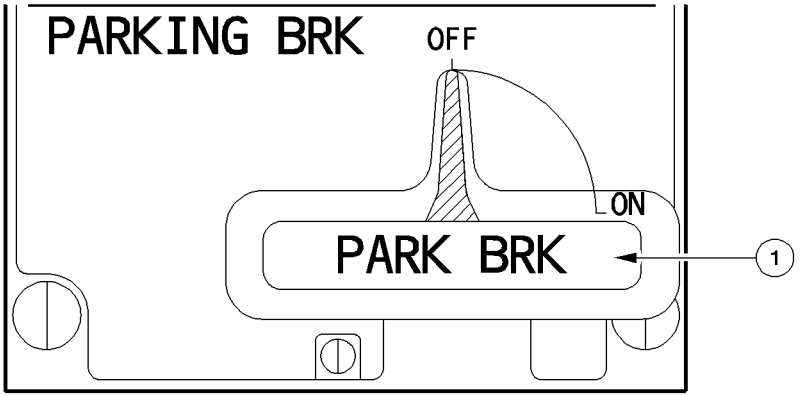


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NFC5-01-3230-009-B100AA



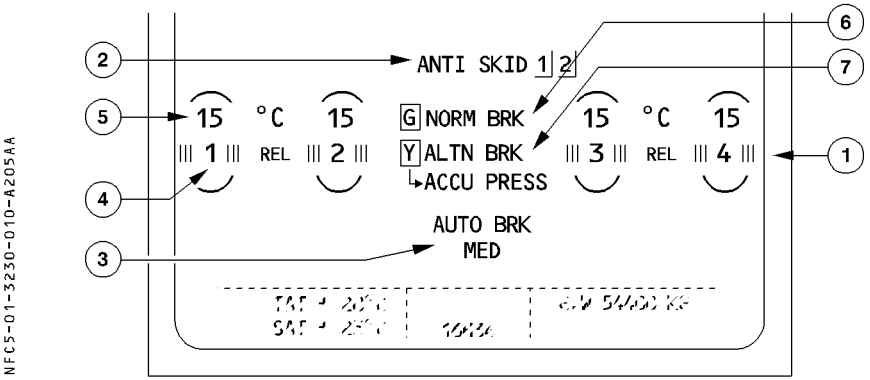
(1) PARKING BRK handle

Flight crew pulls this handle, then turns it clockwise, to apply the parking brake.
The ECAM memo page displays "PARK BRK".

CAUTION

If the pointer is not at ON, the parking brake is not on.

ECAM WHEEL PAGE



(1) Release indicators

Ill It appears in amber in case of brake released fault.

(2) ANTI SKID indication



NFC5-01-3230-010-B205AA

(A) ANTISKID label :
It appears in amber, a long with an ECAM caution, in case of a total BSCU failure, or when the A/SKID & N/W STRG switch is OFF, or if the BSCU detects an ANTI-SKID failure, or in case of normal braking and yellow hydraulic system low pressure.
It appears in green in case of autobrake, normal braking, or alternate braking failure, and antiskid is still available.

(B) BSCU channel indication
When ANTISKID label is displayed, the number of the failed system(s) is (are) displayed in amber, if any.

(3) AUTO BRK

This legend appears :
– in green when auto brake is armed,
– flashing green for 10 seconds after autobrake disengagement.
– in amber, along with an ECAM caution, to indicate a system failure.
MED, LO, or MAX appears underneath in green to show which rate has been selected.

(4) Wheel number

This white number identifies individual wheels of the main landing gear.

R (5) Brake temperature

– The temperature normally appears in green.
– The green arc appears on the hottest wheel when one brake temperature exceeds 100°C.
– The green arc becomes amber, and an ECAM caution appears, when the corresponding brake temperature exceeds 300°C.

(6) ALTN BRK

This legend appears in green if the braking system is in alternate mode.

(3) AUTO BRK

This legend appears :
– in green when auto brake is armed,
– flashing green for 10 seconds after autobrake disengagement.
– in amber, along with an ECAM caution, to indicate a system failure.
MED, LO, or MAX appears underneath in green to show which rate has been selected.

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This white number identifies individual wheels of the main landing gear.

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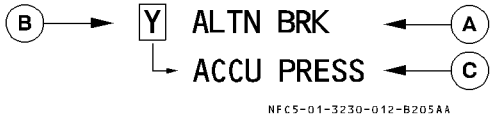
(6) NORM BRK indication



(A) NORM BRK label :
This indication appears in green when autobrake or alternate braking is failed, and normal braking is still available.
The legend appears in amber when normal braking is failed due to total BSCU failure, or to the loss of the green hydraulic pressure, or to the loss of antiskid.

(B) NORM BRK hydraulic supply indication :
G is displayed when the NORM BRK label is displayed. It is green when green hydraulic pressure is available and amber, in case of green hydraulic low pressure.

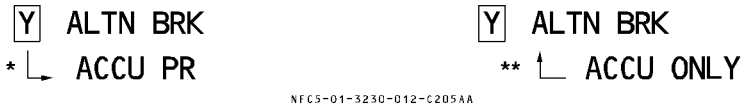
(7) ALTN BRK indication



(A) ALTN BRK label
This indication appears in green, if the braking system is in alternate mode and not failed, or in case autobrake or normal braking is failed and alternate braking is still available.
This indication appears in amber when alternate braking is failed.

(B) ALTN BRK hydraulic supply indication :
Y is displayed when the ALTN BRK label is displayed. It is green when yellow hydraulic pressure is available and amber, in case of yellow hydraulic low pressure.

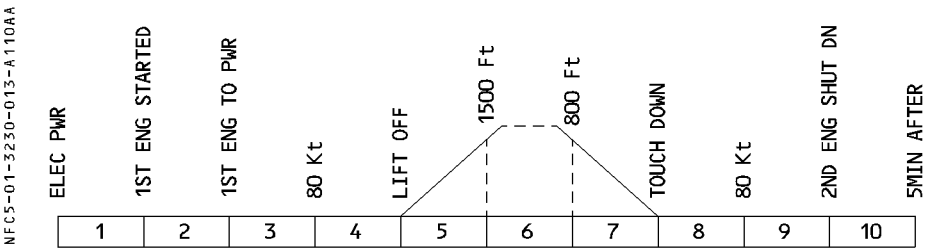
(C) ACCU indications



* Appears in green, when the ALTN BRK label is displayed, and the yellow hydraulic pressure is available.
Appears in amber, with no arrow, when the yellow hydraulic system and the accumulator are in low pressure.

** Appears in green when the alternate braking is pressurized by the yellow accumulator.

WARNINGS AND CAUTIONS

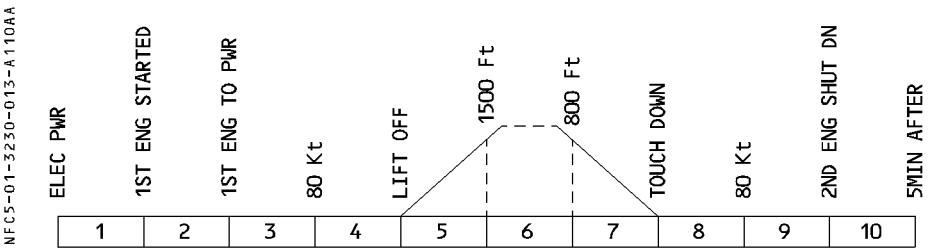


E/WD : FAILURE TITLE condition	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
CONFIG PARK BRK ON parking brake is on when thrust levers are set at TO or FLX TO power position	CRC	MASTER WARN	NIL	NIL	1, 2 5 to 10
BRAKES HOT one brake temperature higher than 300°C	SINGLE CHIME	MASTER CAUT	WHEEL	HOT lt on BRK FAN pb sw	4, 8 to 10
AUTO BRK FAULT failure of autobrake when armed				NIL	3 to 5
A/SKID NWS FAULT · loss of normal brake system associated with Y HYD sys lo press or · failure of both BSCU channels					4, 5
ANTI SKID/NWS OFF switch at OFF position					4, 5
HYD SEL FAULT failure of brake normal selector valve or NWS selector valve in open position			NIL		3 to 5, 7, 8
SYS 1 (2) FAULT failure of one BSCU channel	NIL	NIL			

MEMO DISPLAY

– If the parking brake is on, this display shows "PARK BRK" :
  · In green, in flight phases 1, 2, 9, and 10.
  · In amber, in flight phases 4 to 8.
  It does not display this message in flight phase 3.
– If the autobrake is on, AUTO BRK LO, AUTO BRK MED, or AUTO BRK MAX appears.
– If the autobrake is faulty, AUTO BRK OFF appears.
– BRK FAN appears in green, if the BRK FAN pushbutton is ON ◁.

WARNINGS AND CAUTIONS



E/WD : FAILURE TITLE condition	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
CONFIG PARK BRK ON parking brake is on when thrust levers are set at TO or FLX TO power position	CRC	MASTER WARN	NIL	NIL	1, 2 5 to 10
BRAKES HOT one brake temperature higher than 300°C	SINGLE CHIME	MASTER CAUT	WHEEL	HOT lt on BRK FAN pb sw	4, 8 to 10
AUTO BRK FAULT failure of autobrake when armed				NIL	3 to 5
A/SKID NWS FAULT · loss of normal brake system associated with Y HYD sys lo press or · failure of both BSCU channels					4, 5
ANTI SKID/NWS OFF switch at OFF position					4, 5
HYD SEL FAULT failure of brake normal selector valve or NWS selector valve in open position			NIL		3 to 5, 7, 8
SYS 1 (2) FAULT failure of one BSCU channel	NIL	NIL			

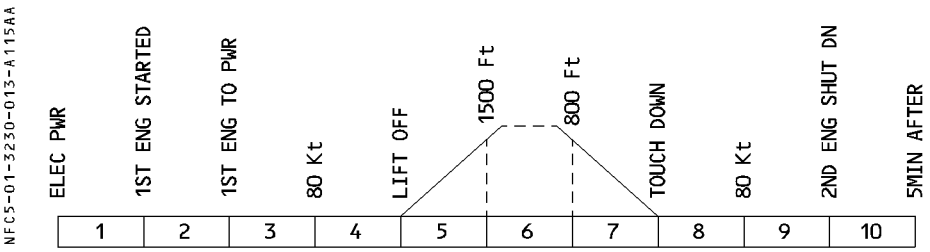
E/WD : FAILURE TITLE condition	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
RELEASED Brake of one wheel is released. It is detected when the landing gear is downlocked and, at least one engine is running, and normal braking is active.	SINGLE CHIME	MASTER CAUT	WHEEL	NIL	4, 5
NORM BRK FAULT Normal braking function is lost.					3 to 5
ALTN BRK FAULT Alternate braking function is lost.	NIL	NIL			3, 4, 5, 7, 8
ALTN L(R) RELEASED Brakes of one gear is released. It is triggered when the landing gear is downlocked, and at least one engine is running, and alternate braking is active.	SINGLE CHIME	MASTER CAUT	NIL		3, 4, 5
NORM + ALTN FAULT Normal and alternate functions are lost. Parking brake available.			WHEEL		4, 5
BRK Y ACCU LO PR The yellow accumulator is in low pressure.					3, 4, 5, 7, 8
BRAKES-N/WS MINOR FAULT Single system failure, loss of redundancy	NIL	NIL	NIL		2 to 9

MEMO DISPLAY

- If the parking brake is on, this display shows "PARK BRK" :
  - In green, in flight phases 1, 2, 9, and 10.
  - In amber, in flight phases 4 to 8.

  It does not display this message in flight phase 3.
- If the autobrake is on, AUTO BRK LO, AUTO BRK MED, or AUTO BRK MAX appears.
- If the autobrake is faulty, AUTO BRK OFF appears.
- BRK FAN appears in green, if the BRK FAN pushbutton is ON ◁.

WARNINGS AND CAUTIONS



E/WD : FAILURE TITLE condition	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
CONFIG PARK BRK ON parking brake is on when thrust levers are set at TO or FLX TO power position	CRC	MASTER WARN	NIL	NIL	1, 2 5 to 10
PARK BRK ON Parking brake is ON during flight.	SINGLE CHIME	MASTER CAUT			1 to 5, 8 to 10
BRAKES HOT one brake temperature higher than 300°C			WHEEL	HOT lt on BRK FAN pb sw	4, 8 to 10
AUTO BRK FAULT failure of autobrake when armed				NIL	3 to 5
A/SKID NWS FAULT · loss of normal brake system associated with Y HYD sys lo press or · failure of both BSCU channels					4, 5
ANTI SKID/NWS OFF switch at OFF position					4, 5
HYD SEL FAULT failure of brake normal selector valve or NWS selector valve in open position			NIL		3 to 5, 7, 8
SYS 1 (2) FAULT failure of one BSCU channel	NIL	NIL			

E/WD : FAILURE TITLE condition	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
RELEASED Brake of one wheel is released. It is detected when the landing gear is downlocked and, at least one engine is running, and normal braking is active.	SINGLE CHIME	MASTER CAUT	WHEEL	NIL	4, 5
NORM BRK FAULT Normal braking function is lost.					3 to 5
ALTN BRK FAULT Alternate braking function is lost.	NIL	NIL			3, 4, 5, 7, 8
ALTN L(R) RELEASED Brakes of one gear is released. It is triggered when the landing gear is downlocked, and at least one engine is running, and alternate braking is active.	SINGLE CHIME	MASTER CAUT	NIL		3, 4, 5
NORM + ALTN FAULT Normal and alternate functions are lost. Parking brake available.			WHEEL		4, 5
BRK Y ACCU LO PR The yellow accumulator is in low pressure.					3, 4, 5, 7, 8
BRAKES-N/WS MINOR FAULT Single system failure, loss of redundancy	NIL	NIL	NIL		2 to 9

MEMO DISPLAY

- If the parking brake is ON, the "PARK BRK" memo appears in green, during flight phases 1, 2, 9, and 10.
- If the autobrake is armed AUTO BRK LO, AUTO BRK MED, or AUTO BRK MAX appears.
- If the autobrake is faulty, "AUTO BRK OFF" appears.
- "BRK FAN" appears in green, if the BRK FAN pushbutton is ON ◁.

BUS EQUIPMENT LIST

R

		NORM		EMER ELEC		
		AC	DC	AC ESS	DC ESS	HOT
LANDING GEAR	LGCIU 1		GRND/ FLT		X	
	LGCIU 2		GRND/ FLT			
	SAFETY VALVE				X	
	L/G INDICATOR PANEL			SHED (1)	X	
BRAKES	BSCU CH 1	AC1	DC1			
	BSCU CH 2	AC2	DC2			
	PARK BRK CTL		GRND/ FLT			HOT1
	PRESS INDICATOR				X	
	BRK FAN CTL ◁		DC2			
	COOLING FANS ◁ (Wheels 1, 2, 3, 4)	AC2	DC2			
	COOLING FANS ◁ (bogie : Wheels 5, 6, 7, 8)	AC1	DC1			
TYRE PRESS	TIRE PRESS IND UNIT◁		DC1			

(1) The AC STAT INV supplies the landing gear indicator panel when the main generators are lost and the emergency generator is not running.

BUS EQUIPMENT LIST

R

		NORM		EMER ELEC		
		AC	DC	AC ESS	DC ESS	HOT
LANDING GEAR	LGCIU 1		GRND/ FLT		X	
	LGCIU 2		GRND/ FLT			
	SAFETY VALVE				X	
	L/G INDICATOR PANEL			SHED (1)	X	
BRAKES	BSCU CH 1	AC1	DC1			
	BSCU CH 2	AC2	DC2			
	ABCU				X	X
	PARK BRK CTL		GRND/ FLT			HOT1
	PRESS INDICATOR				X	
	BRK FAN CTL ◁		DC2			
	COOLING FANS ◁ (Wheels 1, 2, 3, 4)	AC2	DC2			
	COOLING FANS ◁ (bogie : Wheels 5, 6, 7, 8)	AC1	DC1			
TYRE PRESS	TIRE PRESS IND UNIT◁		DC1			

(1) The AC STAT INV supplies the landing gear indicator panel when the main generators are lost and the emergency generator is not running.

33.00 CONTENTS

33.10 COCKPIT LIGHTING
– GENERAL 1
– DESCRIPTION 2
– CONTROLS AND INDICATORS 4

33.20 EXTERIOR LIGHTING
– GENERAL 1
– CONTROLS AND INDICATORS 2

33.30 EMERGENCY LIGHTING
– DESCRIPTION 1
– CONTROLS AND INDICATORS 4

33.40 SIGNS
– CONTROLS AND INDICATORS 1

33.50 ELECTRICAL SUPPLY
R – BUS EQUIPMENT LIST 1

GENERAL

The instrument panel has both integral instrument lighting and flood lighting.
The brightness of all panel lighting is adjustable.
Incandescent spot lights and flood lights illuminate all work surfaces and the side consoles.
Two dimmable dome lights illuminate the overall cockpit. When the batteries are supplying all electrical power, only the righthand dome light is on line.

DESCRIPTION

Integrated lighting for instruments and panels

All instruments and panels in the cockpit (other than display units) have integral lighting. The brightness of all integral lighting is adjustable.

Annunciator lights

The ANN LT switch, on the overhead panel, controls the brightness of all the annunciator lights on the flight deck.

It sets the brightness of all annunciator lights at the same level.

The flight crew can test the annunciator lights by selecting the TEST position on the ANN LT switch, and check to see that all the annunciator lights come on.

Dome lights

Two dome lights give the cockpit shadow-free illumination.

Mapholder lighting

Each pilot's station has a lighted map and chart holder.

Console and briefcase lighting

Each pilot's station has lighting for the briefcase stowage, the side console, and the floor.

Center instrument panel

Lights under the glareshield illuminate the center instrument panel.

Standby compass

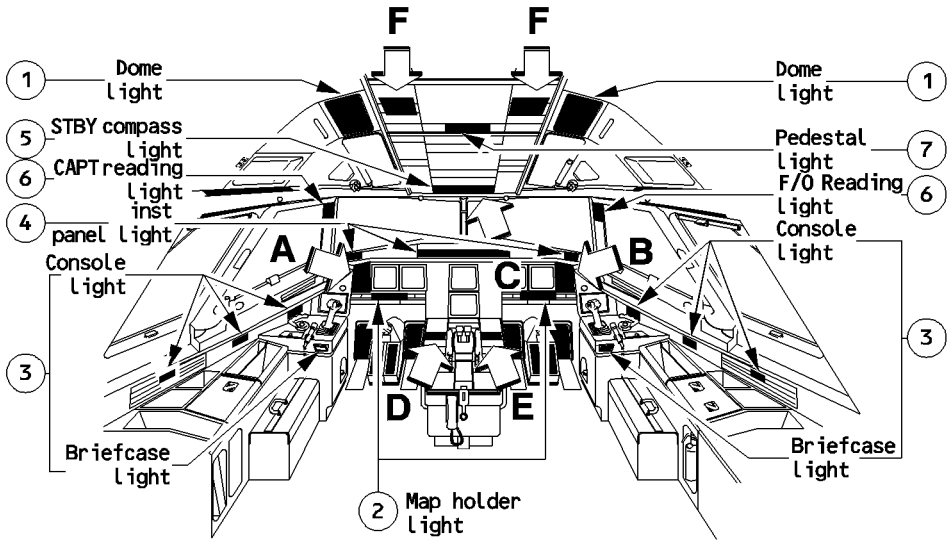
The standby compass has integral lighting.

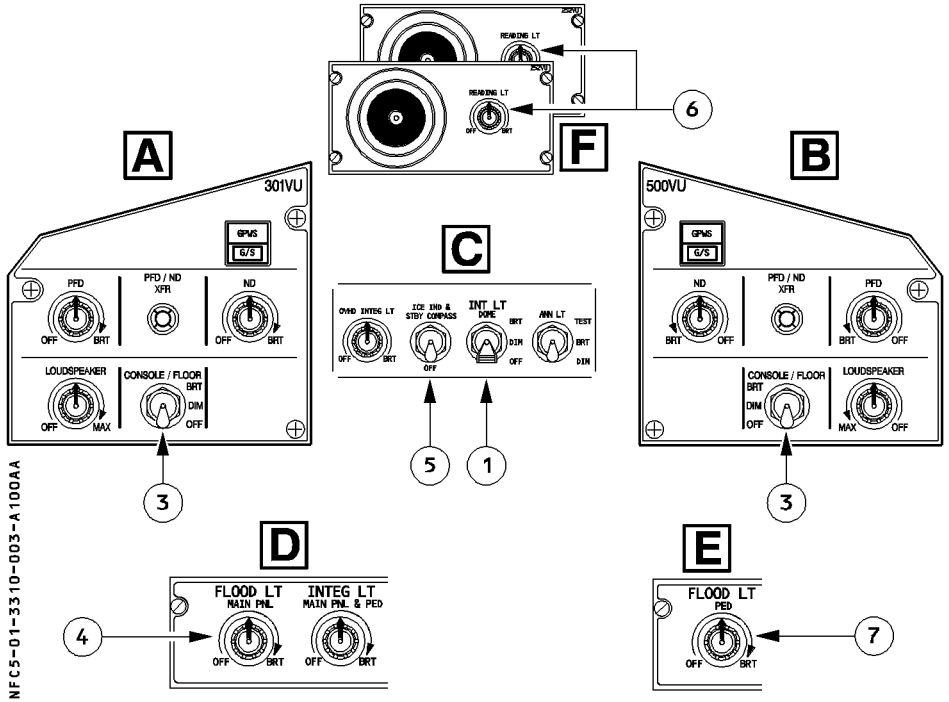
Reading lights

Each pilot's station has a reading light.

Pedestal lighting

A flood light in the middle of the overhead panel illuminates the center pedestal.

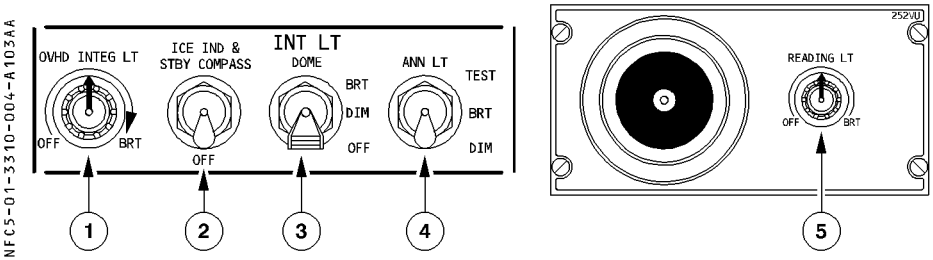

F
F
1 Dome light
Dome light 1
5 STBY compass light
Pedestal light 7
6 CAPT reading light
F/O Reading light 6
4 inst panel light
Console light
A
B
C
Console light
3
3
D
E
Briefcase light
Briefcase light
2 Map holder light


READING LT
6
F
A
301VU
B
500VU
C
GPWS
G/S
PFD
PFD / ND XFR
ND
OVHD INTEG LT
ICE IND & STBY COMPASS
INT LT DOME
ANN LT
TEST
LOUDSPEAKER
CONSOLE / FLOOR
BRT
DIM
OFF
MAX
3
3
5
1
D
E
FLOOD LT MAIN PNL
INTEG LT MAIN PNL & PED
FLOOD LT PED
4
7
NFC5-01-3310-003-A100AA

CONTROLS AND INDICATORS

OVERHEAD PANEL

R



(1) OVHD INTEG LT knob

This knob turns the integral lighting for the overhead panel on and off and adjusts its brightness.

(2) ICE IND & STBY COMPASS sw

This switch turns the integral lighting for the standby compass and the visual indicator on and off.

(3) DOME switch

This switch controls both dome lights.
BRT : Both dome lights on bright.
DIM : Both dome lights on dim.
OFF : Both dome lights off.

(4) ANN LT switch

This switch sets the brightness of all the cockpit annunciator lights at either "bright" or "dim", and also tests them.
TEST : Illuminates all flight deck annunciator lights.
Puts 8's up in all liquid crystal displays (LCDs).
DIM : Reduces voltage to all annunciator lights.
BRT : Allows annunciators to function normally.

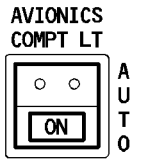
Note : Transfer of data between ECAM and the ND and switching between the electronic instrument system and the display management computer are not allowed during the ANN LT test.

(5) READING LT knob

The reading light on each side of the overhead panel has its own control knob that turns it on and off and adjusts its brightness.

MAINTENANCE PANEL

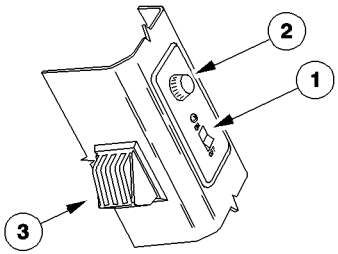
NFC5-01-3310-005-A100AA



AVIONICS COMPT LT pushbutton switch
AUTO : avionic compartment lighting is automatically controlled by door opening.
ON : avionic compartment lighting is on.

LATERAL WINDOW

NFC5-01-3310-005-B100AA

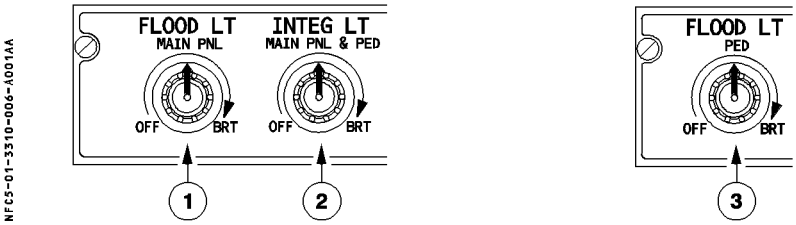


(1) Reading light switch (Captain and F/O).

(2) Brightness adjustment

(3) Light

PEDESTAL



(1) FLOOD LT MAIN PNL knob

This knob adjusts the brightness of the flood lighting for the center instrument panel, and turns it on and off.

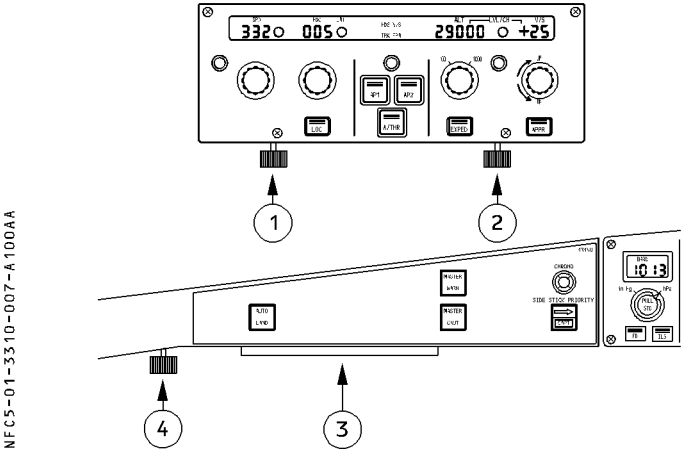
(2) INTEG LT MAIN PNL and PED knob

This knob adjusts the brightness of integral lighting for the main panel and pedestal, and turns it on and off.

(3) FLOOD LT PED knob

This knob adjusts the brightness of the flood lighting for the pedestal, and turns it on and off.

GLARESHIELD



NFCS-01-3310-007-A100AA

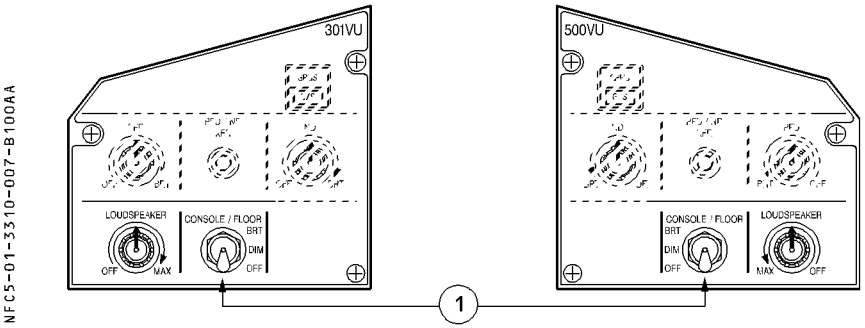
(1) This knob adjusts the brightness of the integral lighting on the glareshield, and of the LEDs on the FCU.

(2) This knob adjusts the brightness of the FCU displays.

(3) This lighting illuminates the sliding table and map holder.

(4) This knob adjusts the brightness of the sliding table and map holder lighting.

MAIN INST PANEL



NFCS-01-3310-007-B100AA

(1) CONSOLE/FLOOR switch

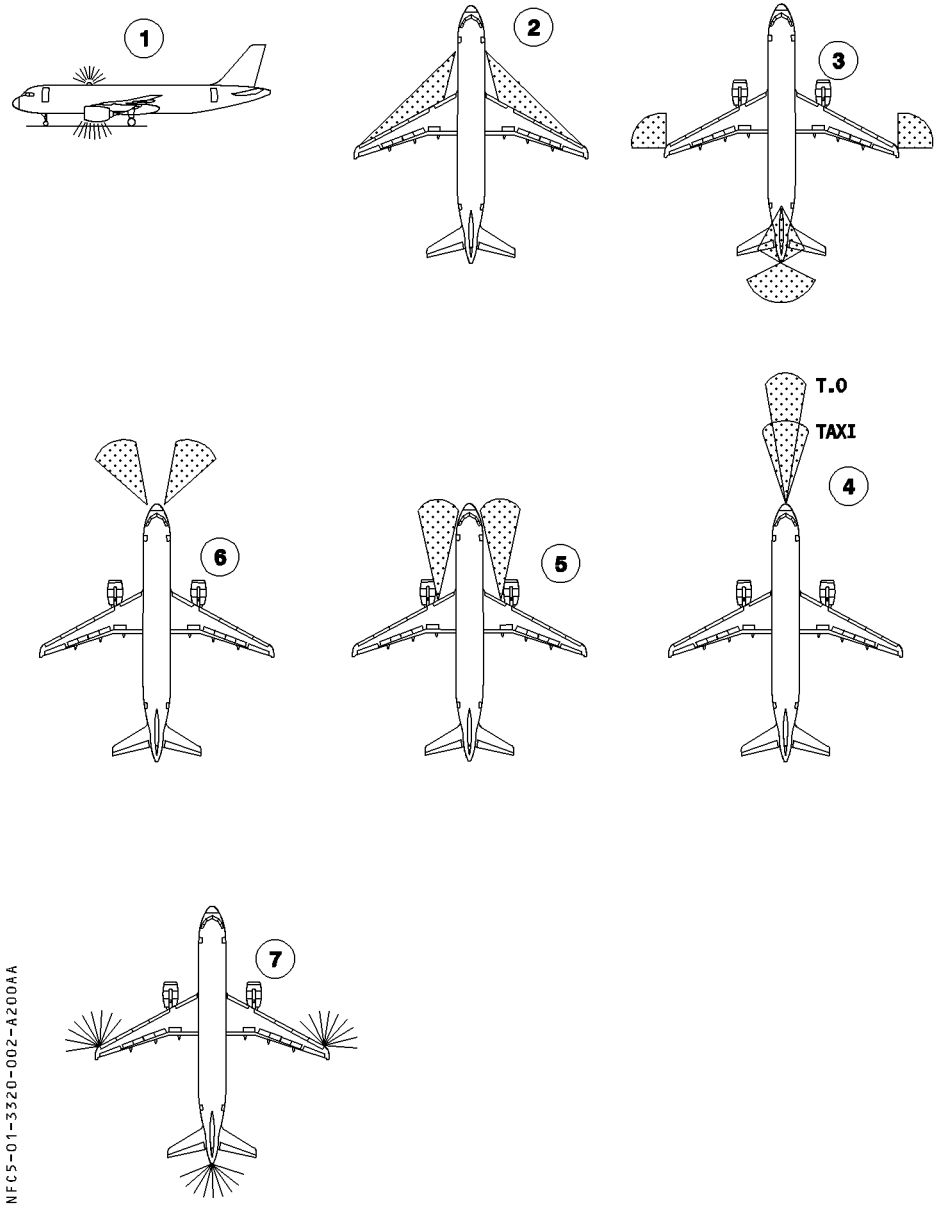
Each of these switches controls the lights for the side console and briefcase on one side of the cockpit, and for the floor around one of the pilot's seats. The lights can either be bright, dim, or off.

GENERAL

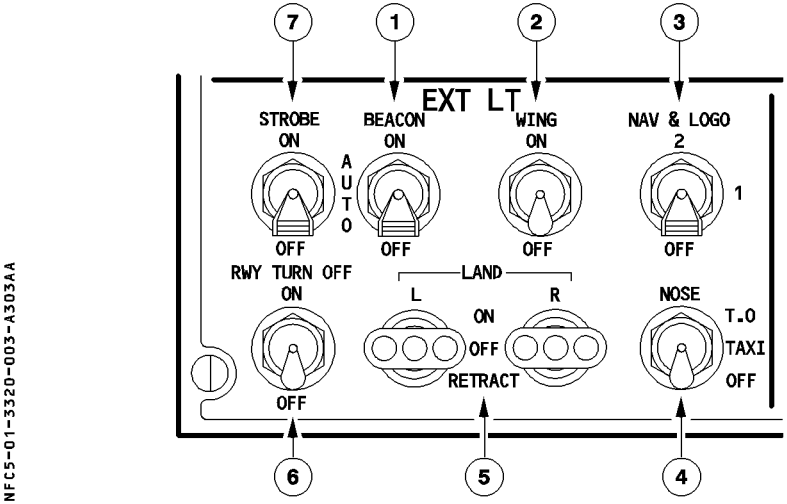
Exterior lighting includes :
- navigation lights
- landing lights
- runway turn off lights
- TO and TAXI lights
- logo lights
- anticollision lights
- wing and engine scan lights

Switches on the overhead panel control the exterior lighting.

CONTROLS AND INDICATORS



OVERHEAD PANEL



(1) BEACON sw

This switch turns on and off the two flashing red lights, one on top and one on the bottom of the fuselage.

(2) WING sw

This switch turns on and off two beam lights on each side of the fuselage. These lights illuminate the leading edge of the wing and the engine air intake to show if ice is accumulating there.

R (3) NAV and LOGO sw

R This switch turns the navigation lights on and off.
R There are dual navigation lights on each wing tip and in the APU tail cone.
R Logo lights are installed in the upper surface of each horizontal stabilizer to illuminate the
R company logo on the vertical stabilizer provided the main gear struts are compressed or
R the flaps are extended at least 15°.
R 1 : Turns on the logo lights and the first set of navigation lights.
R 2 : Turns on the logo lights and the second set of navigation lights.
R OFF : All lights are off.

④ NOSE sw

This switch turns the taxi and takeoff lights on and off.
T.O. : Turns on both taxi and takeoff lights.
TAXI : Turns on only taxi light.
OFF : Taxi and takeoff lights off.

Note : These two lights, attached to the nose gear strut, go off automatically when landing gear is retracted.

⑤ L and R LAND sel

These selectors control the landing light.
ON : Extends the (left or right) landing light which comes on automatically when fully extended.
OFF : Shut off the landing light but leaves it extended.
RETRACT : Retracts the landing light and shuts it off.

⑥ RWY TURN OFF sw

This switch turns the runway turn-off lights on and off.

Note : These lights go off automatically when landing gear is retracted.

⑦ STROBE sw

This switch turns on and off the three synchronized strobe lights, one on each wing tip and one below the tail cone.
ON : The strobe lights flash white.
AUTO : The strobe lights come on automatically when the main gear strut is not compressed.
OFF : The strobe light are off.

DESCRIPTION

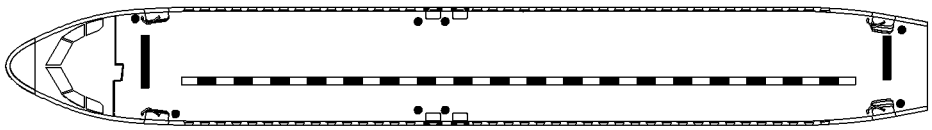
The emergency lighting system has :
- Proximity emergency escape path marking system (escape path and exit markers),
- Overhead emergency lights,
- EXIT signs,
- Lavatory auxiliary lights,
- Overwing escape route lighting, and
- Escape slide lighting.

– EXIT signs come on, if the cabin altitude gets too high, or (depending on the CIDS/CAM programming) if the NO SMOKING signs come on.
– The proximity emergency escape path marking system, overhead emergency lighting and EXIT signs come on, if the EMER EXIT LT selector is ON, or if the EMER pushbutton on the Purser panel is pressed.
– With the EMER EXIT LT selector at ARM :
  - The proximity emergency escape path marking system comes on, if :
    – Normal aircraft electrical power fails, or
    – DC SHED ESS BUS is lost.
  - The overhead emergency lights come on, if :
    – Normal aircraft electrical power system fails, or
    – DC SHED ESS BUS fails, or
    – AC BUS 1 fails.
  - Exit signs automatically come on, if :
    – Normal aircraft electrical power system fails, or
    – DC SHED ESS BUS fails.
– When lighted :
  - The proximity emergency escape path marking system is powered by internal batteries
R for at least 12 minutes.
  - DC SHED ESS BUS supply the overhead emergency lights and the EXIT signs. If DC SHED ESS BUS fails, batteries inside the light fixtures power all the lights.
  - DC SHED ESS BUS charge the internal batteries, if :
    – EMER LT selector is not at ON, and
    – The EMER pushbutton on the Purser's panel is not pressed, and
    – DC SHED ESS BUS is supplied.

Lavatory auxiliary lights are always on. They are supplied by 28V DC ESS BUS.
The escape slides have an integral lighting system. The escape slide lights and overwing route lights come on automatically when the slide is armed and the door or emergency exit is open. They are supplied by the internal batteries.

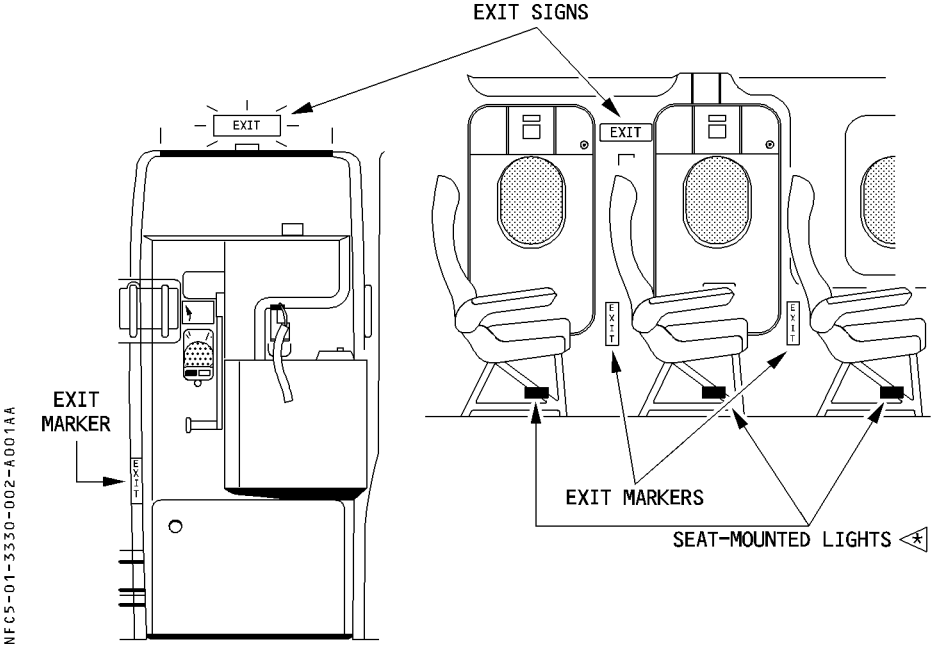
R

PROXIMITY EMERGENCY ESCAPE PATH MARKING SYSTEM/EXIT SIGNS



LEGEND

- PROXIMITY EMERGENCY ESCAPE PATH MARKING SYSTEM
- LIGHT STRIPS IN GALLEY AREA ◁*
- EXIT MARKERS



DESCRIPTION

The emergency lighting system has :
- Proximity emergency escape path marking system (escape path and exit markers),
- Overhead emergency lights,
- EXIT signs,
- Lavatory auxiliary lights,
- Overwing escape route lighting, and
- Escape slide lighting.

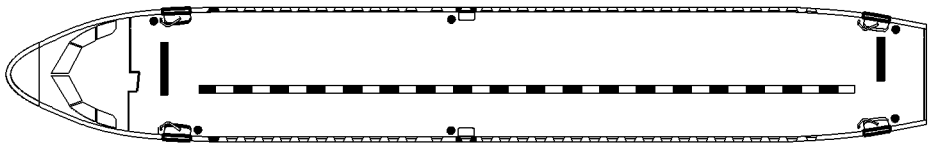
– EXIT signs come on, if the cabin altitude gets too high, or (depending on the CIDS/CAM programming) if the NO SMOKING signs come on.
– The proximity emergency escape path marking system, overhead emergency lighting and EXIT signs come on, if the EMER EXIT LT selector is ON, or if the EMER pushbutton on the Purser panel is pressed.
– With the EMER EXIT LT selector at ARM :
  - The proximity emergency escape path marking system comes on, if :
    – Normal aircraft electrical power fails, or
    – DC SHED ESS BUS is lost.
  - The overhead emergency lights come on, if :
    – Normal aircraft electrical power system fails, or
    – DC SHED ESS BUS fails, or
    – AC BUS 1 fails.
  - Exit signs automatically come on, if :
    – Normal aircraft electrical power system fails, or
    – DC SHED ESS BUS fails.

– When lighted :
  - The proximity emergency escape path marking system is powered by internal batteries
R for at least 12 minutes.
  - DC SHED ESS BUS supply the overhead emergency lights and the EXIT signs. If DC SHED ESS BUS fails, batteries inside the light fixtures power all the lights.
  - DC SHED ESS BUS charge the internal batteries, if :
    – EMER LT selector is not at ON, and
    – The EMER pushbutton on the Purser's panel is not pressed, and
    – DC SHED ESS BUS is supplied.

Lavatory auxiliary lights are always on. They are supplied by 28V DC ESS BUS.
The escape slides have an integral lighting system. The escape slide lights and overwing route lights come on automatically when the slide is armed and the door or emergency exit is open. They are supplied by the internal batteries.

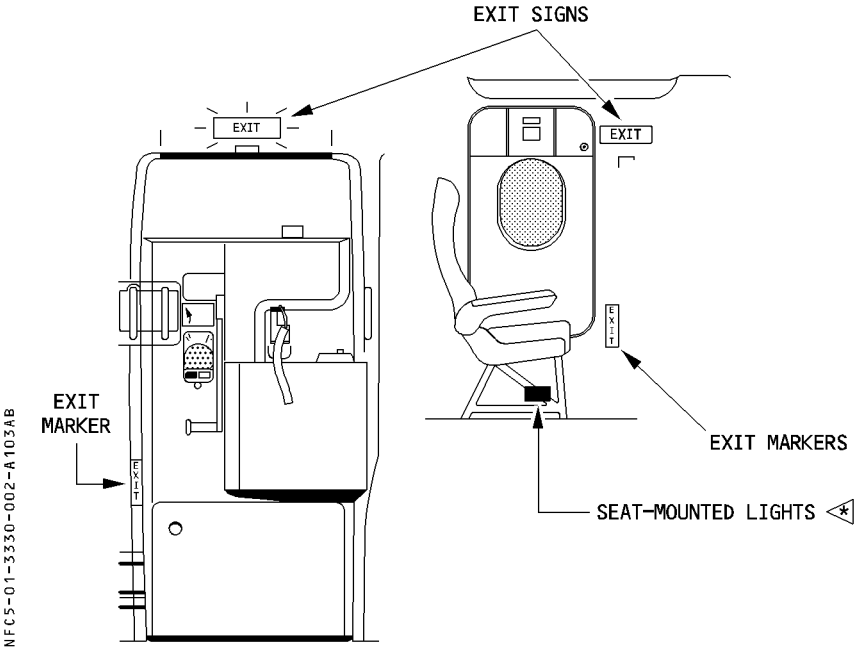
R

PROXIMITY EMERGENCY ESCAPE PATH MARKING SYSTEM/EXIT SIGNS



LEGEND

- PROXIMITY EMERGENCY ESCAPE PATH MARKING SYSTEM
- LIGHT STRIPS IN GALLEY AREA ◁*
- • EXIT MARKERS



DESCRIPTION

The emergency lighting system has :
- Proximity emergency escape path marking systems (escape path and exit markers),
- Overhead emergency lights,
- EXIT signs,
- Lavatory auxiliary lights, and

R - Escape slide lighting.

- EXIT signs come on, if the cabin altitude is too high, or (depending on the CIDS/CAM programming) if the NO SMOKING signs come on.
- The proximity emergency escape path marking system, overhead emergency lighting, and EXIT signs come on, if the EMER EXIT LT selector is ON, or if the EMER pushbutton on the Purser's panel is pressed.
- With the EMER EXIT LT selector at ARM :
  - The proximity emergency escape path marking system comes on, if :
    - Normal aircraft electrical power fails, or
    - DC SHED ESS BUS is lost.
  - The overhead emergency lights come on, if :
    - Normal aircraft electrical power system fails, or
    - DC SHED ESS BUS fails, or
    - AC BUS 1 fails.
  - Exit signs automatically come on, if :
    - Normal aircraft electrical power system fails, or
    - DC SHED ESS BUS fails.
- When on :
  - The proximity emergency escape path marking system is powered by internal batteries

R for at least 12 minutes.

  - The DC SHED ESS BUS supplies the overhead emergency lights and the EXIT signs. If the DC SHED ESS BUS fails, batteries inside the light fixtures power all the lights.
  - The DC SHED ESS BUS charge the internal batteries, if the :
    - EMER LT selector is not ON, and
    - EMER pushbutton on the Purser's panel is not pressed, and
    - DC SHED ESS BUS is supplied.

Lavatory auxiliary lights are always on. They are supplied by 28V DC ESS BUS.

R The escape slides have an integral lighting system. The escape slide lights come on automatically, when the slide is deployed. They are supplied by internal batteries.

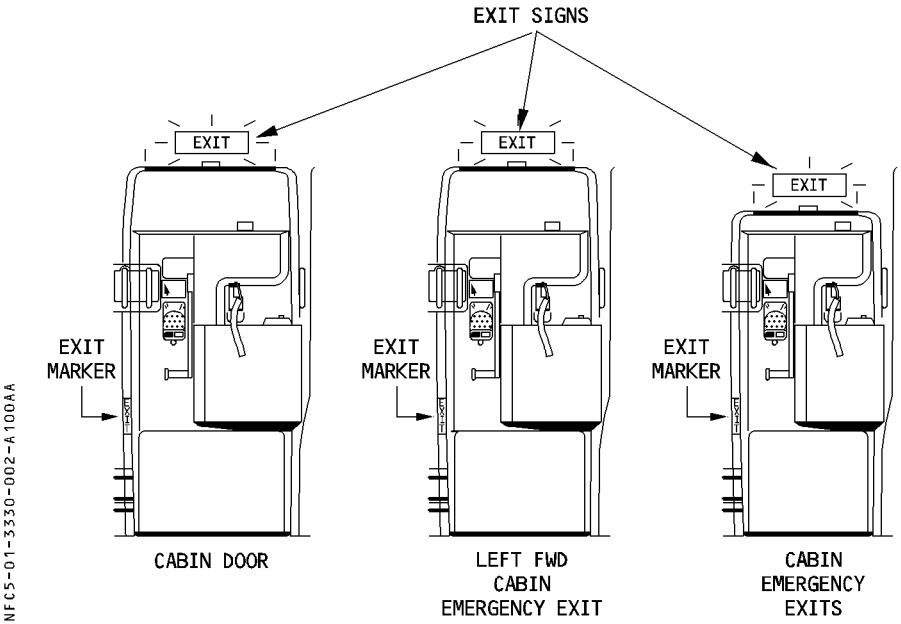
R

PROXIMITY EMERGENCY ESCAPE PATH MARKING SYSTEM/EXIT SIGNS



LEGEND

- PROXIMITY EMERGENCY ESCAPE PATH MARKING SYSTEM
- LIGHT STRIPS IN GALLEY AREA
- EXIT MARKERS



DESCRIPTION

The emergency lighting system has :
- · Proximity emergency escape path marking system (escape path and exit markers),
- · Overhead emergency lights,
- · EXIT signs,
- · Lavatory auxiliary lights,
- · Escape slide lighting.

— EXIT signs come on, if the cabin altitude gets too high, or (depending on the CIDS/CAM programming), if the NO SMOKING signs come on.
— The floor proximity emergency escape path marking is a self-luminescent system.
— The exit marker, overhead emergency lighting, and EXIT signs come on, if the EMER EXIT LT selector is ON, or if the Purser panel's EMER pushbutton is pressed.
— With the EMER EXIT LT selector at ARM :

R · The exit markers of the proximity emergency escape path marking system come on, if :
  — Normal aircraft electrical power fails, or
  — DC SHED ESS BUS is lost.
· The overhead emergency lights come on, if :
  — Normal aircraft electrical power system fails, or
  — DC SHED ESS BUS fails, or
  — AC BUS 1 fails.
· Exit signs automatically come on, if :
  — Normal aircraft electrical power system fails, or
  — DC SHED ESS BUS fails.

— When lit :

R · The exit markers of the proximity emergency escape path marking system are powered by internal batteries for at least 12 minutes.
· DC SHED ESS BUS supplies the overhead emergency lights and the EXIT signs. If DC SHED ESS BUS fails, batteries inside the light fixtures power all the lights.
· DC SHED ESS BUS charges the internal batteries, if :
  — The EMER LT selector is not ON, and
  — The Purser panel's EMER pushbutton is not pressed, and
  — DC SHED ESS BUS is supplied.

Lavatory auxiliary lights are always on. They are supplied by 28V DC ESS BUS.
The escape slides have an integral lighting system. The escape slide lights come on automatically, when the slide is armed and the door or emergency exit is open. They are supplied by the internal batteries.

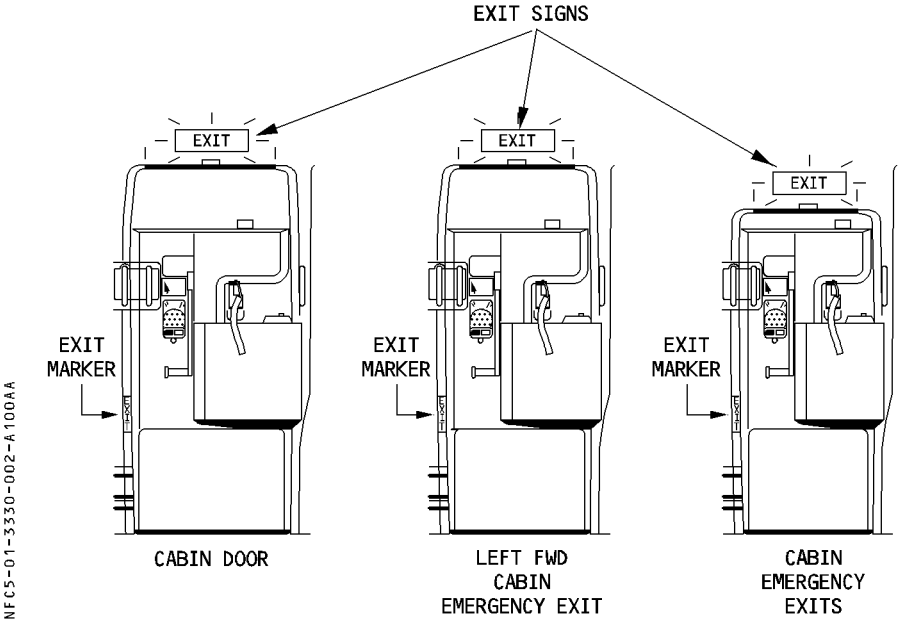
R

PROXIMITY EMERGENCY ESCAPE PATH MARKING SYSTEM/EXIT SIGNS



LEGEND

- PROXIMITY EMERGENCY ESCAPE PATH MARKING SYSTEM
- LIGHT STRIPS IN GALLEY AREA
- EXIT MARKERS



DESCRIPTION

The emergency lighting system has :

- Proximity emergency escape path marking systems (escape path and exit markers),
- Overhead emergency lights,
- EXIT signs,
- Lavatory auxiliary lights,
- Overwing escape route lighting,
- Escape slide lighting.

– EXIT signs come on, if cabin altitude gets too high, or (depending on the CIDS/CAM programming), if the NO SMOKING signs come on.

– The floor proximity emergency escape path marking is a self-luminescent system.

– The exit marker, overhead emergency lighting, and EXIT signs come on, if the EMER EXIT LT selector is ON, or if the Purser panel's EMER pushbutton is pressed.

– With the EMER EXIT LT selector at ARM :

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  – Normal aircraft electrical power fails, or
  – DC SHED ESS BUS is lost.
· The overhead emergency lights come on, if :
  – Normal aircraft electrical power system fails, or
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  – AC BUS 1 fails.
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– When lit :

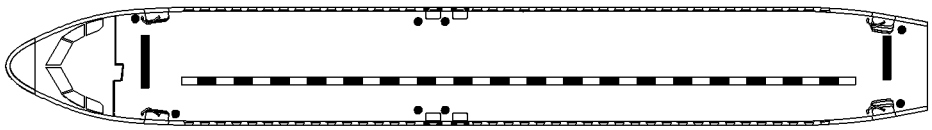
R · The exit markers of the proximity emergency escape path marking system are powered by internal batteries for at least 12 minutes.
· DC SHED ESS BUS supplies the overhead emergency lights and the EXIT signs. If DC SHED ESS BUS fails, batteries inside the light fixtures power all the lights.
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  – The EMER LT selector is not ON, and
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Lavatory auxiliary lights are always on. They are supplied by 28V DC ESS BUS.

The escape slides have an integral lighting system. The escape slide lights and the overwing route lights come on automatically, when the slide is armed and the door or emergency exit is open. They are supplied by the internal batteries.

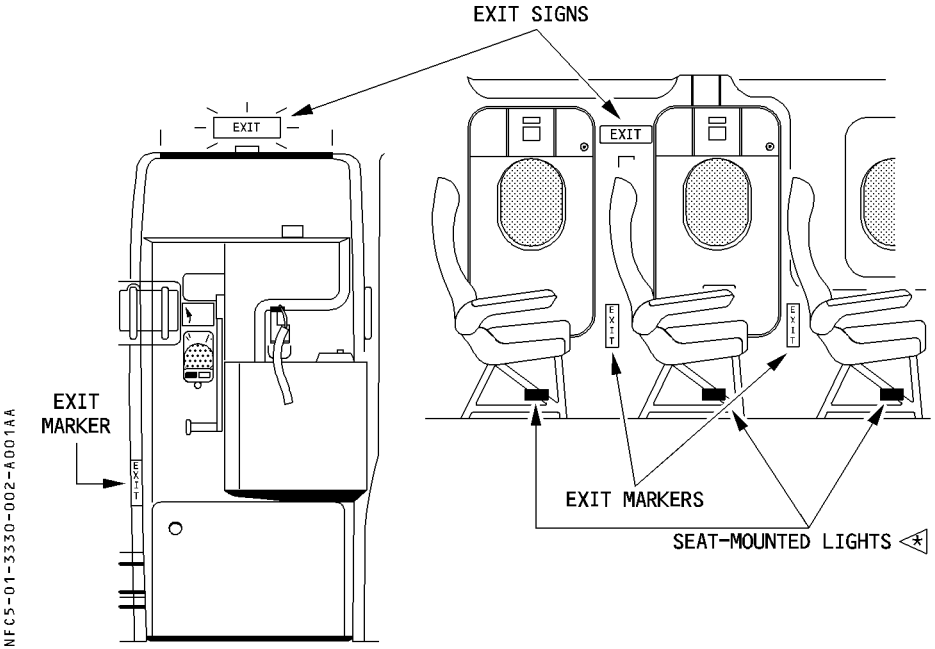
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PROXIMITY EMERGENCY ESCAPE PATH MARKING SYSTEM/EXIT SIGNS



LEGEND

- PROXIMITY EMERGENCY ESCAPE PATH MARKING SYSTEM
- LIGHT STRIPS IN GALLEY AREA ◁*
- EXIT MARKERS



DESCRIPTION

The emergency lighting system has :

- Proximity emergency escape path marking systems (escape path and exit markers),
- Overhead emergency lights,
- EXIT signs,
- Lavatory auxiliary lights,
- Overwing escape route lighting,
- Escape slide lighting.

– EXIT signs come on, if cabin altitude gets too high, or (depending on the CIDS/CAM programming), if the NO SMOKING signs come on.

– The floor proximity emergency escape path marking is a self-luminescent system.

– The exit marker, overhead emergency lighting, and EXIT signs come on, if the EMER EXIT LT selector is ON, or if the Purser panel's EMER pushbutton is pressed.

– With the EMER EXIT LT selector at ARM :

R
- The exit markers of the proximity emergency escape path marking system come on, if :
  – Normal aircraft electrical power fails, or
  – DC SHED ESS BUS is lost.
- The overhead emergency lights come on, if :
  – Normal aircraft electrical power system fails, or
  – DC SHED ESS BUS fails, or
  – AC BUS 1 fails.
- Exit signs automatically come on, if :
  – Normal aircraft electrical power system fails, or
  – DC SHED ESS BUS fails.

– When lit :

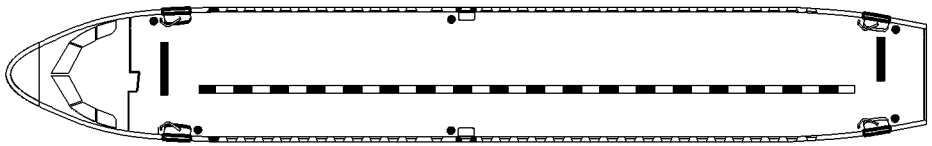
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- The exit markers of the proximity emergency escape path marking system are powered by internal batteries for at least 12 minutes.
- DC SHED ESS BUS supplies the overhead emergency lights and the EXIT signs. If DC SHED ESS BUS fails, batteries inside the light fixtures power all the lights.
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  – The Purser panel's EMER pushbutton is not pressed, and
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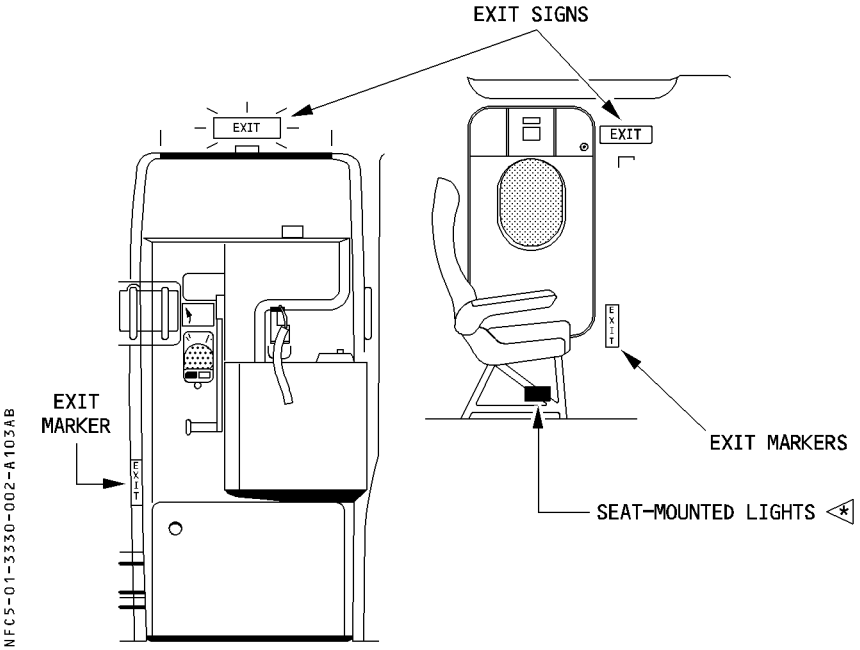
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PROXIMITY EMERGENCY ESCAPE PATH MARKING SYSTEM/EXIT SIGNS



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- PROXIMITY EMERGENCY ESCAPE PATH MARKING SYSTEM
- LIGHT STRIPS IN GALLEY AREA ◁*
- • EXIT MARKERS

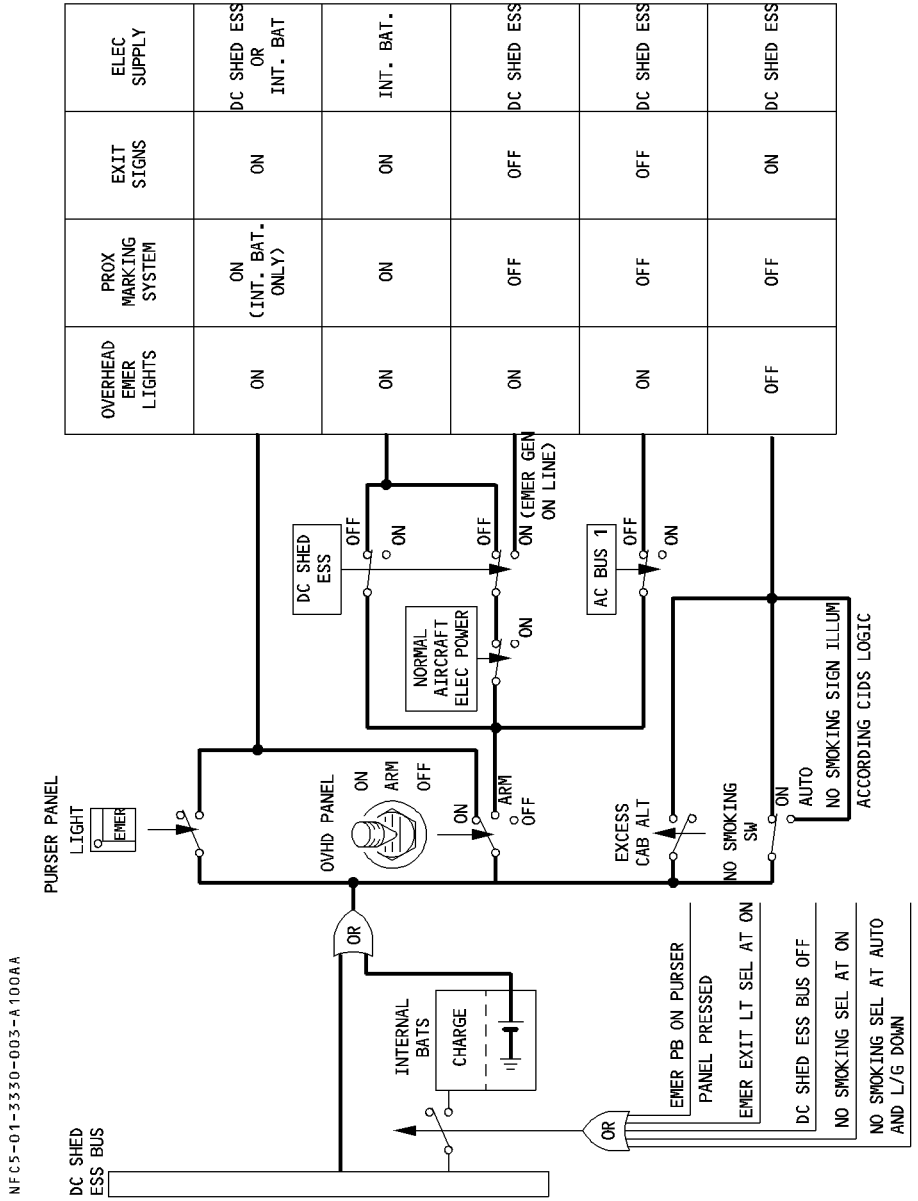


EMERGENCY LIGHTING CONTROL LOGIC

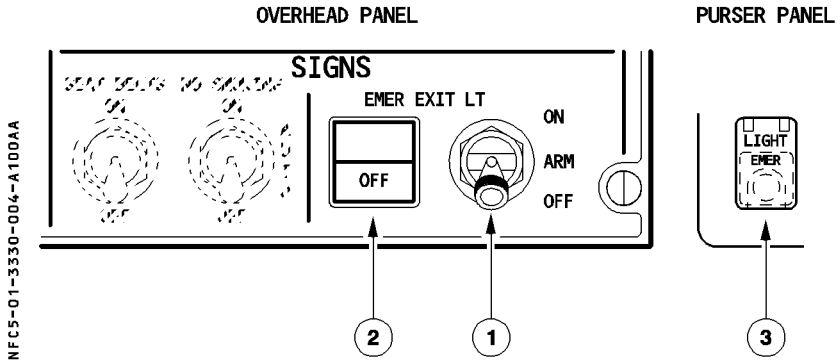
FOR INFO

R

OVERHEAD EMER LIGHTS	PROX MARKING SYSTEM	EXIT SIGNS	ELEC SUPPLY
ON	ON (INT. BAT. ONLY)	ON	DC SHED ESS OR INT. BAT
ON	ON	ON	INT. BAT.
ON	OFF	OFF	DC SHED ESS
ON	OFF	OFF	DC SHED ESS
OFF	OFF	ON	DC SHED ESS



CONTROLS AND INDICATORS



(1) EMER EXIT LT sel

The selector has three detent positions.

R ON : Overhead emergency lights, EXIT signs and proximity marking system come
R on.

OFF : Above lights are off.

R ARM : · The proximity emergency escape path marking system comes on when the normal aircraft electrical power or DC SHED ESS BUS is lost.

· The overhead emergency lights come on if :

– Normal aircraft electrical power system fails or

R – DC SHED ESS BUS fails

– AC BUS 1 fails.

R · Exit signs come on if :

– Normal aircraft elec power system fails or

– DC SHED ESS BUS fails, or

Note : The LIGHT EMER pushbutton on the purser's panel can turn on the emergency lighting independently of the positions of this selector switch.

(2) EMER EXIT LT-OFF lt

This light comes on amber when the EMER EXIT LT selector is selected OFF.

(3) LIGHT EMER pb

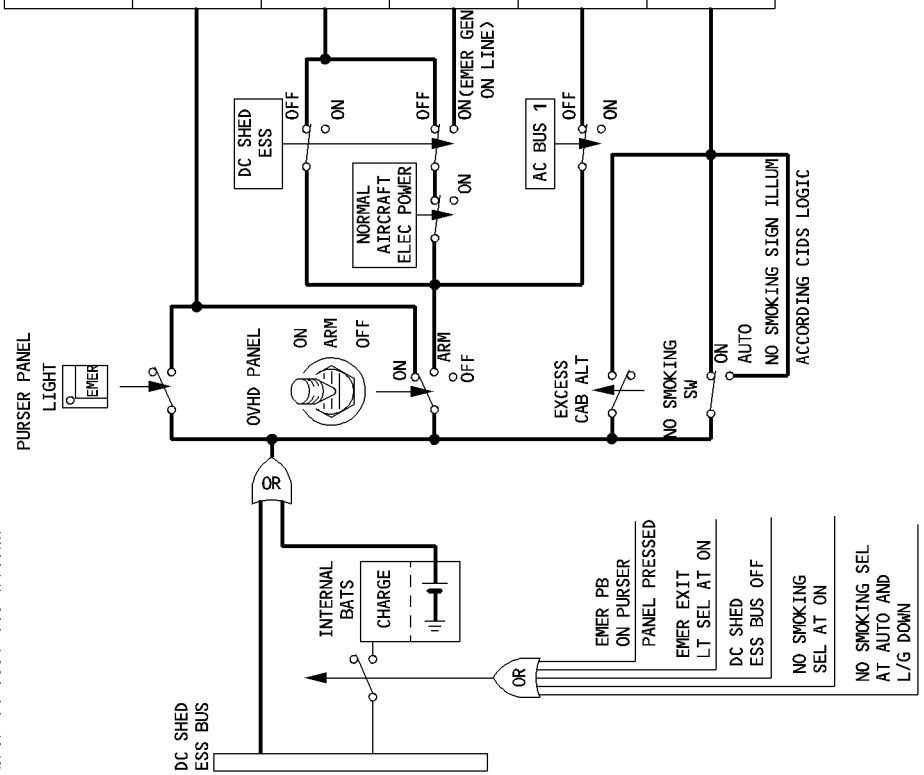
When pressed, this button performs the same function as the EMER EXIT LT switch when it is ON.

EMERGENCY LIGHTING CONTROL LOGIC

FOR INFO

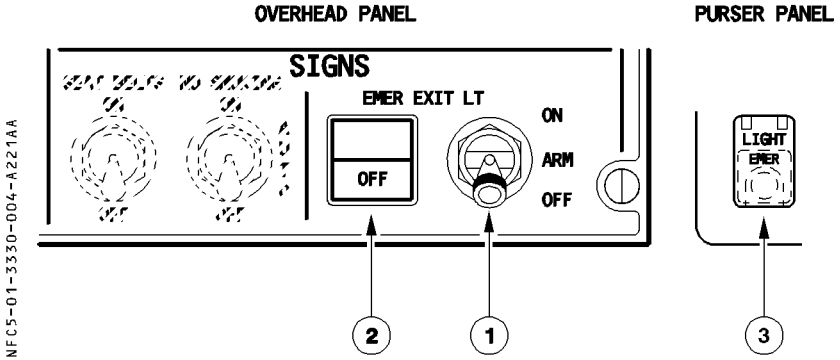
R

ELEC SUPPLY	EXIT SIGNS	PROX MARKING SYSTEM	OVERHEAD EMER LIGHTS
DC SHED ESS OR INT. BAT	ON	ON	ON
INT. BAT.	ON	OFF	ON
DC SHED ESS	OFF	OFF	ON
DC SHED ESS	OFF	ON	ON
DC SHED ESS	ON	OFF	OFF



NFC5-01-3330-003-A110AA

CONTROLS AND INDICATORS



① EMER EXIT LT sel

The selector has three detent positions.

ON : Overhead emergency lights, EXIT signs and proximity marking system come on.

OFF : Above lights are off.

ARM : · Exit markers come on when the normal aircraft electrical power or DC SHED ESS BUS is lost.

· The overhead emergency lights come on if :
- Normal aircraft electrical power system fails or
- DC SHED ESS BUS fails or
- AC BUS 1 fails.

· Exit signs come on if :
- Normal aircraft elec power system fails or
- DC SHED ESS BUS fails or

Note : The LIGHT EMER pushbutton on the purser's panel can turn on the emergency lighting independently of the positions of this selector switch.

② EMER EXIT LT-OFF lt

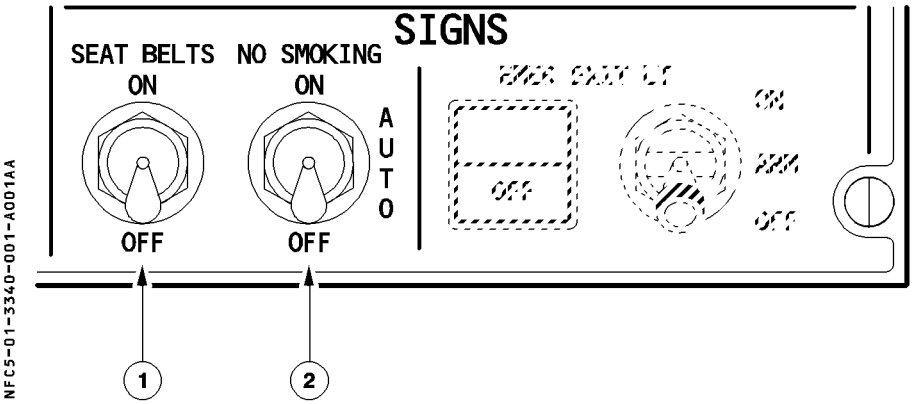
This light comes on amber when the EMER EXIT LT selector is selected OFF.

③ LIGHT EMER pb

When pressed, this button performs the same function as the EMER EXIT LT switch when it is ON.

CONTROLS AND INDICATORS

OVERHEAD PANEL



(1) SEAT BELTS sw

R ON : FASTEN SEAT BELT and RETURN TO SEAT signs come on together with a
R low tone chime.
R OFF : Signs are off. Low tone chime sounds upon extinction of lights (depending on the CIDS/CAM programming).

(2) NO SMOKING sel

R ON : NO SMOKING and EXIT signs come on together with a low tone chime.
R AUTO : NO SMOKING and EXIT signs come on when landing gear is extended and
R go off when landing gear is retracted. Low tone chime sounds (depending on the CIDS/CAM programming) when the lights go on or off.
R OFF : Signs are off. Low tone chime sounds upon extinction of lights (depending on the CIDS/CAM programming).

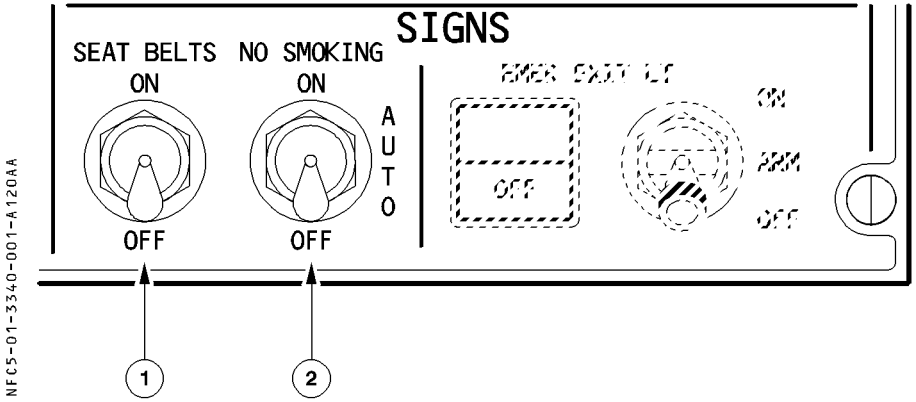
Note : If the cabin altitude goes above 11300 feet (± 350 feet), the cabin illuminates (depending on the CIDS/CAM programming) and the NO SMOKING, FASTEN SEAT BELT, EXIT signs come on regardless of SEAT BELTS and NO SMOKING selector switches.

MEMO DISPLAY

- Displays "LDG LT" in green, if one landing light is extended.
- Displays "STROBE LT OFF" in green, if the STROBE switch is OFF in flight.
- Displays "SEAT BELTS" and "NO SMOKING" messages in green, when the corresponding sign is on.
- Displays "CABIN READY" in green, pulsing 10 seconds then steady, when a signal from cabin crew is sent, in the takeoff and landing phases.

CONTROLS AND INDICATORS

OVERHEAD PANEL



(1) SEAT BELTS sw

ON : The FASTEN SEAT BELT and RETURN TO SEAT signs come on, alongwith a low tone chime.

OFF : Signs are off. A low tone chime sounds, when the lights go off (depending on the CIDS/CAM programming).

(2) NO SMOKING sw

R ON : The EXIT and NO SMOKING signs come on, with a low tone chime.

AUTO : The EXIT signs come on, when the landing gear is extended, and they go off when the landing gear is retracted. A low tone chime sounds (depending on the CIDS/CAM programming), when the lights go on or off.

R The NO SMOKING signs are on.

R OFF : The EXIT and NO SMOKING signs are off. A low tone chime sounds, when the lights go off (depending on the CIDS/CAM programming).

Note : If the cabin altitude goes above 11300 feet (± 350 feet), the cabin illuminates (depending on the CIDS/CAM programming), and the FASTEN SEAT BELT, EXIT
R *and NO SMOKING signs come on, regardless of the SEAT BELTS and NO*
R *SMOKING switches.*

MEMO DISPLAY

- Displays “LDG LT” in green, if one landing light is extended.
- Displays “STROBE LT OFF” in green, if the STROBE switch is OFF in flight.
- Displays “SEAT BELTS” and “NO SMOKING” messages in green, when the corresponding sign is on.
- Displays “CABIN READY” in green, pulsing 10 seconds then steady, when a signal from cabin crew is sent, in the takeoff and landing phases.

BUS EQUIPMENT LIST

			NORM		EMER ELEC		
			AC	DC	AC ESS	DC ESS	HOT
COCKPIT LIGHTS	Dome light	L		DC GND/ FLT			
		R				X	
	Console light	L		DC1			
		R		DC2			
	Main inst panel	L				X	
		R		DC1			
	Stby compass/ice ind					X	
	Supplementary reading light			DC1			
	Pedestal light			DC1			
	Reading light	L		DC1			
		R		DC2			
	Briefcase light	L		DC1			
		R		DC2			
	Map holder light	L		DC1			
		R		DC2			
	Floor light			DC1			
	Inst, panels-integral light		AC1				
	Annunciator light		AC1, 2 and AC STAT INV				
	Annunciator light test/dim			DC2			

		NORM		EMER ELEC		
		AC	DC	AC ESS	DC ESS	HOT
EXTERIOR LIGHTS	Navigation lts	GRD/ FLT				
	Landing lts L	AC1				
	Landing lts R	AC2				
	RWY turn off lts L	AC1	DC 2 *			
	RWY turn off lts R	AC2	DC 2 *			
	Taxi and TO lts	AC1	DC 2 *			
	Taxi and TO lts	AC2	DC 2 *			
	Logo lts L ◁	AC1	DC 2 *			
	Logo lts R ◁	AC2	DC 2 *			
	Beacon lts Upper	AC1				
	Beacon lts Lower	AC2				
	Strobe lts ◁	AC2				
	Wing lts R	AC1				
	Wing lts L	AC2				
CABIN LIGHTING		AC1 AC2 and GRND/ FLT			SHED **	

* Supply for the light control
** Standby supply (refer to EMERGENCY LIGHTING CONTROL LOGIC)

BUS EQUIPMENT LIST

			NORM		EMER ELEC		
			AC	DC	AC ESS	DC ESS	HOT
COCKPIT LIGHTS	Dome light	L		DC GND/ FLT			
		R				X	
	Console light	L		DC1			
		R		DC2			
	Main inst panel	L				X	HOT 1 (1)
		R		DC1			
	Stby compass/ice ind					X	
	Supplementary reading light			DC1			
	Pedestal light			DC1			
	Reading light	L		DC1			
		R		DC2			
	Briefcase light	L		DC1			
		R		DC2			
	Map holder light	L		DC1			
		R		DC2			
	Floor light			DC1			
	Inst, panels-integral light		AC1				
	Annunciator light		AC1, 2 and AC STAT INV				
	Annunciator light test/dim			DC2			

(1) Backup supply

		NORM		EMER ELEC		
		AC	DC	AC ESS	DC ESS	HOT
EXTERIOR LIGHTS	Navigation lts	GRD/ FLT				
	Landing lts L	AC1				
	Landing lts R	AC2				
	RWY turn off lts L	AC1	DC 2 *			
	RWY turn off lts R	AC2	DC 2 *			
	Taxi and TO lts	AC1	DC 2 *			
	Taxi and TO lts	AC2	DC 2 *			
	Logo lts L ◁	AC1	DC 2 *			
	Logo lts R ◁	AC2	DC 2 *			
	Beacon lts Upper	AC1				
	Beacon lts Lower	AC2				
	Strobe lts ◁	AC2				
	Wing lts R	AC1				
	Wing lts L	AC2				
CABIN LIGHTING		AC1 AC2 and GRND/ FLT			SHED **	

* Supply for the light control
** Standby supply (refer to EMERGENCY LIGHTING CONTROL LOGIC)

34.00 CONTENTS

34.10 ADIRS
– DESCRIPTION 1
– CONTROLS AND INDICATORS 4
– WARNINGS AND CAUTIONS 8

34.15 GPS
– DESCRIPTION 1
– NORMAL OPERATION 2
– OPERATION IN CASE OF FAILURE 3
– WARNINGS AND CAUTIONS 3

34.20 STANDBY INSTRUMENTS
– COMPASS 1
– HORIZON 1
– AIRSPEED INDICATOR 2
– ALTIMETER 2
– ALTIMETER (in meter) ◁ 3

34.30 RADIO NAV
– TUNING 1
– NAVAIDS 3
– CONTROLS AND INDICATORS 4

34.40 RADIO ALTIMETER
– DESCRIPTION 1
– WARNINGS AND CAUTIONS 2

34.50 ATC
– DESCRIPTION 1
– CONTROL PANEL 1

34.60 WEATHER RADAR
– DESCRIPTION 1
– CONTROL PANEL 1
– WINDSHEAR PREDICTION FUNCTION 3
– WARNINGS AND CAUTIONS 5

34.70 GPWS
– DESCRIPTION 1
R – GPWS BASIC MODES 3
– EGPWS FUNCTIONS ◁ 8
– CONTROLS AND INDICATORS 11
– WARNINGS AND CAUTIONS 14

34.80 TCAS ◁
– DESCRIPTION 1
– CONTROLS AND INDICATORS 7
– WARNINGS AND CAUTIONS 13

34.85 HEADUP DISPLAY (HUD) ◁
– GENERAL 1
– INFORMATION DISPLAYED 2
– FAILURES MODE 8
– CONTROLS AND INDICATORS 9

34.90 PARA VISUAL INDICATOR (PVI) ◁
– GENERAL 1
– CONTROLS AND INDICATORS 2

34.95 ANGLE OF ATTACK INDICATING ◁

34.97 ELECTRICAL SUPPLY

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– CONTROL PANEL 1
– REMOTE ATC BOX 3

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34.97 ELECTRICAL SUPPLY

DESCRIPTION

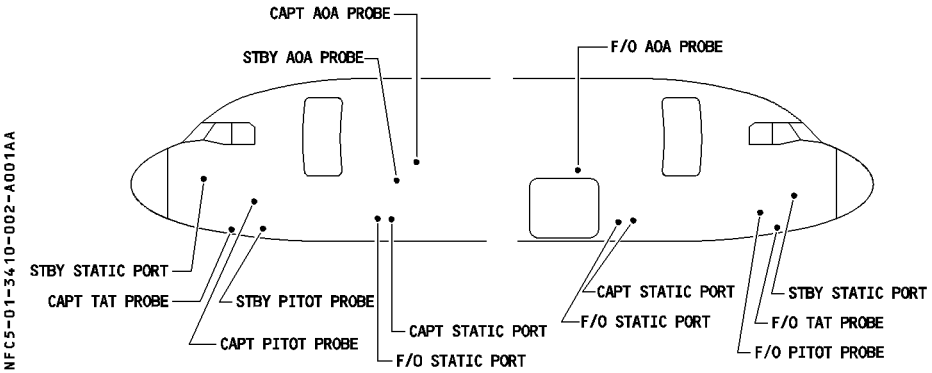
The Air Data and Inertial Reference System (ADIRS) supplies temperature, anemometric, barometric and inertial parameters to the EFIS system (PFD and ND) and to other user systems (FMGC , FADEC, ELAC, SEC, FAC, FWC, SFCC, ATC, GPWS, CFDIU, CPC).
The system includes :

- three identical ADIRU's (Air Data and Inertial Reference Units).
  Each ADIRU is divided in two parts, either of which can work separately in case of failure in the other :
  · the ADR part (Air Data Reference) which supplies barometric altitude, airspeed, mach, angle of attack, temperature and overspeed warnings.
  · the IR part (Inertial Reference) which supplies attitude, flight path vector, track, heading, accelerations, angular rates, ground speed and aircraft position.

  Note : Above 73° North and above 60° South, the ADIRU gives true heading instead of magnetic heading.

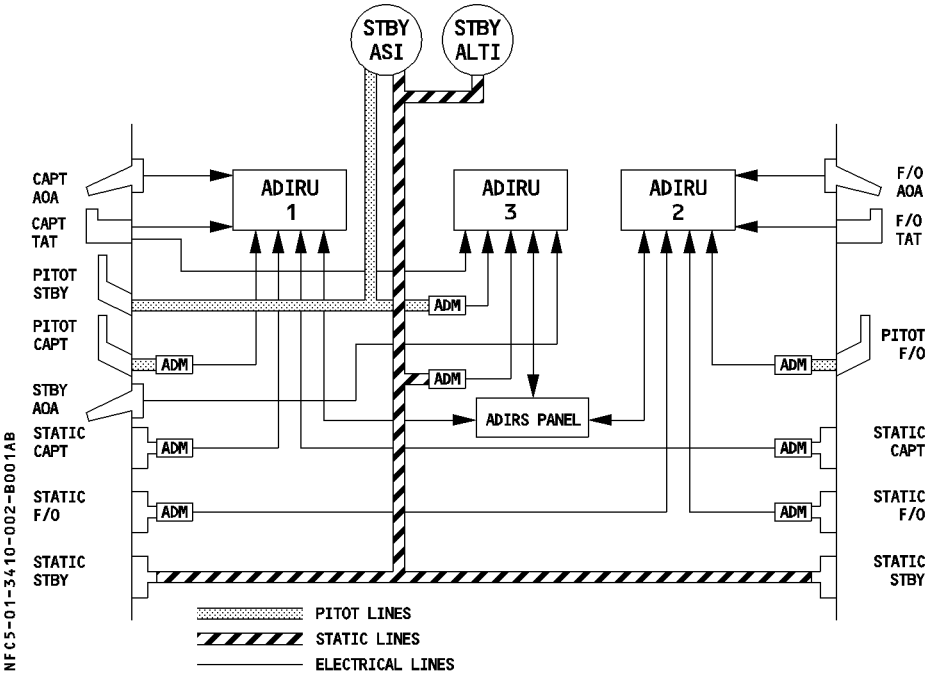
- one ADIRS control panel (ADIRS CDU) on the overhead panel for selection of modes (NAV, ATT, OFF) and indications of failures.
  The IR is normally initialized through the FMGS, but the ADIRS CDU may be used as a back up.
- two GPS receivers, which are connected to the IR part of the ADIRU's for GP/IR hybrid position calculation.
- four types of sensors :
  · pitot probes (3)
  · static pressure probes (STAT) (6)
  · angle of attack sensors (AOA) (3)
  · total air temperature probes (TAT) (2)
  These sensors are electrically heated to prevent from icing up.
- eight ADMs (Air Data Modules) which convert pneumatic data from PITOT and STAT probes into numerical data for the ADIRUs.
- a switching facility for selecting ADR3 or IR3 for instrument displays in case of ADIRU 1 or 2 failure.

PROBES LOCATION



PROBES SCHEMATIC

R



Note : ADIRU (1) is supplied by CAPT probes,
(2) is supplied by F/O probes,
(3) is supplied by STBY probes and CAPT TAT.

DESCRIPTION

The Air Data and Inertial Reference System (ADIRS) supplies temperature, anemometric, barometric and inertial parameters to the EFIS system (PFD and ND) and to other user systems (FMGC , FADEC, ELAC, SEC, FAC, FWC, SFCC, ATC, GPWS, CFDIU, CPC).
The system includes :

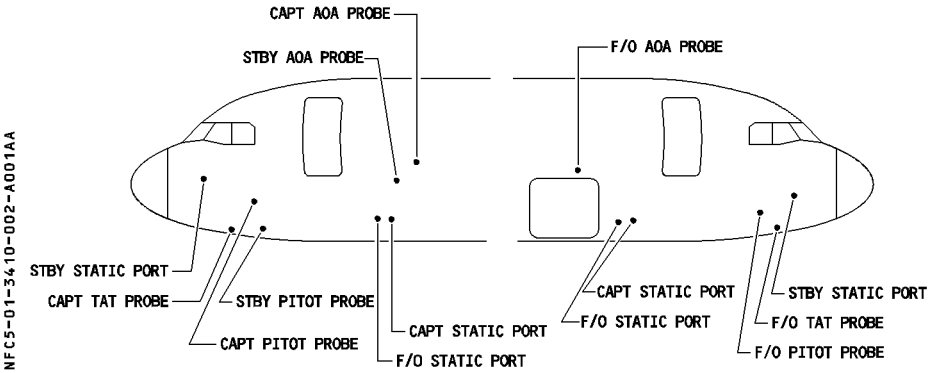
- three identical ADIRU's (Air Data and Inertial Reference Units).
  Each ADIRU is divided in two parts, either of which can work separately in case of failure in the other :
  - the ADR part (Air Data Reference) part which supplies barometric altitude, airspeed, mach, angle of attack, temperature and overspeed warnings.
  - the IR part (Inertial Reference) which supplies attitude, flight path vector, track, heading, accelerations, angular rates, ground speed and aircraft position.

  Note : The ADIRU gives true heading instead of magnetic heading :
  - *above 82° North*
  - *above 73° North between 90° and 120° West (magnetic polar region)*
  - *above 60° South*

- one ADIRS control panel (ADIRS CDU) on the overhead panel for selection of modes (NAV, ATT, OFF) and indications of failures.
  The IR is normally initialized through the FMGS, but the ADIRS CDU may be used as a back up.
- two GPS receivers, which are connected to the IR part of the ADIRU's for GP/IR hybrid position calculation.
- four types of sensors :
  - pitot probes (3)
  - static pressure probes (STAT) (6)
  - angle of attack sensors (AOA) (3)
  - total air temperature probes (TAT) (2)

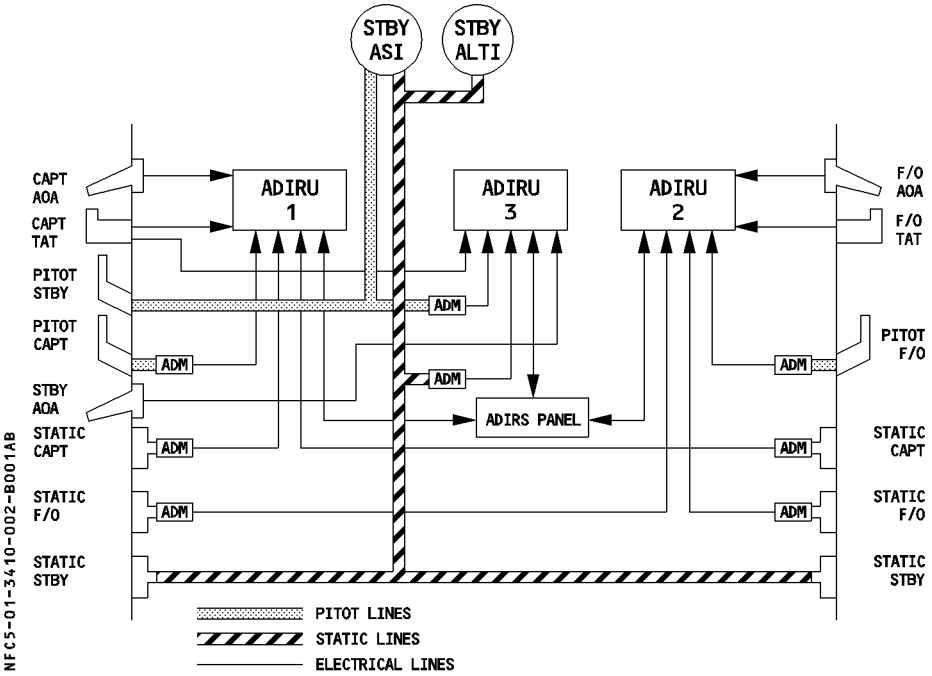
  These sensors are electrically heated to prevent from icing up.
- eight ADMs (Air Data Modules) which convert pneumatic data from PITOT and STAT probes into numerical data for the ADIRUs.
- a switching facility for selecting ADR3 or IR3 for instrument displays in case of ADIRU 1 or 2 failure.

PROBES LOCATION



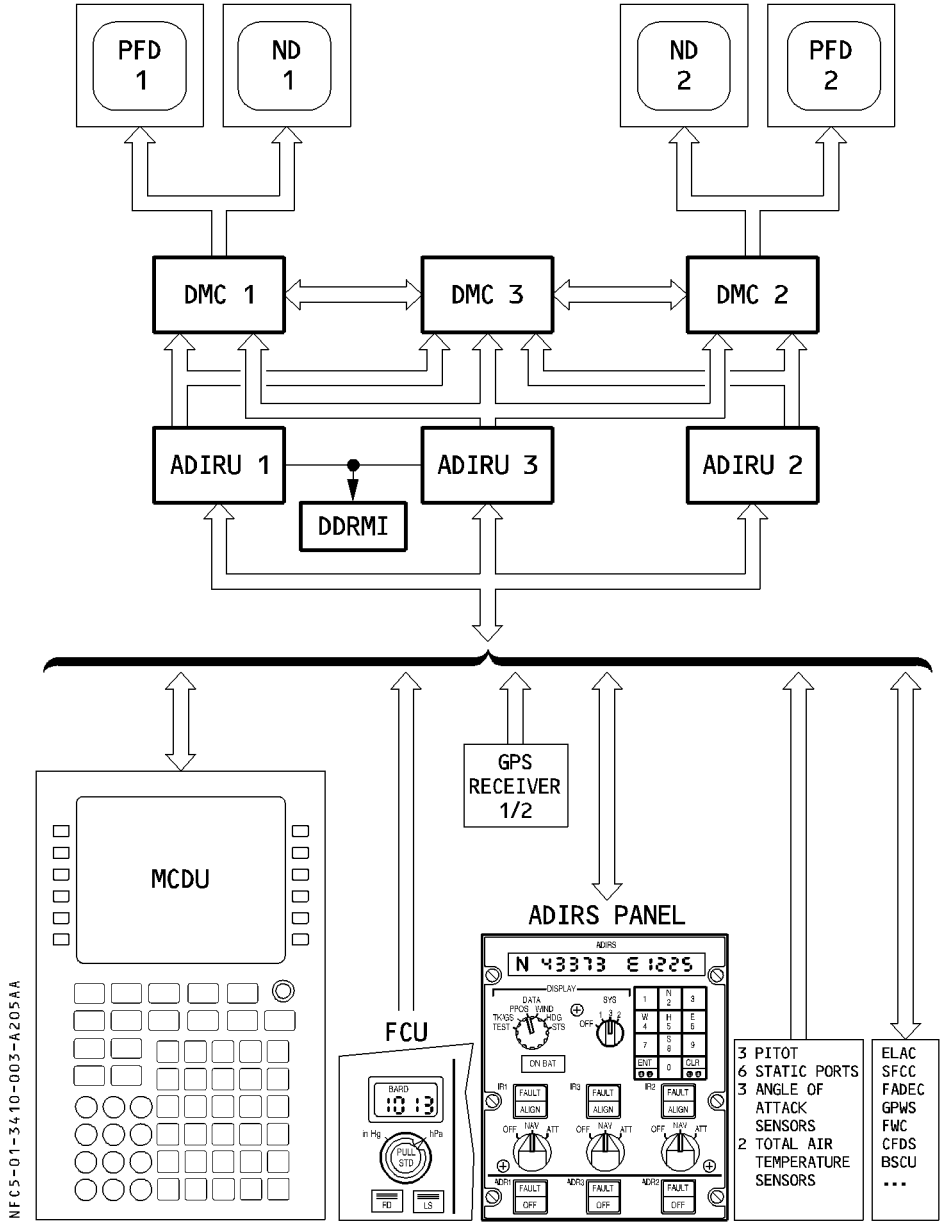
PROBES SCHEMATIC

R



Note : ADIRU (1) is supplied by CAPT probes,
(2) is supplied by F/O probes,
(3) is supplied by STBY probes and CAPT TAT.

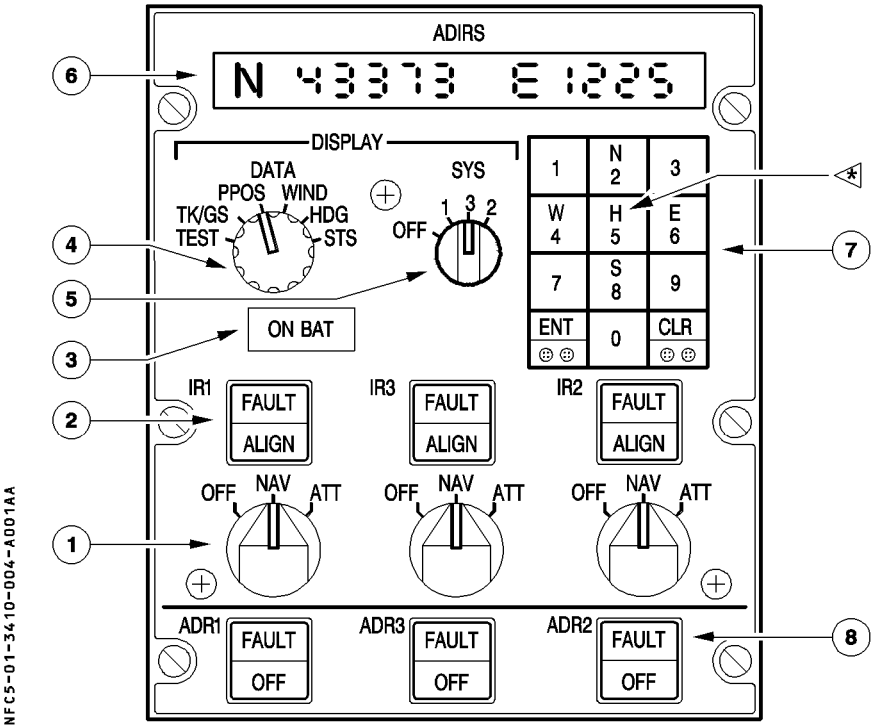
ADIRS SCHEMATIC



CONTROLS AND INDICATORS

OVERHEAD PANEL

R The ADIRS CDU on the overhead panel provides the controls and indicators to permit :
- selection of power supplies to the ADR and IR systems
- selection and display of navigation data
- manual initialization (normally performed through the FMGC)
- status and fault indication of IRs or ADRs.



(1) IR 1(2)(3) Mode rotary sel :

OFF : The ADIRU is not energized. ADR and IR data are not available.
NAV : Normal mode of operation. Supplies full inertial data to aircraft systems.
ATT : IR mode supplying only attitude and heading information if the system loses its ability to navigate.
The heading must be entered through the CDU keyboard and has to be reset frequently (about every 10 minutes)

(2) IR 1 (2) (3) lt

FAULT : Comes on amber associated with an ECAM caution when a fault affects the respective IR.
- Steady : the respective IR is lost.
- Flashing : the attitude and heading information may be recovered in ATT mode.

ALIGN : Steady : the respective IR is operating normally in align mode.
- Flashing if : IR alignment fault, or no present position entry after 10 min, or difference between position at shutdown and entered position exceeds 1° of latitude or longitude.
- Extinguished : Alignment has been completed.

(3) ON BAT lt

Comes on amber when one or more IRs is supplied only by the a/c battery. It also comes on for a few sec at the beginning of the alignment, but not for a fast realignment.

Note : If, when the aircraft is on the ground, at least one ADIRU is supplied by aircraft batteries :
– an external horn sounds
R *– the ADIRU and AVNCS light comes on amber on the EXTERNAL POWER panel.*

(4) DATA selector knob

This knob selects the information to be displayed in the ADIRS display window.

TEST The ENT and CLR buttons on the keyboard come on, and the display shows all 8's.
TK/GS The display shows true track and ground speed.
PPOS The display shows present latitude and longitude
WIND The display shows true wind direction and speed.
HDG The display shows true heading and the minutes remaining until alignment is completed.
STS The display shows an action code.

(5) SYS selector knob

OFF : The CDU display is not energized. ADIRS are still energized if the associated IR mode rotary selectors are not at OFF.
1.2.3 : System selected for data display.

(6) Display

The display presents the data selected by the DATA selector.
A keyboard entry overrides the selected display.

(7) Keyboard

The flight crew can use the keyboard to enter the present position, or the heading in ATT mode, into the selected system.

Letter keys : Used to enter N, S, E, or W for position, or entering H (◁) for heading (ATT mode).

Number keys : Used to enter the present position (or the present magnetic heading in ATT mode).

CLR key : The integral cue light comes on after an entry operation, if the data has an unreasonable value.
Pressing this key clears the data display, that has been keyed in but not yet entered.

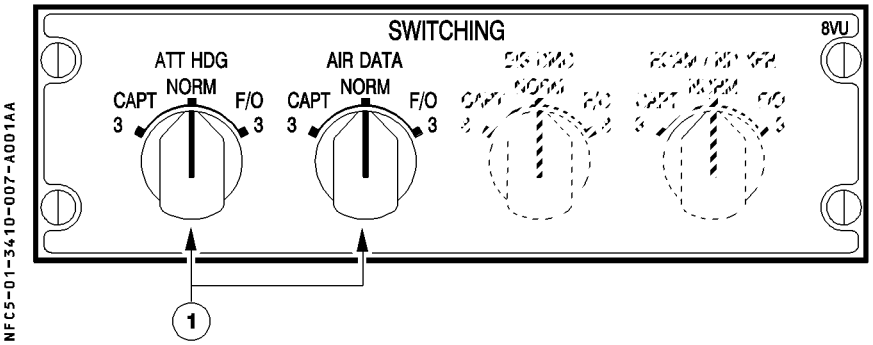
ENT Key : The integral cue light comes on when a crewmember has keyed in a number for N, S, W, E or H (◁).
Pressing the key enters data into the ADIRS.

R (8) ADR 1 (2) (3) pb (momentary action)

OFF Air data output disconnected.

FAULT This amber light comes on with an ECAM caution, if a fault is detected in the air data reference part.

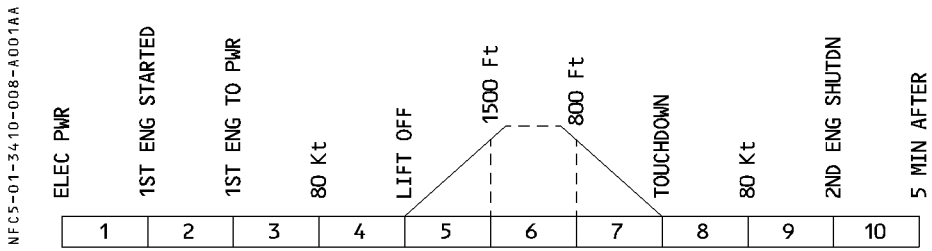
PEDESTAL



(1) ATT HDG and AIR DATA sel

NORM : ADIRU 1 supplies data to PFD 1, ND 1, RMI and VOR/DME.
ADIRU 2 supplies data to PFD 2, and ND2.
CAPT 3 : ADR 3 or IR 3 replaces ADR 1 or IR 1.
F/O 3 : ADR 3 or IR 3 replaces ADR 2 or IR 2.

WARNINGS AND CAUTIONS



R

E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
STALL WARNING (No ECAM message) An aural stall warning is triggered when the AOA is greater than a predetermined angle This angle depends on the : – Slats/Flap position – Speed/Mach – F/CTL law (normal, alternate/direct)	CRICKET + STALL SYNTHETIC VOICE)	MASTER WARN	NIL	NIL	GND
OVERSPEED – VMO/MMO Aircraft speed/mach greater than VMO + 4 kt/MMO + 0.006 – VLE Aircraft speed greater than VLE + 4 kt, with L/G not uplocked, or L/G doors not closed – VFE Aircraft speed greater than VFE + 4 kt, with slats or/and flaps extended	CRC				2, 3, 4 8, 9,10
ADR 1 (2) FAULT	SINGLE CHIME	MASTER CAUT		ADR FAULT lt	1, 4,8,10
ADR 3 FAULT					1,4,5 7,8,10
ADR (1+2) (1+3) (2+3) FAULT					1,4,8,10
IR 1 (2) FAULT				IR FAULT lt	4,5,7,8
IR 3 FAULT					4,5 7,8
IR (1 + 3) (2+3) FAULT					4, 8
IR 1 + 2 FAULT					

E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
HDG DISCREPANCY Difference between the heading on CAPT and F/O displays is greater than 5°.	SINGLE CHIME	MASTER CAUT	NIL	CHECK HDG (on PFD and ND)	4, 8
ATT DISCREPANCY Difference between roll or pitch angle, displayed on the CAPT and F/O PFD is greater than 5°.				CHECK ATT (on PFD)	3, 4, 8
ALTI DISCREPANCY Difference between the altitude displayed on the CAPT and F/O PFD is greater than : – 500 ft, if baro ref STD is selected. – 250 ft if QNH (or QFE) is selected.				CHECK ALT (on PFD)	
BARO REF DISCREPANCY Difference between the CAPT and F/O sides.				NIL	
ADR DISAGREE One ADR is faulty, or has been rejected by the ELAC, and there is a speed or angle-of-attack disagree between the two remaining ADRs.				FAULT lts on ELAC pbs	3, 4, 5, 7
IR DISAGREE Disagree between two IRs, with the third one failed.				PFD message	

MEMO DISPLAY

· This displays IRS IN ALIGN X MN during Phase 1 or 2, if :
  – At least one active IRS is in ALIGN submode
  – The time remaining until NAV mode is obtained, is X minutes ($1 < x < 10$).
· "IRS IN ALIGN" appears, if one of the 3 IRS is still in alignment.

These 2 messages are displayed :
– In green, if both engines are stopped.
– In amber, if one engine is running.

E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
HDG DISCREPANCY Difference between the heading on CAPT and F/O displays is greater than 5°.	SINGLE CHIME	MASTER CAUT	NIL	CHECK HDG (on PFD and ND)	4, 8
ATT DISCREPANCY Difference between roll or pitch angle, displayed on the CAPT and F/O PFD is greater than 5°.				CHECK ATT (on PFD)	3, 4, 8
ALTI DISCREPANCY Difference between the altitude displayed on the CAPT and F/O PFD is greater than : – 500 ft, if baro ref STD is selected. – 250 ft if QNH (or QFE) is selected.				CHECK ALT (on PFD)	
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IR DISAGREE Disagree between two IR, with the third one failed.				PFD message	
IR NOT ALIGNED Problem detected during IR alignment				NIL	1

MEMO DISPLAY

– "IRS IN ALIGN X MN" memo appears during phase 1 or 2, during IRS alignment. X MN indicates the number of minutes remaining (1<x<10), until NAV mode is reached.
  · Before any engine is started, "IRS IN ALIGN X MN" memo :
    * Appears in green when at least one active IRS is being aligned,
    * Pulses in green if the alignment of one IRS is faulty.
  · When one engine is started, "IRS IN ALIGN X MN" memo appears in amber during IRS alignment. If the alignment of one IRS is faulty, "IRS IN ALIGN X MN"memo is repalced by the "IR NOT ALIGNED" ECAM caution.
– "IR IN ATT ALIGN" appears in green during the IR alignment in Attitude mode.

E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
HDG DISCREPANCY Difference between the heading on the CAPT and F/O displays is greater than 5°.	SINGLE CHIME	MASTER CAUT	NIL	CHECK HDG (on PFD and ND)	4, 8
ATT DISCREPANCY Difference between the roll or pitch angle, displayed on the CAPT and F/O PFD, is greater than 5°.				CHECK ATT (on PFD)	3, 4, 8
ALTI DISCREPANCY Difference between the altitude, displayed on the CAPT and F/O PFD, is greater than : – 500 feet, if baro ref STD is selected. – 250 feet, if QNH (or QFE) is selected.				CHECK ALT (on PFD)	
BARO REF DISCREPANCY difference between CAPT and F/O sides				NIL	
IAS DISCREPANCY Caution activated when there is a discrepancy between the speeds displayed on the PFDs.				NIL	4, 5, 7, 8
ADR DISAGREE One ADR is faulty, or has been rejected by the ELAC, and there is a speed or angle-of-attack disagree between the two remaining ADRs.				FAULT lts on ELAC pbs	3, 4, 5, 7
IR DISAGREE Disagree between two IRs, with the third one failed.				PFD message	

MEMO DISPLAY

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ATT DISCREPANCY Difference between roll or pitch angle, displayed on the CAPT and F/O PFD is greater than 5°.				CHECK ATT (on PFD)	3, 4, 8
ALTI DISCREPANCY Difference between the altitude displayed on the CAPT and F/O PFD is greater than : – 500 ft, if baro ref STD is selected. – 250 ft if QNH (or QFE) is selected.				CHECK ALT (on PFD)	
BARO REF DISCREPANCY difference between CAPT and F/O sides				NIL	
IAS DISCREPANCY Caution activated when there is a discrepancy between the speeds displayed on the PFDs.				NIL	4, 5, 7, 8
ADR DISAGREE One ADR is faulty or has been rejected by the ELAC and there is a speed or angle-of-attack disagree between the two remaining ADR.				FAULT lts on ELAC pbs	3, 4, 5, 7
IR DISAGREE Disagree between two IR, with the third one failed.				PFD message	
IR NOT ALIGNED Problem detected during IR alignment				NIL	1

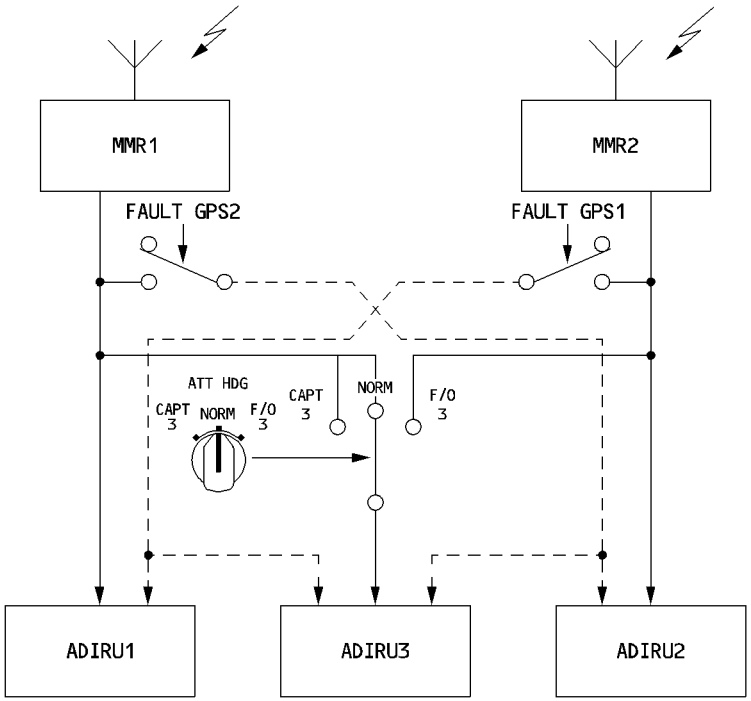
MEMO DISPLAY

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  · Before any engine is started, "IRS IN ALIGN X MN" memo :
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  · When one engine is started, "IRS IN ALIGN X MN" memo appears in amber during IRS alignment. If the alignment of one IRS is faulty, "IRS IN ALIGN X MN"memo is repalced by the "IR NOT ALIGNED" ECAM caution.
– "IR IN ATT ALIGN" appears in green during the IR alignment in Attitude mode.

DESCRIPTION

The Global Positioning System (GPS) is a satellite based radio navigation aid.
Worldwide 24 satellites broadcast accurate navigation data that aircraft can use for the precise determination of its position.
The aircraft has two independent GPS receivers. Each GPS receiver is integrated in a modular avionics unit called MMR (Multi Mode Receiver) (GPS 1 receiver in MMR1, GPS2 receiver in MMR2).
The MMR processes the data received and transfers them to the ADIRUs, which then perform a GP-IRS hybrid position calculation. The FMGCs use the hybrid position. The GPS MONITOR page on MCDU1 or MCDU2 can display pure GPS position, true track, ground speed, estimated position, accuracy level, and mode of operation for the information and use of the flight crew.

R *Note : Flight crew can use the MCDU NAVAID page to deselect the use of GPS data for calculating position (refer to FCOM 4.03).*



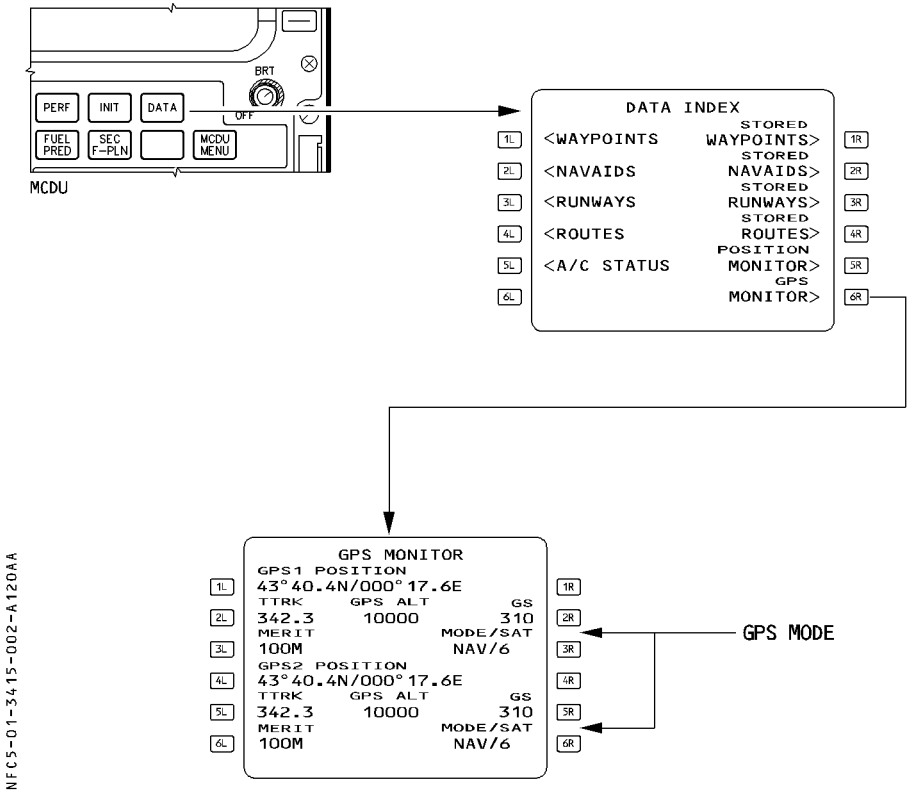
NFCS-01-3415-001-A110AA

NORMAL OPERATION

In normal operation, the GPS receiver 1 supplies ADIRU 1 and ADIRU 3, the GPS receiver 2 supplies ADIRU 2.

The MMR operates in different modes which are indicated on the GPS MONITOR page :

R



R — **Initialization mode (INIT)**

R When this mode is entered, the GPS hardware and software are initialized.

— **Acquisition mode (ACQ)**

The MMR enters in this mode after power-up or during long periods of lost satellite signal. It remains in this mode until it is able to track at least 4 satellites, then transfers to NAV mode. To enter navigation mode more quickly, MMR uses initial position, time and altitude from IRS.

– **Navigation Mode (NAV)**
When the MMR can track 4 or more satellites, it enters NAV mode and continuously supplies data to the ADIRUs.

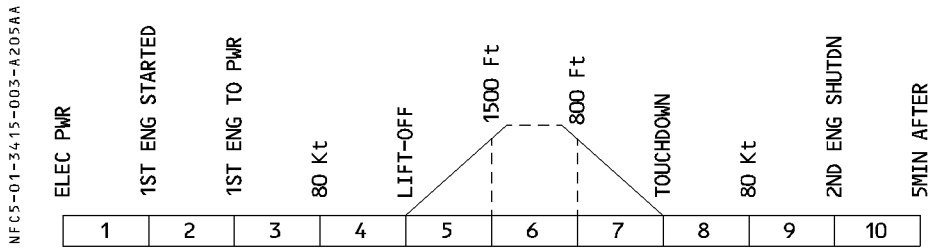
– **Altitude Aiding (ALTAID)**
If the MMR can track at least 4 satellites, it uses the GPS altitude and the IR altitude to calculate an altitude bias.
If the number of satellites drops to three, the altitude bias is frozen and the MMR enters
R ALTAID mode, using the IR altitude (corrected with the altitude bias).

– **Fault Mode (FAULT)**
The fault mode is entered when a failure, which may prevent the MMR from transmitting valid data, has been detected.

OPERATION IN CASE OF FAILURE

If one GPS receiver fails, the three ADIRUs automatically select the only operative GPS receiver. If ADIRU 1 fails, ADIRU 3 is supplied by MMR 1, and ADIRU 2 is supplied by MMR 2. To maintain Side 1 and Side 2 segregation, in case ADIRU 2 fails, the ATT HDG selector must be set to F/O 3, so that ADIRU 3 will be supplied with MMR 2 data. If two ADIRUs fail, the remaining ADIRU is supplied by its own side GPS receiver.

WARNINGS AND CAUTIONS



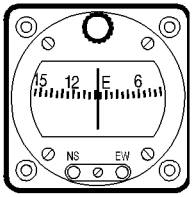
E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
GPS 1 (2) FAULT	SINGLE CHIME	MASTER CAUTION	NIL	NIL	4, 5, 7, 8
FM/GPS POS DISAGREE					1, 3, 4, 10
GPS PRIMARY LOST (No ECAM warning)	TRIPLE CLICK During non ILS approach only	NIL			2,3,4,5 8,9,10

COMPASS

There is a compass located is on top of the windshield center post.
The deviation card is located above the compass.

Note : Because of the location of the APU power on contactor in the cockpit, the APU start sequence may disturb the compass reading.

NFCS-01-3420-001-A001AA

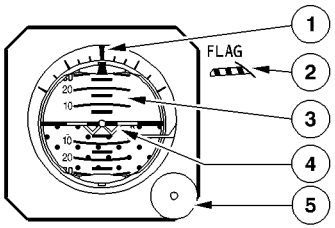


HORIZON

The electric standby horizon normally obtains current from the DC ESS BUS. In the case of a total electrical failure, the horizon remains usable for 5 minutes.

R *Note : When leveling the wings, after performing a small turn of a small bank angle, the*
R *displayed roll attitude may temporarily be incorrect by a few degrees.*

NFCS-01-3420-001-B001AA



(1) Roll scale

The roll scale indicates the bank angle. It has bank angle graduations up to 60°. There is no rotation limit.

(2) Flag

The flag appears if the instrument fails or if power supply fails.

(3) Pitch scale

The pitch scale indicates the pitch attitude. It can show pitch angle up to ± 85°.

(4) Aircraft reference

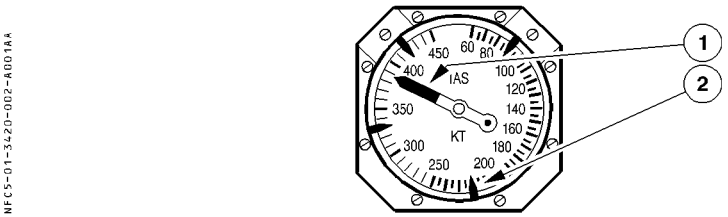
Fixed symbol.

(5) Caging knob

The flight crew pulls it out to reinitialize the gyro, and to level and center the horizon. (The airplane should be level during this procedure).

R *Note : After low-rate turns, the standby horizon may not give accurate indications. To*
R *correct this behavior, use the caging knob when the aircraft is level.*

AIRSPEED INDICATOR

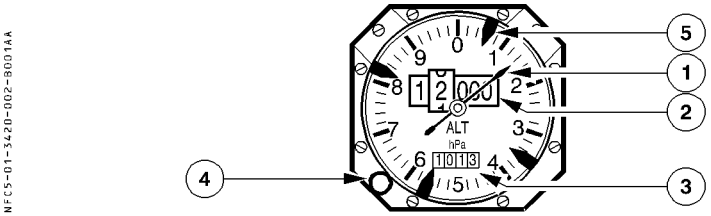


(1) Airspeed pointer

(2) Airspeed bugs (4)

For marking airspeed references.

ALTIMETER



(1) Altitude pointer

(2) Altitude counter (feet)

(3) Altimeter setting

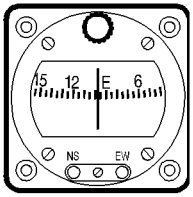
Displays the pressure setting in hPa.

COMPASS

There is a compass located is on top of the windshield center post.
The deviation card is located above the compass.

Note : Because of the location of the APU power on contactor in the cockpit, the APU start sequence may disturb the compass reading.

NFCS-01-3420-001-A100AA

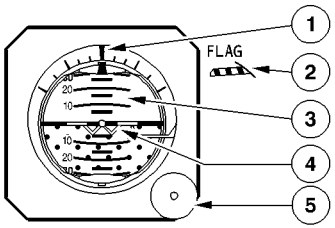


HORIZON

The electric standby horizon is powered by the DC ESS BUS. Backup power is supplied by the HOT BUS 1.

Note : When leveling the wings, after performing a small turn of a small bank angle, the displayed roll attitude may temporarily be incorrect by a few degrees.

NFCS-01-3420-001-B100AA



(1) Roll scale

The roll scale indicates the bank angle. It has bank angle graduations up to 60°. There is no rotation limit.

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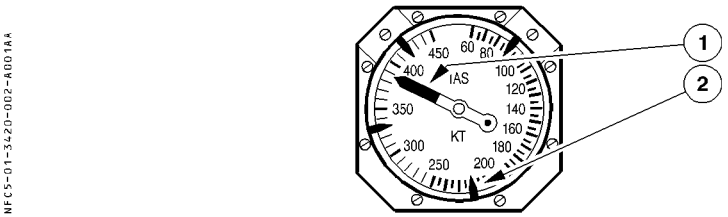
Fixed symbol.

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AIRSPEED INDICATOR

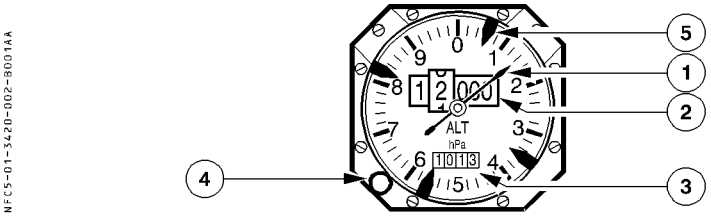


(1) Airspeed pointer

(2) Airspeed bugs (4)

For marking airspeed references.

ALTIMETER



(1) Altitude pointer

(2) Altitude counter (feet)

(3) Altimeter setting

Displays the pressure setting in hPa.

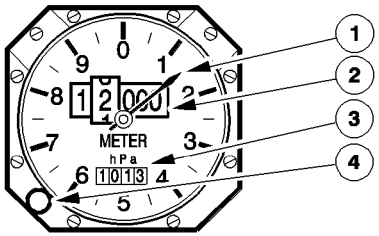
(4) Altimeter setting knob

(5) Altitude bugs (4)

For marking of altitude references.

ALTIMETER (in meter)

NFC5-01-3420-003-A100AA



(1) Altitude pointer

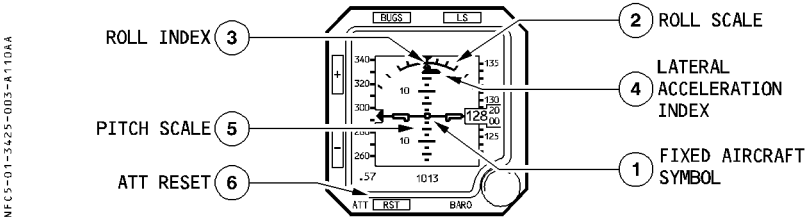
(2) Altitude counter (meter)

(3) Altimeter setting

Display pressure setting in hPa

(4) Altimeter setting knob

ATTITUDE



(1) Fixed aircraft symbol

The fixed aircraft symbol is in black, and outlined in yellow.

(2) Roll scale

The roll scale is in white.
The markers are at 0 (small yellow triangle), 10, 20, 30, 45, 60 degrees of bank.

(3) Roll index

The roll index indicates the bank angle. It is in black, and outlined in white.

(4) Lateral acceleration index

Lateral acceleration index indicates the aircraft's lateral acceleration. It is represented by a trapezoidal index that moves beneath the roll index.

(5) Pitch scale

The pitch scale indicates the aircraft attitude, and it is in white. The scale has markers every 2.5 degrees, between 30 degrees nose up and 30 degrees nose down. If the pitch exceeds 30 degrees, large (V-shaped) red arrowheads indicate that the attitude is excessive. They also indicate the direction to follow, to resume normal attitude. The minimum displayed pitch scale is – 17.5 degrees + 15 degrees at 0 degrees pitch.

(6) ATT RST pushbutton

Attitude indication is reset, by pressing "ATT RST" for at least 2 seconds. The aircraft must be level during this procedure. During the reset time (approx. 10 seconds), the "ATT 10s" message is displayed on the screen. "ATT RST" is also used to realign the system, if excessive aircraft movement is detected during the alignment phase, or after 350 hours of continuous electrical supply.

TUNING

The FMGC is the basic means for tuning navaids.
Three modes of tuning are available.

AUTOMATIC TUNING

In normal operation, the FMGC tunes navaids automatically, with each FMGC controlling its own receivers.
If one FMGC fails, the remaining one controls both sides receivers.

MANUAL TUNING

The crew can use the MCDU to override the FMGC's automatic selection and tuning of navaids and select a specific navaid for visual display.
This does not affect the automatic function of the FMGC. Any entry on one MCDU is sent to both FMGC in dual mode, or the remaining FMGC in single.

BACK UP TUNING

If both FMGCs fail, the flight crew can use the RMPs (Radio Management Panels 1 and 2) on the pedestal for back up tuning.

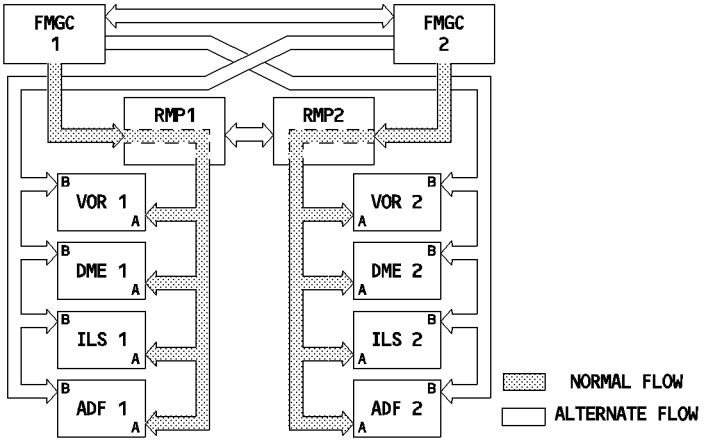
R The CAPT RMP controls VOR 1 and ADF 1 ◁.

R The F/O RMP controls VOR 2 and ADF 2 ◁.

Either RMP controls both ILSs (provided NAV back up is selected on RMP 1 and RMP 2).
RMP 3 (if installed) is not used for navaids tuning.

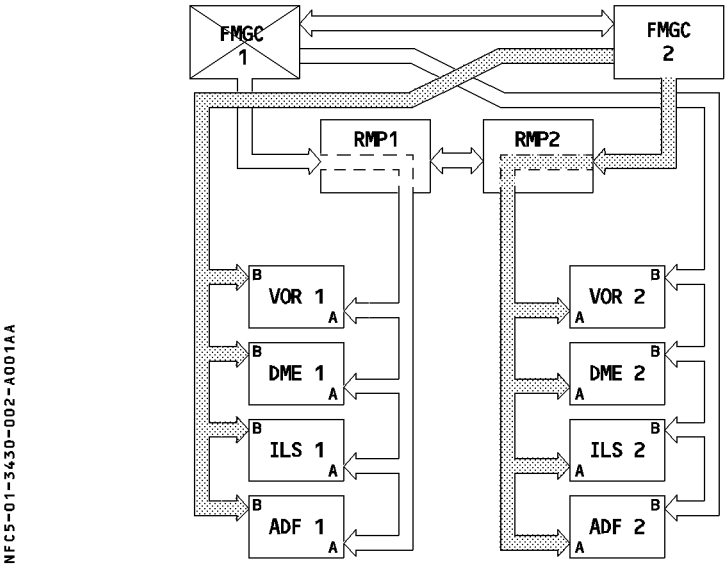
ARCHITECTURE

Normal operation



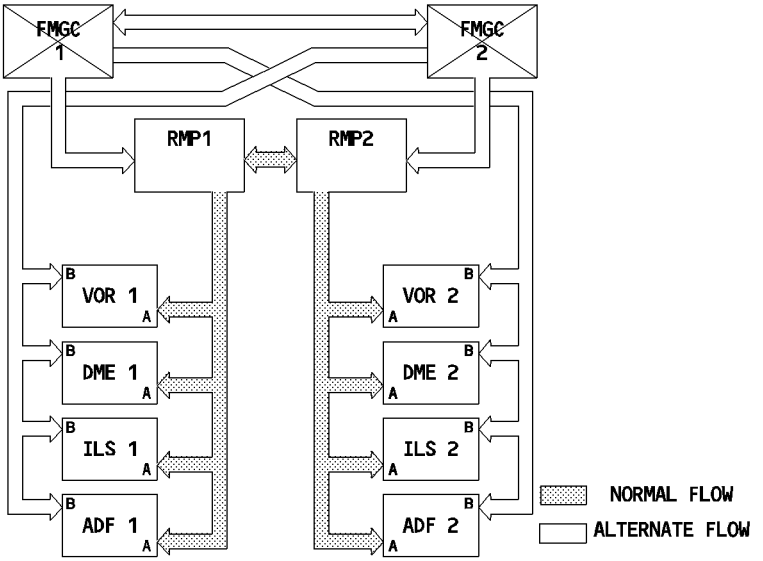
NFCS-01-3430-001-A001AA

FMGC 1 failure



NFC5-01-3430-002-A001AA

Back up tuning



NFC5-01-3430-002-B001AA

NAVAIDS

VOR

The aircraft has two VOR receivers.
(For tuning instructions, refer to the TUNING paragraph).
- The Navigation Displays (NDs) show VOR1 and VOR2 information, in accordance with the position of the ADF/VOR selectors on the EFIS control panel (refer to 1.31).
- The DDRMI on the center panel also displays VOR1 and VOR2 bearings, if the heading signal is valid.

ILS

The aircraft has two ILS receivers. Each ILS receiver is integrated in a modular avionics unit called MMR (Multi Mode Receiver) (ILS1 receiver in MMR1, ILS2 receiver in MMR2).
(For tuning instructions, refer to the TUNING paragraph).
- PFD1 and ND2 display ILS1 information.
- PFD2 and ND1 display ILS2 information.
- The flight crew can put the same ILS information on each PFD by pressing the LS button on the EFIS control panel (the green bars come on).
- The NDs display ILS information, if the flight crew selects the ROSE LS mode on the EFIS control panel (refer to 1.31).

ADF

The aircraft has two ADF systems.
(For tuning instructions refer to the TUNING paragraph).
- The NDs display ADF information, depending on the position of the ADF/VOR selectors on the EFIS control panel (refer to 1.31).
  The DDRMI ◁ also displays ADF1 and ADF2 bearings, depending on the position of the ADF/VOR selector (on the DDRMI).

DME

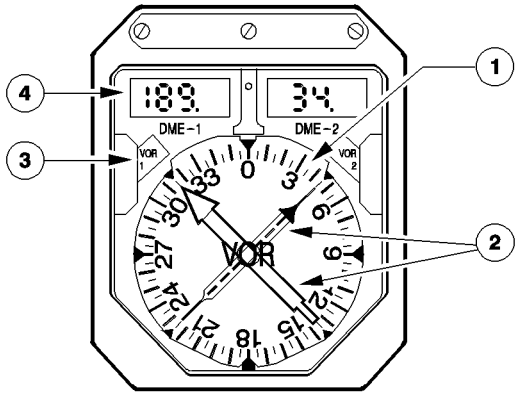
The aircraft has two DMEs.
The frequency that is automatically set on the DME corresponds to the one that is set on the VOR or ILS.
The NDs and the DDRMI can display VOR DME information, and the PFDs can display ILS DME information (refer to 1.31).

MARKER BEACON

One marker beacon system is included in VOR receiver 1.
The PFD displays the outer, middle, and inner marker signals (refer to 1.31).

CONTROLS AND INDICATORS

DIGITAL DISTANCE AND RADIO MAGNETIC INDICATOR (DDRMI)



NFC5-01-3430-004-A001AA

(1) Compass card

ADIRU 1 normally supplies the signal that positions the compass card. ADIRU3 supplies it when selected by the ATT HDG SWITCHING selector.

(2) Bearings pointers

Indicate the magnetic bearing to the station received by VOR 1 (dashed pointer) and VOR 2 (double pointer).

Note : Depending on the quality of the VOR beacon's signal, and mainly at distances greater than 25 NM from the station, the processing of the signal, on aircraft equipped with COLLINS or BENDIX VOR may lead to bearing pointer oscillations.

(3) VOR 1(2) flags

The indicators display these flags if :
- the VOR receiver fails
- the RMI has an internal failure
- the heading signal from ADIRS is not valid
- the power supply fails.

As long as the flag shows, the relevant pointer remains at the last valid position.

(4) DME 1(2) counters

The counters indicate distances in NM and 1/10th at less than 20 NM.
At less than 1 NM, 0 is shown.

NAVAIDS

VOR

The aircraft has two VOR receivers.
(For tuning instructions, refer to the TUNING paragraph).
- The Navigation Displays (NDs) show VOR1 and VOR2 information, in accordance with the position of the ADF/VOR selectors on the EFIS control panel (refer to 1.31).
- The DDRMI on the center panel also displays VOR1 and VOR2 bearings, if the heading signal is valid.

ILS

The aircraft has two ILS receivers. Each ILS receiver is integrated in a modular avionics unit called MMR (Multi Mode Receiver) (ILS1 receiver in MMR1, ILS2 receiver in MMR2).
(For tuning instructions, refer to the TUNING paragraph).
- PFD1 and ND2 display ILS1 information.
- PFD2 and ND1 display ILS2 information.
- The flight crew can put the same ILS information on each PFD by pressing the LS button on the EFIS control panel (the green bars come on).
- The NDs display ILS information, if the flight crew selects the ROSE LS mode on the EFIS control panel (refer to 1.31).

ADF

The aircraft has two ADF systems.
(For tuning instructions refer to the TUNING paragraph).
- The NDs display ADF information, depending on the position of the ADF/VOR selectors on the EFIS control panel (refer to 1.31).
  The DDRMI ◁ also displays ADF1 and ADF2 bearings, depending on the position of the ADF/VOR selector (on the DDRMI).

DME

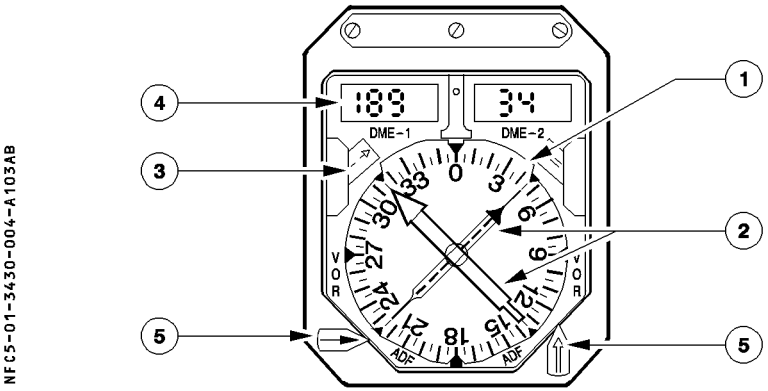
The aircraft has two DMEs.
The frequency that is automatically set on the DME corresponds to the one that is set on the VOR or ILS.
The NDs and the DDRMI can display VOR DME information, and the PFDs can display ILS DME information (refer to 1.31).

MARKER BEACON

One marker beacon system is included in VOR receiver 1.
The PFD displays the outer, middle, and inner marker signals (refer to 1.31).

CONTROLS AND INDICATORS

R **DIGITAL DISTANCE AND RADIO MAGNETIC INDICATOR (DDRMI)**



(1) Compass card

ADIRU 1 normally supplies the signal that positions the compass card. ADIRU3 supplies it when selected by the ATT HDG SWITCHING selector.

(2) Bearings pointers

Indicate the magnetic bearing to the station received by VOR 1 or ADF 1 (dashed pointer) and VOR 2 or ADF 2 ◁ (double pointer).

Note : Depending on the quality of the VOR beacon signal, and mainly at distances greater than 25 NM from the station, the processing of the signal, on aircraft equipped with COLLINS or BENDIX VOR may lead to bearing pointer oscillations.

(3) VOR/ADF flags

The indicators display these flags if :
- the VOR or ADF receiver fails (VOR/ADF selector position indicates the failed receiver)
- the RMI has an internal failure
- the heading signal from ADIRS is not valid
- the power supply fails.

As long as the flag shows, the relevant pointer moves into horizontal position.

(4) DME 1(2) counters

The counters indicate distances in NM and 1/10th at less than 20 NM.
At less than 1 NM, 0 is shown.

INTENTIONALLY LEFT BLANK

INTENTIONALLY LEFT BLANK

(5) VOR/ADF sel

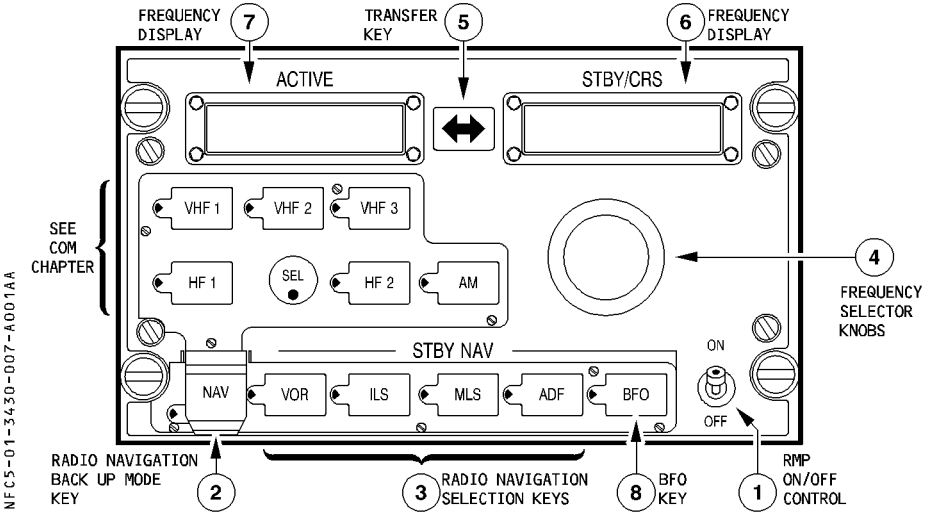
– VOR 1 or ADF 1 on the dashed pointer.

R – VOR 2 or ADF 2 (◁ ; if not installed, then ADF 1) on the double pointer.

INTENTIONALLY LEFT BLANK

RADIO MANAGEMENT PANEL (RMP)

R



(1) ON/OFF sw

This switch controls the power supply to the panel.

(2) NAV key (transparent switchguard)

- Pressing this key engages the radio navigation backup mode. It takes control of the VOR, ILS, MLS, and ADF (◁) receivers away from the FMGC and gives it to the RMP.
- The green monitor light comes on.
- Pressing the NAV key a second time returns control of the navigation radios to the FMGC.

Note :
- *The flight crew must select this backup tuning mode on both RMP1 and RMP2 if both FMGCs or both MCDUs fail. In the emergency electrical configuration, only RMP1 receives power.*
- *Pressing the NAV key on RMP3 (if installed) has no effect.*
- *In the NAV backup mode, the flight crew can select radio communication systems as it would in the normal mode.*
  Setting one RMP to NAV backup mode removes navaids tuning from both FMGCs.
- *When the flight crew uses an RMP to turn an ILS/DME, the PFDs do not display the DME distance.*

③ STBY NAV keys

When the NAV key is on and the flight crew presses one of these STBY NAV keys, the ACTIVE window displays the frequency to which that receiver is tuned. The green monitor light on the selected key comes on, and the one on the previously selected STBY NAV or COM key goes out.

④ Frequency selector knob

Two concentric knobs allow the flight crew to preselect frequencies for communication radios and stand-by navigation systems and select courses for VOR and ILS.
The desired frequency or course is set in the STBY/CRS window.
– setting frequency :
The outer knob controls the most significant digits, the inner knob controls the least significant digits. A rate multiplier speeds up the tuning when the knob is rotated rapidly.
– setting course :
Selected by inner knob only.

⑤ Transfer key

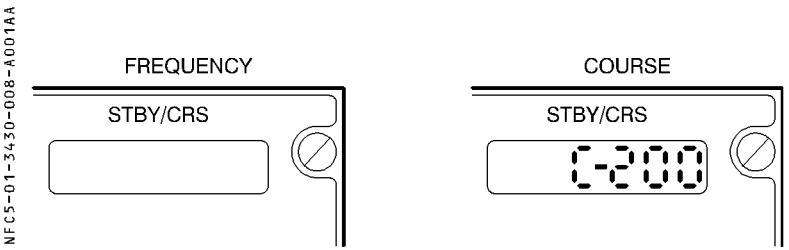
The flight crew presses this key to interchange ACTIVE and STBY frequencies. This action tunes the selected receiver to the new ACTIVE frequency.

⑥ STBY/CRS window

The flight crew can make the frequency displayed in this window become the active frequency by pressing the transfer key, or change it by rotating the tuning knob.
If this window displays a course, then the ACTIVE window displays the associated frequency.

Note : If the STBY/CRS window is displaying a course, then pressing the transfer key displays the active frequency in both windows.

R



(7) ACTIVE window

This window displays the frequency of the selected navaid, which is identified by a green monitor light on the selection key.

(8) BFO key

Pressing this key activates the BFO (Beat Frequency Oscillator), if the ADF receiver is selected.
The green monitor light comes on.
R For most ADF, with BFO activated, the audio identification is heard. However there are
R some ADF where the BFO must be deactivated in order to hear the audio identification.

DESCRIPTION

The aircraft has two radio altimeters.
Normally, the CAPT's PFD displays the RA1 height, and the F/O's PFD displays the RA2 height. If either radio altimeter fails, both PFDs display the height from the remaining one.

INDICATIONS ON PFD

(Refer to 1.31).

AUTOMATIC CALLOUT

The FWC generates a synthetic voice for radio height announcement below 2500 feet. These announcements come through the cockpit loudspeakers, even if the speakers are turned off.

Predetermined callout

The altitude callout uses the following predetermined threshold :

Height (feet)	Callout
2500	TWO THOUSAND FIVE HUNDRED OR TWENTY FIVE HUNDRED
2000	TWO THOUSAND
1000	ONE THOUSAND
500	FIVE HUNDRED
400	FOUR HUNDRED
300	THREE HUNDRED
200	TWO HUNDRED
100	ONE HUNDRED
50	FIFTY
40	FORTY
30	THIRTY
20	TWENTY
10	TEN
5	FIVE
DH (or MDA/MDH) + 100	HUNDRED ABOVE
DH (or MDA/MDH)	MINIMUM

Note : The reference altitude for callouts is the radio altitude for precision approaches (DH), and baro altitude (MDA/MDH) for non precision approaches.

Pin programming enables Operators to select the required callouts. If the aircraft remains at a height that is in the detection zone for a height callout, the corresponding message is repeated at regular intervals.

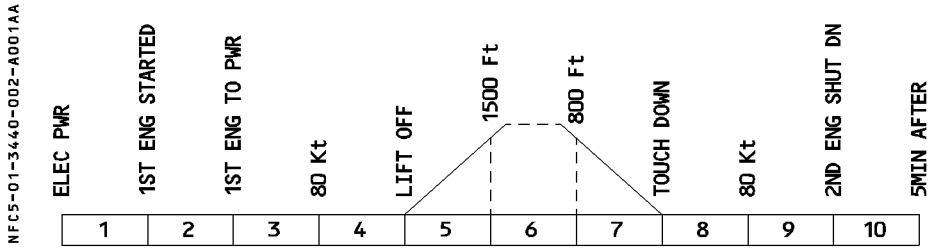
Intermediate call out

If time between two consecutive predetermined call outs exceeds a certain threshold, the present height is repeated at regular intervals.
The threshold is : 11 seconds above 50 feet
4 seconds below 50 feet
The repeating interval is 4 seconds.

RETARD announcement

The loudspeaker announces RETARD at 20 feet or at 10 feet if autothrust is active and one autopilot is in LAND mode.

WARNINGS AND CAUTIONS



E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
RA 1 (2) FAULT	SINGLE CHIME	MASTER CAUT	NIL	NIL	3, 4 5, 8

DESCRIPTION

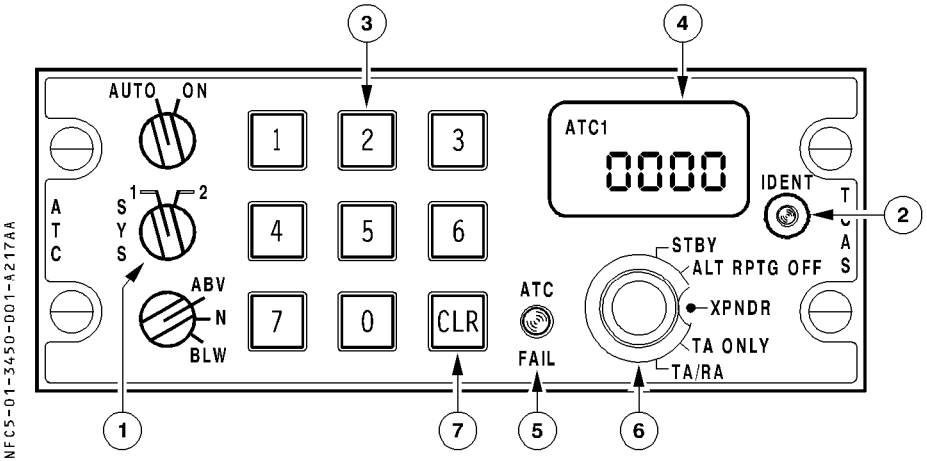
The aircraft has two ATC transponders which are controlled by a dual control box on the center pedestal.
Only the selected ATC transponder operates.
The associated ADIRS (1 for transponder 1, etc ...) supplies the altitude for altitude reporting.
The ATC transponder is capable of enhanced surveillance : It transmits the following parameters upon ground request :

- Indicated airspeed, Mach number, and baro vertical speed, that are all supplied by the ADRs.
- Magnetic heading, roll angle, ground speed, track angle, track angle rate, and inertial vertical speed, that are all supplied by the IRs.
- Selected altitude and barometric reference settings supplied by the FCUs.

In the case of an ADR (1 or 2) failure, ADR 3 replaces the faulty ADR, when the AIR DATA SWITCHING Selector is set to CAP on 3 or F/O on 3.
IR/FCU parameters are only transmitted to :

- ATC 1 by IR 1/FCU 1
- ATC 2 by IR 2/FCU 2

CONTROL PANEL



(1) XPNDR sel

This switch selects transponder 1 or 2.

(2) Mode sel

IDENT sw The flight crew presses this button to send the aircraft identification signal.

(3) Pushbuttons

Set(s) the code that is assigned by the ATC.

(4) Code display

This window displays the selected code.

(5) ATC FAIL light

This light comes on, if the selected Transponder fails.

(6) Mode selector

STBY : The two ATC Transponders and the TCAS are electrically-supplied, but are not operating.
ALT RPTG OFF : No altitude data is transmitted.
XPNDR : – On ground : The selected ATC Transponder only operates in the selective aircraft interrogation mode of Mode S.
– In flight : The selected ATC Transponder operates.
Baro altitude data is transmitted.
ATC 1 uses ADR 1 or ADR 3. ATC 2 uses ADR 2 or ADR 3.
The TCAS is on standby.
TA ONLY/TA/RA : Refer to 1.34.80.

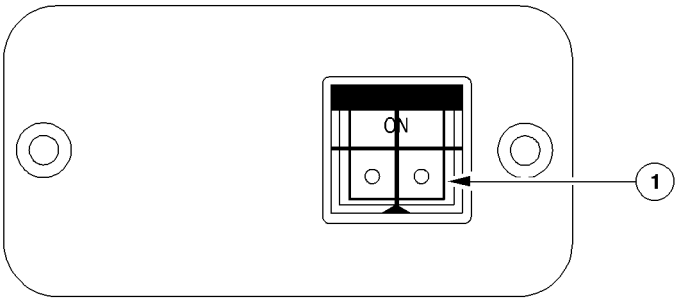
(7) CLR pushbutton

This pushbutton clears the code display.

Note : The previous code remains, until a new four-digit code is entered.

REMOTE ATC BOX

This control panel enables the crew to easily and rapidly inform the ATC of an hijacking situation. By pushing one of the two pushbuttons, the crew causes the transponder 1 to emit the Hijacking code (7500) via the remote ATC box supplied by a secured power source.



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(1) ATC hijacking alert pushbutton ON light

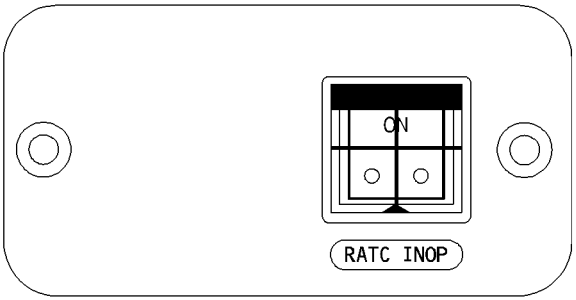
ON : One of the two pushbuttons has been pressed, Transponder 1 continuously emits the hijacking code. Transponder 2 is on standby.
Off : The automatic hijacking mode has not been activated, or has been activated but Transponder 1 is failed.

Note : When activated, the hijacking mode can only be reset on ground, with the aircraft de-energized, for at least three seconds ; it is not possible to reset it in flight.
When the hijacking mode is activated, the TCAS is forced to TA only mode, to avoid any collision due to the crew's incapacity to perform any maneuver.

CAUTION
Do not use the ATC hijacking alert pushbutton without hijacking threat.

REMOTE ATC BOX

This control panel enabled the crew to easily and rapidly inform the ATC of a hijacking situation. When one of the two pushbuttons was pressed, Transponder 1 emitted the Hijacking code (7500) via the remote ATC box that was powered by a secured power source.
This function is now deactivated.



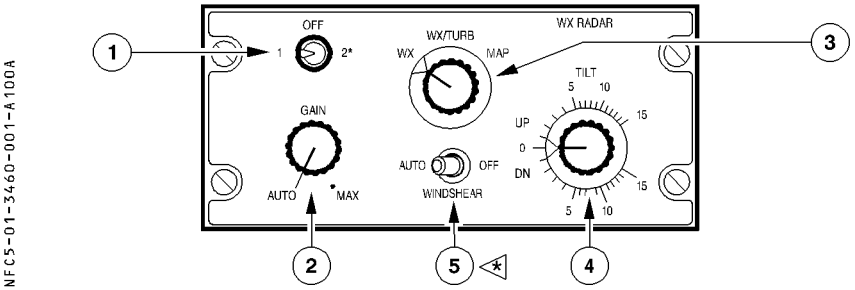
NFCS-01-3450-003-A205AA

DESCRIPTION

The aircraft has two weather radar systems. Only one transceiver is working at a time. It can display the weather image on the ND, in any ND mode except PLAN.
Each pilot may remove the weather image from his ND by setting the associated brightness control to the minimum (refer to 1.31).

R *Note : Some aircraft may be fitted with one weather radar system only.*

CONTROL PANEL



* If only one radar system is installed, "2" is replaced by an "INOP" sticker.

(1) Transceiver 1-2 sel

This switch allow to select one radar or to turn both radars to off.

R *Note : When one radar only is fitted on aircraft, no weather image will be displayed*
R *when switching on system 2.*

(2) GAIN knob

This knob adjusts the sensitivity of the receiver in all modes.
AUTO automatically adjusts the gain to the optimum setting.

(3) Mode sel

WX : Weather mode : colors indicate the intensity of precipitation (black for the lowest intensity, green, amber and red indicating progressively higher intensities).
WX / TURB : The screen shows turbulence areas (in precipitation areas) in magenta (within 40 NM).
MAP : Radar operates in ground mapping mode : black indicates water, green ground and amber cities and mountains.

④ TILT knob

This knob controls antenna tilt.

R Radar 1 depends on ADIRS 1, radar 2 ◁ on ADIRS 2. ADIRS 3 replaces either ADIRS if
R ATT HDG selector is used.
Zero represents the horizon as seen by ADIRS.

R ⑤ WINDSHEAR sw ◁ (operative only if the predictive windshear function is embodied)

R AUTO : Predictive windshear function is activated : windshear areas are detected by
R the antenna scanning below 2300 feet RA, even if the transceiver 1-2
R selector is set to OFF, and displayed on the ND if below 1500 feet.
R OFF : No predictive windshear function.

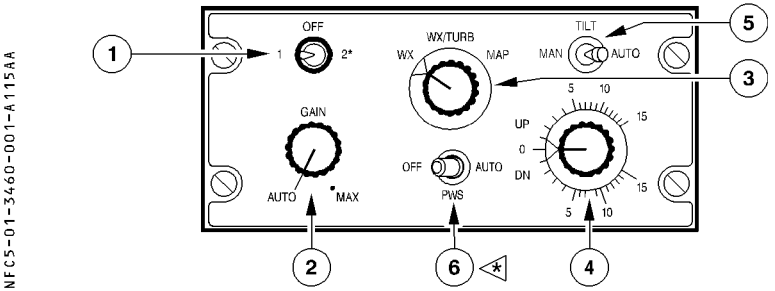
DESCRIPTION

The aircraft has two weather radar systems. Only one transceiver works at a time.
It can display the weather image on the ND, in any ND mode except PLAN.
Each pilot may remove the weather image from their ND, by setting the associated brightness control to the minimum (Refer to 1.31).

Note : Some aircraft may be fitted with only one weather radar system only.

CONTROL PANEL

R



(1) Transceiver 1-2 switch

This switch selects one radar or turns off both radars.

Note : If there is only one radar on the aircraft, no weather image is displayed when system 2 is switched on.

(2) GAIN knob

Adjusts the sensitivity of the receiver in all modes.
AUTO : Automatically adjusts the gain to the optimum setting.

(3) Mode selector

WX : Weather mode : colors indicate the intensity of precipitation (Black indicates the lowest intensity. Green, amber and red indicate progressively higher intensities).
WX / TURB : The screen shows turbulence areas (in precipitation areas) in magenta (within 40 NM).
MAP : The radar operates in ground mapping mode. Black indicates water. Green indicates the ground and Amber indicates cities and mountains.

(4) TILT knob

This knob controls the antenna tilt.
Radar 1 depends on ADIRS 1. Radar 2 ◁ depends on ADIRS 2. ADIRS 3 replaces either one of the ADIRS, if ATT HDG selector is set to CAPT 3 or F/O 3.
Zero represents the horizon as seen by the ADIRS.

(5) TILT toggle switch

AUTO : Automatically selects tilt to optimize weather detection and minimize ground clutter.
MAN : When set to MAN, the crew can then manually adjust the tilt by using the TILT knob.

(6) PWS sw ◁ (operative only if the predictive windshear function is embodied)

AUTO : Predictive windshear function is activated : windshear areas are detected by the antenna scanning below 2300 feet RA, even if the SYS switch is set to OFF, and displayed on the ND if below 1500 feet.
OFF : No predictive windshear function.

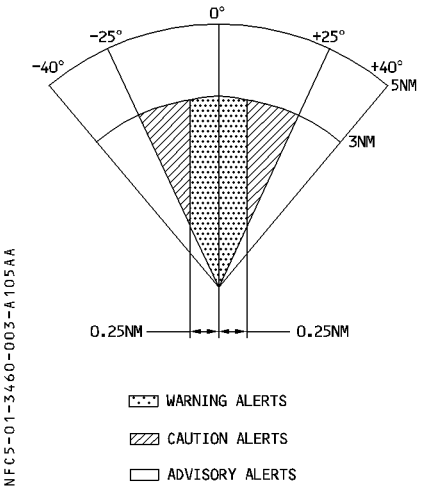
WINDSHEAR PREDICTION FUNCTION

The weather radars have a Predictive Windshear System (PWS) that operates when :
- The PWS switch is in the AUTO position (Even if the weather radar is turned OFF), and
- The aircraft is below 2300 feet AGL, and
- The ATC is switched to the ON, or AUTO, or XPDR, or XPNDR, position (depending on the ATC panel), and
- Either engine is running.

Note : When two weather radars are installed, if the selected weather radar fails, the PWS function is recovered by selecting the non-failed weather radar on the control panel.

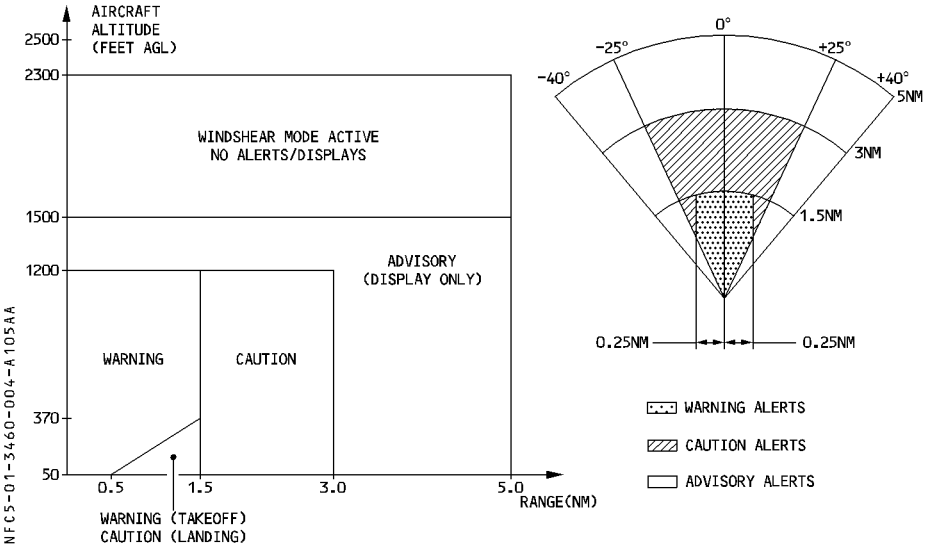
The system scans the airspace, within a range of 5 NM ahead of the aircraft, for windshears. Below 1500 feet, when the system detects windshear, depending on the range selected on the ND, a warning, caution, or advisory message appears on the ND. Predictive windshear warnings and cautions are associated with an aural warning.

WINDSHEAR ALERTS during takeoff roll, up to 100 knots



During the takeoff roll, up to 100 knots, both warnings and cautions are available within a range of 3 NM.

WINDSHEAR ALERTS above 50 feet



During final approach, the visual and aural warning alerts are downgraded to caution alerts between 370 feet AGL and 50 feet AGL, and range between 1.5 NM and 0.5 NM.

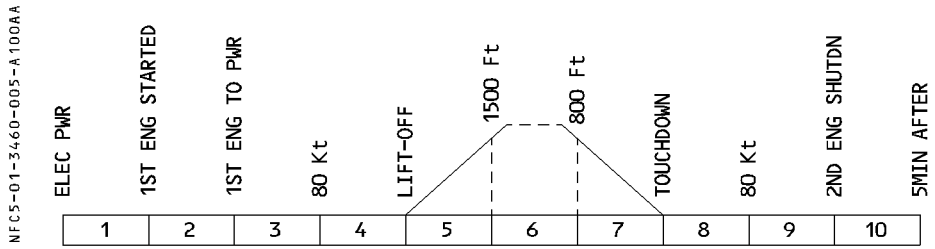
WINDSHEAR ALERTS inhibition

At takeoff, alerts are inhibited above 100 knots and up to 50 feet. During landing, alerts are inhibited below 50 feet.

Alert Level	Aural Warning	PFD	ND (refer to 1.31.45)
Warning (Approach)	«GO AROUND WINDSHEAR AHEAD»	W/S AHEAD (red)	Windshear icon
Warning (Takeoff)	«WINDSHEAR AHEAD» (twice)	W/S AHEAD (red)	Windshear icon
Caution	«MONITOR RADAR DISPLAY»	W/S AHEAD (amber)	Windshear icon
Advisory	Nil	Nil	Windshear icon

The aural alerts of the Predictive Windshear System (PWS) :
- Have priority over TCAS, GPWS, and other FWC aural warnings
- Are inhibited by windshear detection, via the FAC, stall warnings and aural messages.

WARNINGS AND CAUTIONS



E/WD : FAILURE TITLE Conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
PRED. W/S DET FAULT	SINGLE CHIME	MASTER CAUTION	NIL	NIL	3, 4, 5, 8

MEMO DISPLAY

The "PRED W/S OFF" message appears, when windshear is set to OFF on the weather radar panel.
The "PRED W/S OFF", message appears in green during fligth phases 1, 2, 6 and 10.
It appears in amber :
- In flight phases 3, 4, 5, 7, 8, and 9
- When the T.O. CONFIG pushbutton is pressed during phase 2.

DESCRIPTION

The Ground Proximity Warning System (GPWS) generates aural and visual warnings, when one of the following conditions occurs between radio altitudes 30 and 2450 feet.

- Mode 1 : Excessive rate of descent.
- Mode 2 : Excessive terrain closure rate.
- Mode 3 : Altitude loss after takeoff, or go-around.
- Mode 4 : Unsafe terrain clearance when not in landing configuration.
- Mode 5 : Too far below glideslope.

In addition to the basic GPWS functions, the GPWS has an enhanced function (EGPWS) which provides, based on a worldwide terrain database :

- A Terrain Awareness Display (TAD), which predicts the terrain conflict, and displays the terrain on the ND.
- A Terrain Clearance Floor (TCF), which improves the low terrain warning during landing.

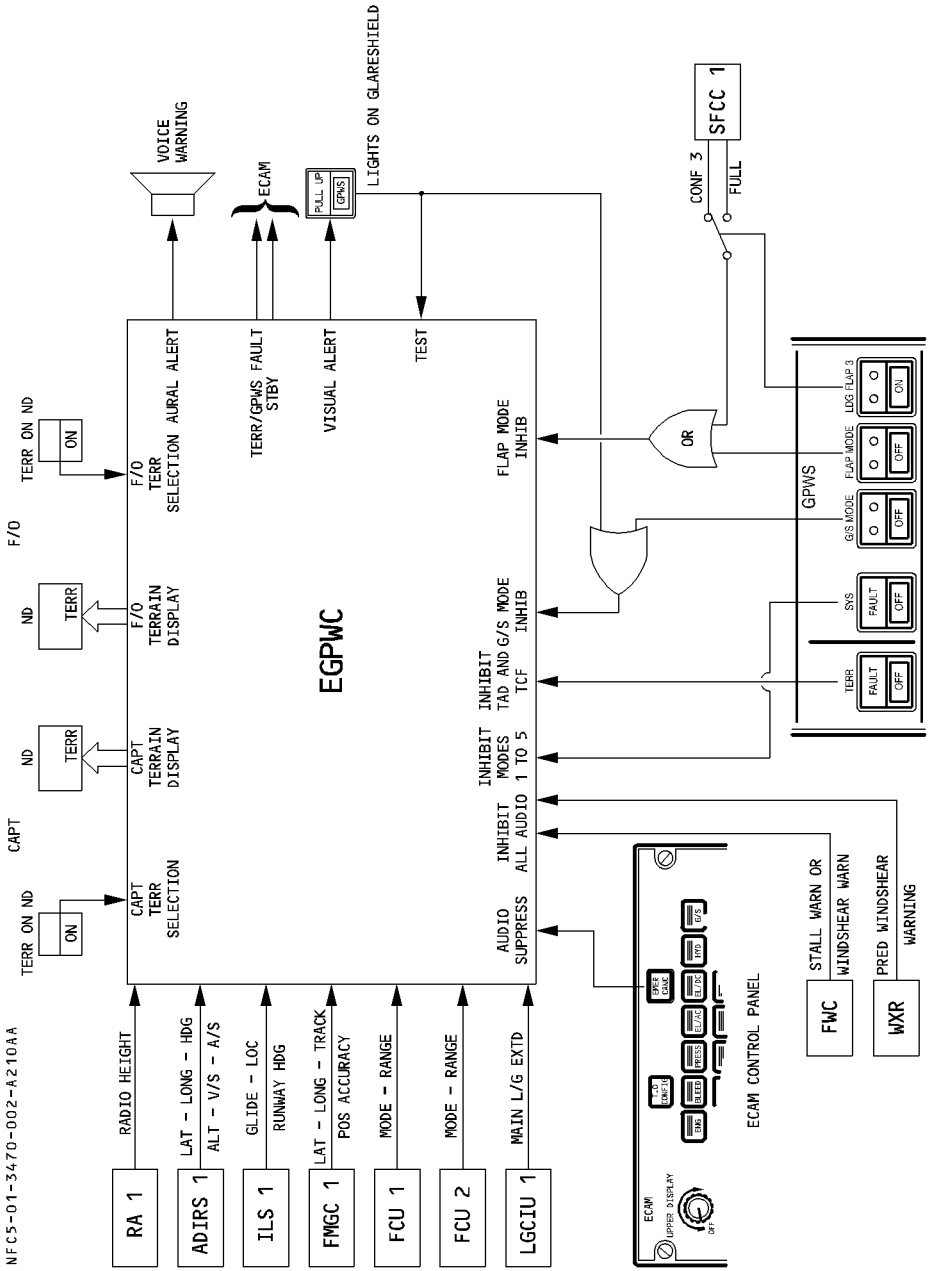
The EGPWS uses the geometric altitude. The geometric altitude is calculated by means of a specific algorithm that uses the following as inputs : The pressure altitude, GPS altitude, radio altitude, and data from the terrain database.

The cockpit loudspeakers broadcast, even if turned off, the aural warning or caution messages associated with each mode. The audio volume of these messages is not controlled by the loudspeaker volume knobs. (These knobs only allow volume adjustment for radio communication).

PULL UP or GPWS lights, on the Captain and First Officer instrument panels, come on to give a visual warning depending on the engaged GPWS mode.

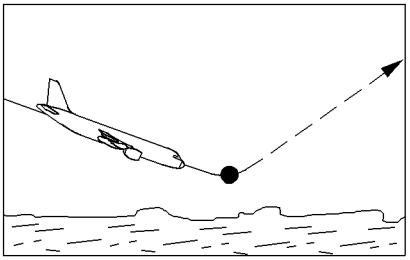
Note : A number of airports throughout the world have approaches or departures that are not entirely compatible with standard GPWS operation. These airports are identified in the envelope modulation database, in such a way that, when the GPWS recognizes such an airport, it modifies the profile to avoid nuisance warnings.

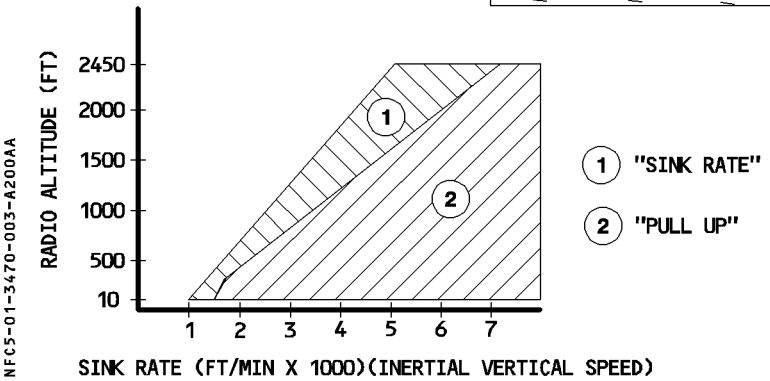
FOR INFO


NFC5-01-3470-002-A210AA
RA 1
ADIRS 1
ILS 1
FMGC 1
FCU 1
FCU 2
LGCIU 1
RADIO HEIGHT
LAT - LONG - HDG
ALT - V/S - A/S
GLIDE - LOC
RUNWAY HDG
LAT - LONG - TRACK
POS ACCURACY
MODE - RANGE
MODE - RANGE
MAIN L/G EXTD
EGPWC
CAPT TERR SELECTION
AUDIO SUPPRESS
INHIBIT ALL AUDIO
INHIBIT MODES 1 TO 5
INHIBIT TAD AND G/S MODE INHIB
INHIBIT TCF
FLAP MODE INHIB
F/O TERR SELECTION AURAL ALERT
F/O TERRAIN DISPLAY
CAPT TERRAIN DISPLAY
TERR/GPWS FAULT STBY
VISUAL ALERT
TEST
TERR ON ND
ON
CAPT
F/O
ND
TERR
VOICE WARNING
ECAM
PULL UP
GPWS
LIGHTS ON GLARESHIELD
SFCC 1
CONF 3
FULL
OR
GPWS
TERR
SYS
G/S MODE
FLAP MODE
LDG FLAP 3
FAULT
OFF
ON
ECAM CONTROL PANEL
ECAM
UPPER DISPLAY
FWC
STALL WARN OR
WINDSHEAR WARN
WXR
PRED WINDSHEAR
WARNING

GPWS BASIC MODES

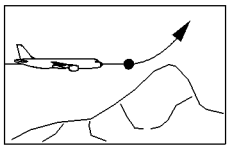
MODE 1: EXCESSIVE RATE OF DESCENT

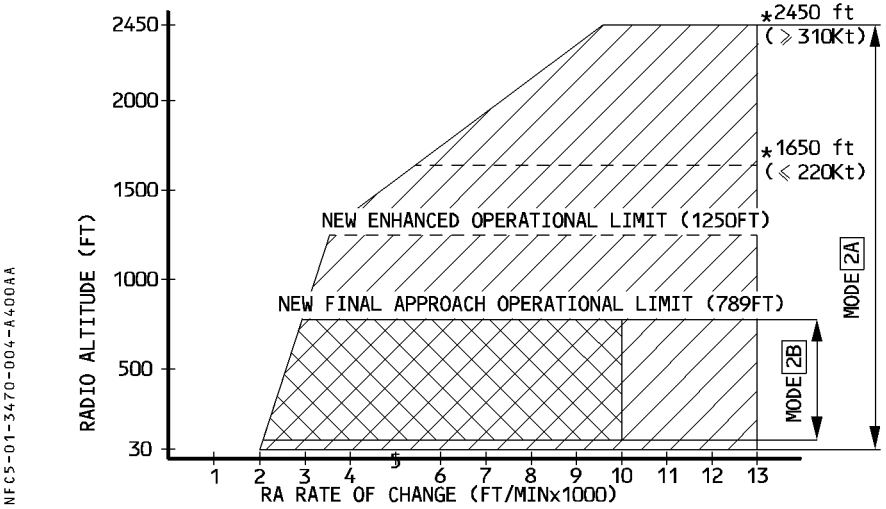




R Mode 1 has two boundaries. Penetration of the first boundary generates a repeated aural alert "SINK RATE" and causes the GPWS lights to come on. Penetration of the second boundary generates a repetitive "PULL UP" and illuminates both PULL UP lights.
The upper cut-off limit is 2450 feet radio altitude.
The lower cut-off limit is 10 feet radio altitude.

MODE 2 : EXCESSIVE TERRAIN CLOSURE RATE





2A — Flaps not in landing configuration, and aircraft not on the glideslope beam.

R Penetration of the boundary causes the GPWS lights to come on, and generates the repeated aural alert: "TERRAIN".

R After "TERRAIN" has sounded twice, the warning switches to "PULL UP", repeated continually until the aircraft leaves the warning envelope. In addition, the PULL UP lights

R come on.

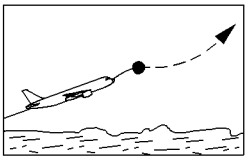
After the aircraft leaves the boundary , the PULL UP lights stay on and the "TERRAIN" aural message persists. These alerts stop when the aircraft increases either the barometric or inertial altitude by 300 feet. If it enters another alert region during this altitude-gain time, then the whole process begins again with a new reference altitude for the 300 feet altitude gain.

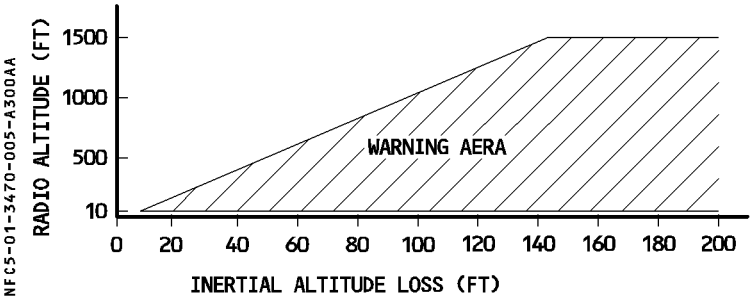
* The upper cut-off limit varies from 1650 to 2450 feet radio altitude, depending on speed (between 220 to 310 knots). At certain airports, the upper boundary may be lowered down to 1250 feet to reduce the warning sensitivity and minimize the nuisance warnings.

The new enhanced operational upper limit is reduced to 1250 feet and to 789 feet in final approach, when the enhanced functions and the Geometric Altitude are of high integrity.

2B — Flaps in landing configuration
Lowering the flaps to the landing position automatically switches GPWS to Mode 2B. In this case lower boundary varies between 200 feet and 600 feet depending on altitude rate. In ILS approach (glide slope deviation $< \pm 2$ dots) the lower boundary is fixed at 30 feet. When the aircraft enters the envelope, the alert is the same as for mode 2A. When gear and flaps are in the landing configuration, the aural message is "TERRAIN " only and is not followed by "PULL UP" if the aircraft remains in the envelope.

MODE 3 : ALTITUDE LOSS AFTER TAKEOFF

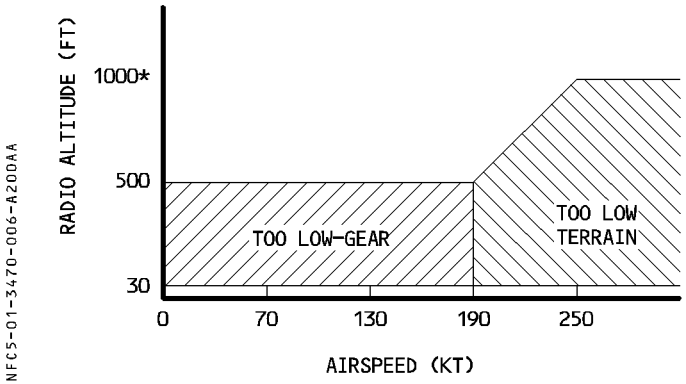




R If the aircraft descends during the initial takeoff climb or during a go around, the GPWS
R lights come on and the aural alert "DON'T SINK" sounds repeatedly.
The lower cut-off limit is 10 feet radio altitude.
Mode 3 is desensitized according to the time accumulated after departure and the radio altitude.

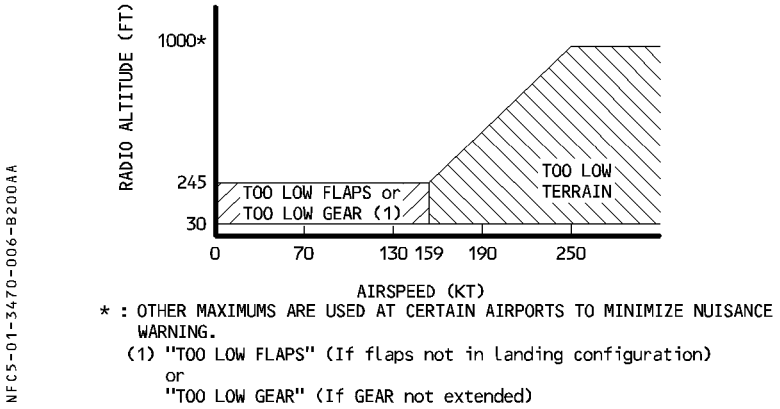
MODE 4 : UNSAFE TERRAIN CLEARANCE WHEN NOT IN LANDING CONFIGURATION

4A - Landing gear up and flaps not in landing configuration.



R Two aural warnings may be triggered, depending on the area : "TOO LOW-GEAR" or "TOO LOW-TERRAIN". In addition, the GPWS lights come on.

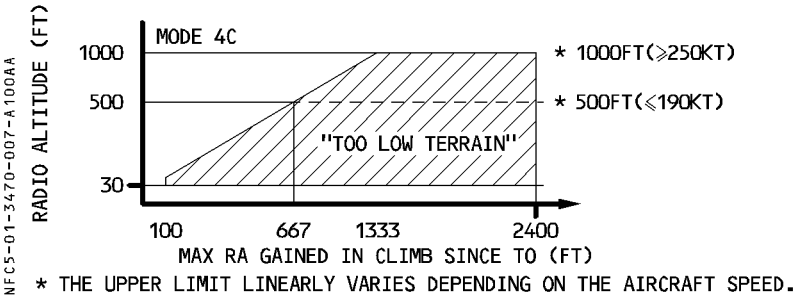
4B - Landing gear down and flaps not in landing configuration or, Landing gear up, and flaps in landing configuration.



R Three aural warnings may be generated, depending on the area and configuration : "TOO LOW-GEAR", "TOO LOW-FLAPS", or "TOO LOW-TERRAIN". In addition, the GPWS lights
R come on.

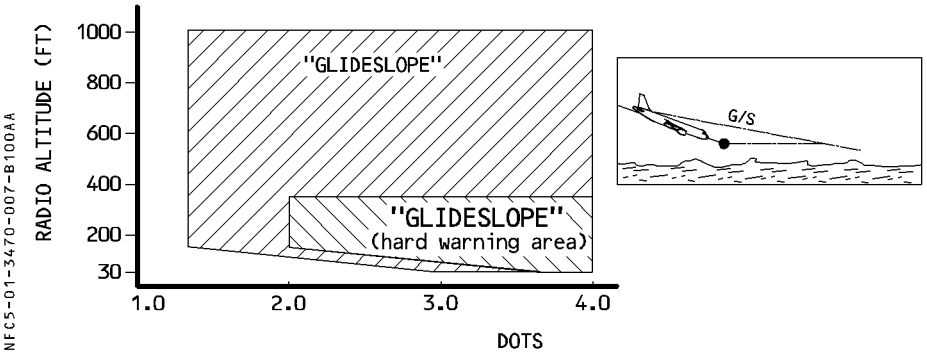
If the enhanced GPWS functions and the geometric altitude are of high integrity, the upper operational limit is reduced to 500 feet. If not, it is only reduced to 800 feet when an overflight is detected.

4C — Landing gear up, or flaps not in landing configuration.



If the aircraft starts an inadvertant controlled flight into the ground, during takeoff and climb, and penetrates the boundary, then the GPWS lights come on, and the "TOO LOW TERRAIN" aural alert sounds repeatedly.

MODE 5 : DESCENT BELOW GLIDESLOPE



Note : Normally, the glideslope alert is only triggered with the gear down. For a few airports, the gear down logic requirement is deleted and other upper limits are used to increase the warning envelope.

R In both areas, the alert is a repeated "GLIDESLOPE" aural message, and the GPWS lights
R come on.

The loudness of the aural message increases, when the aircraft enters the hard warning areas.

The mode is armed, when ILS 1 receives a valid signal.

Pressing the GPWS pushbutton cancels the warning. This is temporary ; the mode is automatically reactivated for a new envelope.

The upper cut-off limit is 1000 feet radio altitude.

The lower cut-off limit is 30 feet radio altitude.

EGPWS FUNCTIONS

TERRAIN AWARENESS AND DISPLAY

The Terrain Awareness and Display (TAD) function computes a caution and a warning envelope in front of the aircraft, depending on the aircraft altitude, the nearest runway altitude, the distance to the nearest runway threshold, the ground speed, and the turn rate. When the boundary of these envelopes conflicts with the terrain, or with an obstacle memorized in the database, the system generates the relevant alert :

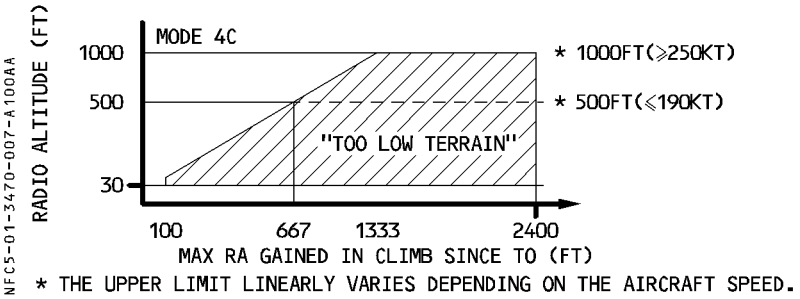
Alert Level	Aural Warning	ND (refer to 1.31.45)	Local Warning
Warning	TERRAIN AHEAD, PULL UP	– Automatic terrain display* – Solid red areas – TERR AHEAD (red)	On each pilot's instrument panel, the pushbutton light comes on.
	OBSTACLE AHEAD, PULL UP	– Automatic terrain display* – Solid red areas – OBST AHEAD (red)	
Caution	TERRAIN AHEAD	– Automatic terrain display* – Solid yellow areas – TERR AHEAD (amber)	
	OBSTACLE AHEAD	– Automatic terrain display* – Solid yellow areas – OBST AHEAD (amber)	

* When the TERR ON ND pushbutton is set to ON, and ARC or ROSE mode is selected, the ND displays the terrain and the obstacles memorized in the database, depending on the aircraft's position. The terrain is displayed in various densitites of green, yellow, red, or magenta, depending on the threat, (See 1.31.45 : INDICATIONS ON ND). If an alert is generated (caution or warning), and TERR ON ND is not selected, the terrain and the obstacles are automatically displayed, and the ON light of the TERR ON ND pushbutton comes on.

Note : 1. When TERR ON ND is selected, the weather radar image is not displayed.
2. The Geometric Altitude function can protect against certain baro setting errors, provided the components used to compute the Geometric Altitude are sufficiently valid and accurate.
3. The TAD and Terrain Clearance Floor (TCF) functions use FMS1 position information to perform their calculations. Therefore, in case of an FMS1 position error, the TAD and TCF will also provide erroneous information and/or warnings.

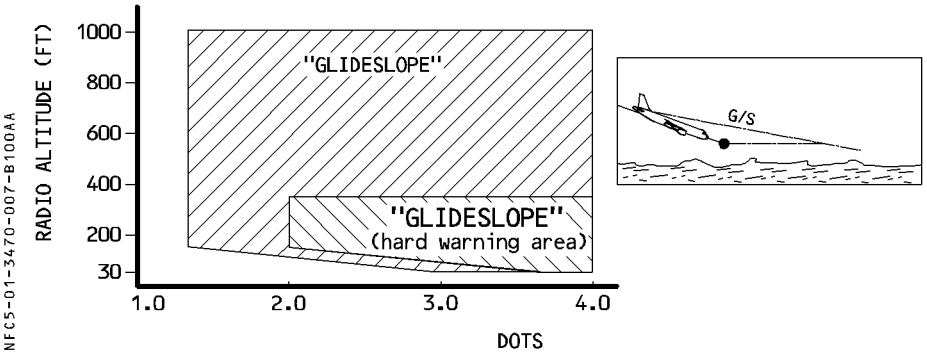
If the crew identifies that navigation accuracy is low, it must set the enhanced modes to off, via the TERR pushbutton. The 5 GPWS modes remain active.

4C — Landing gear up, or flaps not in landing configuration.



If the aircraft starts an inadvertant controlled flight into the ground, during takeoff and climb, and penetrates the boundary, then the GPWS lights come on, and the "TOO LOW TERRAIN" aural alert sounds repeatedly.

MODE 5 : DESCENT BELOW GLIDESLOPE



Note : Normally, the glideslope alert is only triggered with the gear down. For a few airports, the gear down logic requirement is deleted and other upper limits are used to increase the warning envelope.

R In both areas, the alert is a repeated "GLIDESLOPE" aural message, and the GPWS lights
R come on.
The loudness of the aural message increases, when the aircraft enters the hard warning areas.
The mode is armed, when ILS 1 receives a valid signal.
Pressing the GPWS pushbutton cancels the warning. This is temporary ; the mode is automatically reactivated for a new envelope.
The upper cut-off limit is 1000 feet radio altitude.
The lower cut-off limit is 30 feet radio altitude.

EGPWS FUNCTIONS

TERRAIN AWARENESS AND DISPLAY

The Terrain Awareness and Display (TAD) function computes a caution and a warning envelope in front of the aircraft, depending on the aircraft altitude, the nearest runway altitude, the distance to the nearest runway threshold, the ground speed, and the turn rate. When the boundary of these envelopes conflicts with the terrain, or with an obstacle memorized in the database, the system generates the relevant alert :

Alert Level	Aural Warning	ND (refer to 1.31.45)	Local Warning
Warning	TERRAIN AHEAD, PULL UP	– Automatic terrain display* – Solid red areas – TERR AHEAD (red)	On each pilot's instrument panel, the pushbutton light comes on.
	OBSTACLE AHEAD, PULL UP	– Automatic terrain display* – Solid red areas – OBST AHEAD (red)	
Caution	TERRAIN AHEAD	– Automatic terrain display * – Solid yellow areas – TERR AHEAD (amber)	
	OBSTACLE AHEAD	– Automatic terrain display * – Solid yellow areas – OBST AHEAD (amber)	

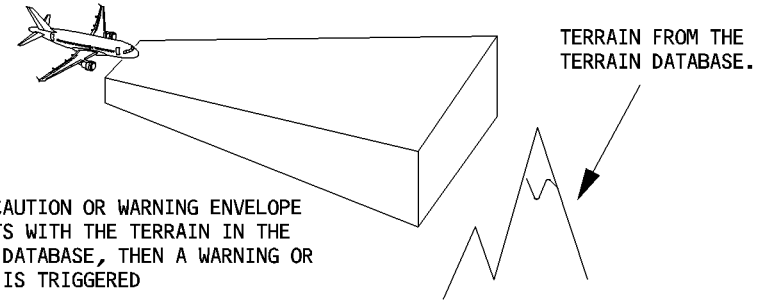
* When the TERR ON ND pushbutton is set to ON, and ARC or ROSE mode is selected, the ND displays the terrain and the obstacles memorized in the database, depending on the aircraft's position. The terrain is displayed in various densitites of green, yellow, red, or magenta, depending on the threat (See 1.31.45 : INDICATIONS ON ND). If an alert is generated (caution or warning), and TERR ON ND is not selected, the terrain and the obstacles are automatically displayed, and the ON light of the TERR ON ND pushbutton comes on.

Note : 1. When TERR ON ND is selected, the weather radar image is not displayed.
2. The Geometric Altitude function can protect against certain baro setting errors, provided the components used to compute the Geometric Altitude are valid and accurate enough.
3. The TAD and Terrain Clearance Floor (TCF) functions operate using the pure lateral GPS position and, the FMS 1 position as backup.

In case of low accuracy of the aircraft position computed by the EGPWS, the enhanced modes of the EGPWS are automatically deactivated. The five GPWS modes remain active.

TERRAIN CAUTION AND WARNING ENVELOPE

R

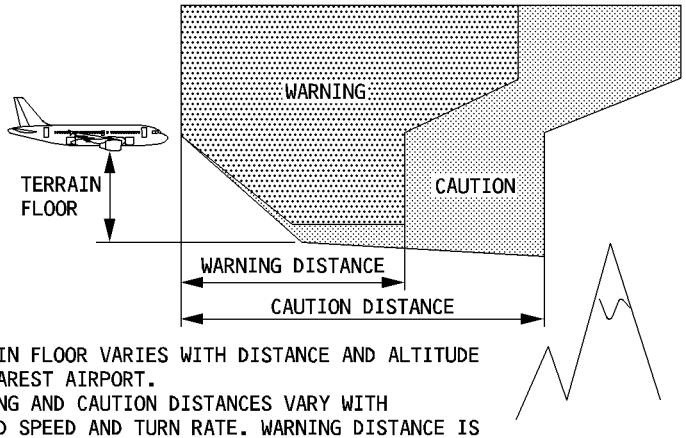


NFC5-01-3470-009-A100AA

IF THE CAUTION OR WARNING ENVELOPE CONFLICTS WITH THE TERRAIN IN THE TERRAIN DATABASE, THEN A WARNING OR CAUTION IS TRIGGERED

VERTICAL ENVELOPE

R

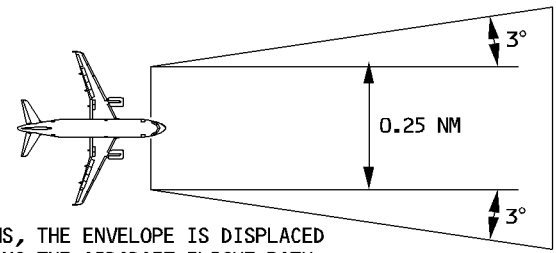


NFC5-01-3470-009-B100AA

TERRAIN FLOOR VARIES WITH DISTANCE AND ALTITUDE TO NEAREST AIRPORT.
WARNING AND CAUTION DISTANCES VARY WITH GROUND SPEED AND TURN RATE. WARNING DISTANCE IS APPROX. 30 SECONDS. CAUTION DISTANCE IS APPROX. 60 SECONDS.

HORIZONTAL ENVELOPE

R

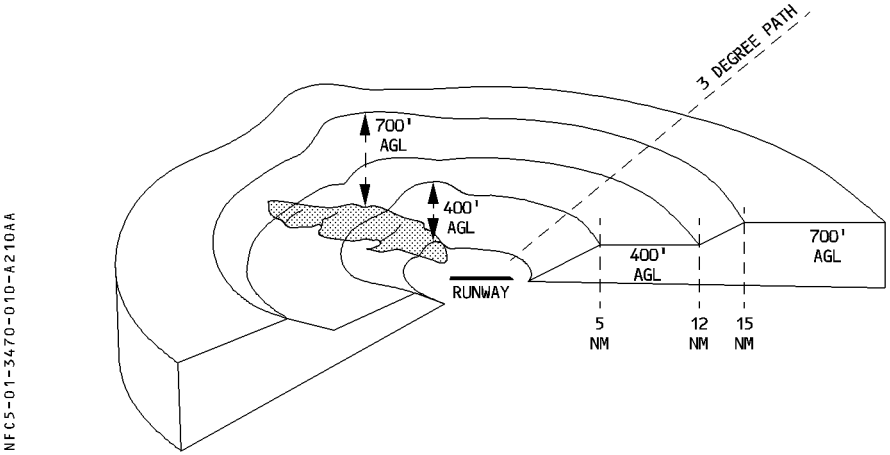


NFC5-01-3470-009-C100AA

DURING TURNS, THE ENVELOPE IS DISPLACED TO LOOK ALONG THE AIRCRAFT FLIGHT PATH.

TERRAIN CLEARANCE FLOOR

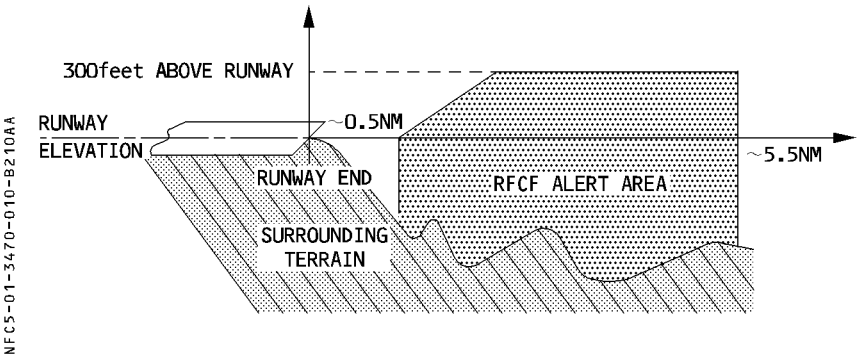
A terrain clearance floor envelope is stored in the database for each runway for which terrain data exist. The Terrain Clearance Floor (TCF) function warns of a premature descent below this floor, regardless of the aircraft's configuration.



If the airplane descends below this floor, a TOO LOW TERRAIN aural warning sounds and the pushbutton light comes on, on the glareshield.

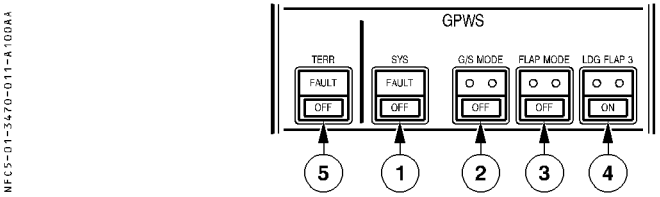
RUNWAY FIELD CLEARANCE FLOOR

The Runway Field Clearance Floor (RFCF) provides an additional envelope protection, for runways that are significantly higher than the surrounding terrain. It is contained in a circle within the 5.5 NM of the runway threshold and it is based on the geometric altitude and the runway elevation.



CONTROLS AND INDICATORS

OVERHEAD PANEL



(1) SYS pb

OFF : All basic GPWS alerts (Mode 1 to 5) are inhibited.
FAULT lt : This amber light comes on, along with an ECAM caution, if the basic GPWS mode 1 to 5 malfunction.

Note : If ILS 1 fails, only mode 5 is inhibited. Consequently, the FAULT light does not come on and the GPWS FAULT warning is not triggered.

(2) G / S MODE pb

OFF : Glideslope mode (mode 5) is inhibited.

(3) FLAP MODE pb

OFF : Flap mode ("TOO LOW FLAPS" mode 4) is inhibited.
(To avoid nuisance warning in case of landing with flaps setting reduced).

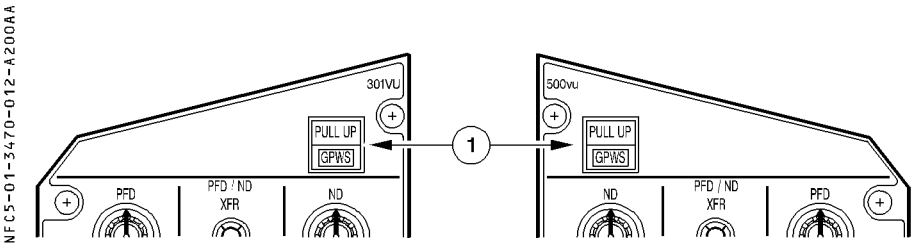
(4) LDG FLAP 3 pb

ON : Flap mode is inhibited when FLAPS CONF 3 is selected (to avoid nuisance warning in case of landing in CONF 3).
In this case, LDG MEMO displays FLAPS ... 3 instead of "CONF ... FULL".

(5) TERR pb

R OFF : Inhibits the Terrain Awareness Display (TAD) and Terrain Clearance Floor (TCF) modes, and does not affect the basic GPWS mode 1 to 5. If OFF is
R selected the ECAM caution NAV GPWS TERR DET FAULT is displayed.
R FAULT lt : This amber light comes on, along with an ECAM caution, if the TAD or TCF mode fails. The terrain is not shown on the ND. The basic GPWS mode 1 to mode 5 are still operative if the SYS pushbutton OFF or FAULT lights are not illuminated.

INSTRUMENT PANELS



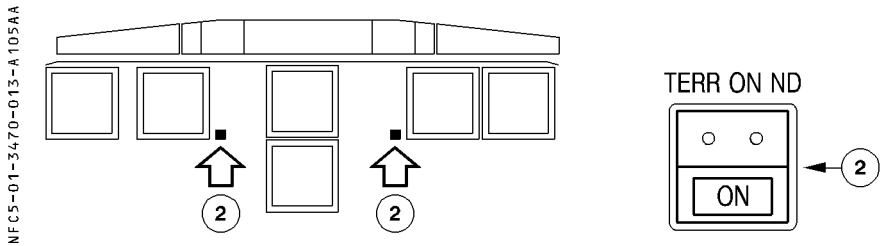
(1) PULL UP – GPWS pb

PULL UP : Comes on red when the second boundary of Mode 1 is penetrated or when Mode 2, or any TAD or TCF alert is activated. It is accompanied by a corresponding voice alert.

GPWS : Comes on amber when any other mode is activated. It is accompanied by a corresponding voice warning.

Note : 1. If the flight crew briefly presses this button when one of these modes is activated, the GPWS light goes out and the voice warning stops.

R *2. The GPWS can be tested by pressing this pushbutton. If the pushbutton is*
R *pressed briefly, some of the aural warnings sound and pushbutton captions,*
R *related to the GPWS, come on. If the pushbutton is pressed continuously, then*
R *all the aural warnings sound.*



(2) TERR ON ND pb

These pushbuttons are located on either side of the ECAM. Each pushbutton controls the onside terrain display.

ON : The terrain is displayed on the ND, if the :
- TERR pushbutton is selected ON, and
- TERR FAULT light is not on.

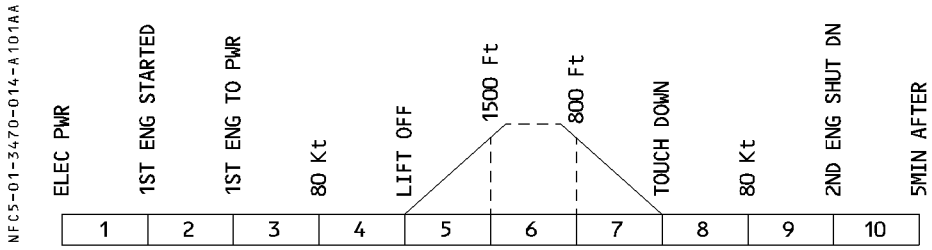
The ON light comes on.

OFF : The terrain data is not displayed on the ND.

Note : · *If the Terrain Awareness Display (TAD) mode generates a caution, or a warning, while the TERR ON ND is not switched ON, the terrain is automatically displayed on the NDs (see EGPWS specific caution and warning due to TAD mode), and the ON light of the TERR ON ND pushbutton comes on.*

· *To differentiate between the terrain and the weather displays, the terrain display sweeps from the center outward to both sides of the ND.*

WARNINGS AND CAUTIONS

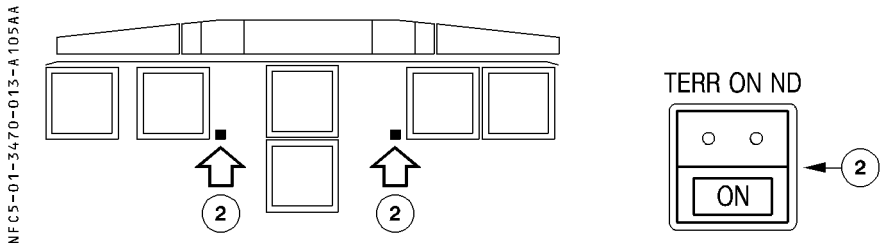


E / WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
GPWS FAULT	SINGLE CHIME	MASTER CAUT	NIL	GPWS SYS FAULT lt	1, 3, 4, 5, 8, 9, 10
GPWS TERR DET FAULT The enhanced terrain detection function is inoperative. The basic GPWS mode 1 to 5 are still operative.				GPWS TERR FAULT lt	1, 3, 4, 5 8,10

MEMO DISPLAY

GPWS FLAP 3 is displayed in green when GPWS LDG FLAP 3 pushbutton switch is ON. GPWS FLAP MODE OFF is displayed in green when GPWS FLAP MODE pushbutton switch is OFF.

R Airborne TERR STBY appears in green when the aircraft position accuracy (provided by the
R FMS) is not sufficient to allow the enhanced TCF and TAD modes to operate. These modes
R are not available until the TERR STBY memo disappears. If selected, the terrain data display
R on ND is automatically deselected when the TERR STBY memo is triggered."



(2) TERR ON ND pb

These pushbuttons are located on either side of the ECAM. Each pushbutton controls the onside terrain display.

ON : The terrain is displayed on the ND, if the :
- TERR pushbutton is selected ON, and
- TERR FAULT light is not on.

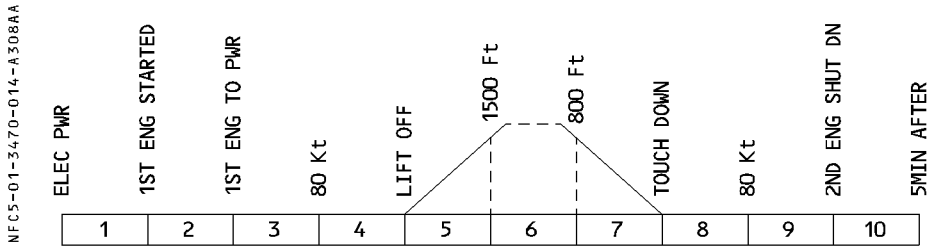
The ON light comes on.

OFF : The terrain data is not displayed on the ND.

Note : · *If the Terrain Awareness Display (TAD) mode generates a caution, or a warning, while the TERR ON ND is not switched ON, the terrain is automatically displayed on the NDs (see EGPWS specific caution and warning due to TAD mode), and the ON light of the TERR ON ND pushbutton comes on.*

· *To differentiate between the terrain and the weather displays, the terrain display sweeps from the center outward to both sides of the ND.*

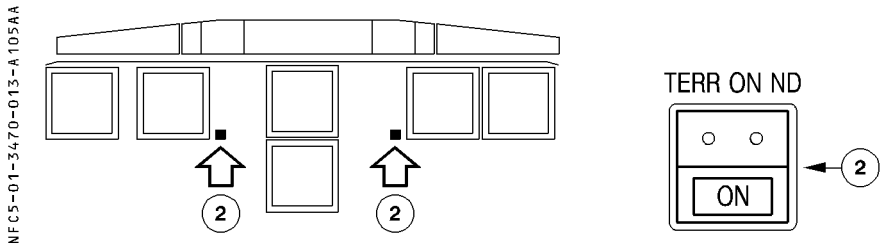
WARNINGS AND CAUTIONS



E / WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
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GPWS TERR DET FAULT The enhanced terrain detection function is inoperative. The basic GPWS mode 1 to 5 are still operative.				GPWS TERR FAULT lt	1, 3, 4, 5 8,10

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Airborne TERR STBY appears in green when the aircraft position accuracy (computed by the EGPWS) is not sufficient to allow the enhanced TCF and TAD modes to operate. These modes are not available until the TERR STBY memo disappears. If selected, the terrain data display on ND is automatically deselected when the TERR STBY memo is triggered."



(2) TERR ON ND pb

These pushbuttons are located on either side of the ECAM. Each pushbutton controls the onside terrain display.

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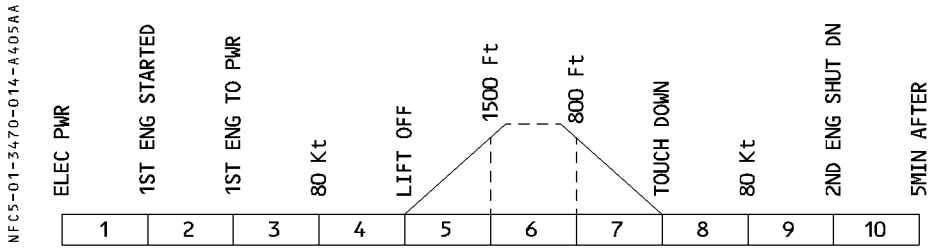
The ON light comes on.

OFF : The terrain data is not displayed on the ND.

Note : · *If the Terrain Awareness Display (TAD) mode generates a caution, or a warning, while the TERR ON ND is not switched ON, the terrain is automatically displayed on the NDs (see EGPWS specific caution and warning due to TAD mode), and the ON light of the TERR ON ND pushbutton comes on.*

· *To differentiate between the terrain and the weather displays, the terrain display sweeps from the center outward to both sides of the ND.*

WARNINGS AND CAUTIONS



E / WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
GPWS FAULT	SINGLE CHIME	MASTER CAUT	NIL	GPWS SYS FAULT lt	1, 3, 4, 5, 8, 9, 10
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MEMO DISPLAY

GPWS FLAP 3 is displayed in green when GPWS LDG FLAP 3 pushbutton switch is ON.
GPWS FLAP MODE OFF is displayed in green when GPWS FLAP MODE pushbutton switch is OFF.
Airborne TERR STBY appears in green when the aircraft position accuracy (computed by the EGPWS) is not sufficient to allow the enhanced TCF and TAD modes to operate. These modes are not available until the TERR STBY memo disappears. If selected, the terrain data display on ND is automatically deselected when the TERR STBY memo is triggered."
TERR OFF is displayed when the TERR pushbutton is switched OFF :

- It appears in green in flight phase 2, before the Take Off Configuration test is launched, and in flight phase 6.
- It appears in amber in flight phase 2, after the Take Off Configuration test, and in flight phases 3, 4, 5, 7, 8 and 9.

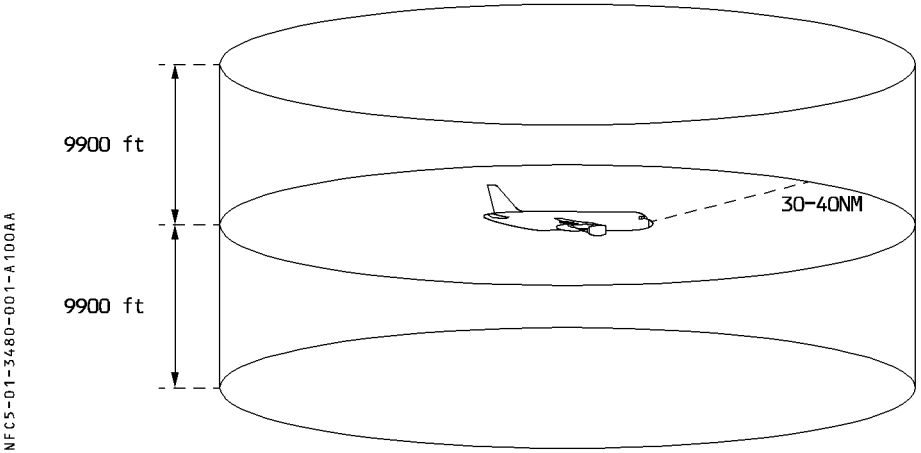
DESCRIPTION

GENERAL

The TCAS (Traffic alert and Collision Avoidance System) :
- Detects any aircraft, equipped with transponders, flying in its vicinity ;
- Displays potential and predicted collision targets ;
- Issues vertical orders to avoid conflict.

The TCAS is normally independent of the ground-based air traffic control system.

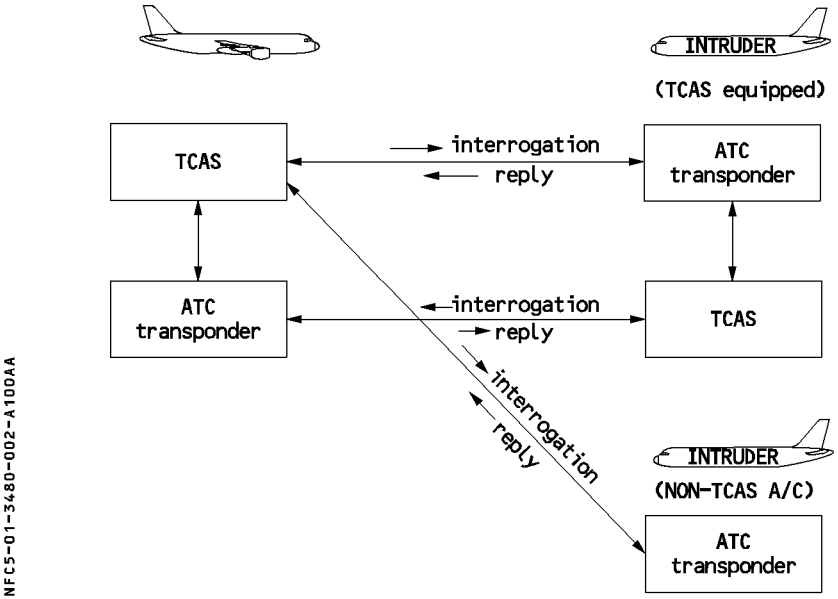
The TCAS detection capability is limited to intruders flying within a maximum range of 30-40 NM (depending on aircraft configuration and external conditions), and within a
R maximum altitude range of 9900 feet (above and below the threatened aircraft).



MAIN COMPONENTS

The system includes :

- a single channel TCAS computer
- two TCAS antennas
- two mode S ATC transponders, one active the other in standby.
  These transponders allow :
  · interface between the ATC / TCAS control panel and the TCAS computer
  · communication between the aircraft and intruders equipped with a TCAS system
- an ATC /TCAS control panel.



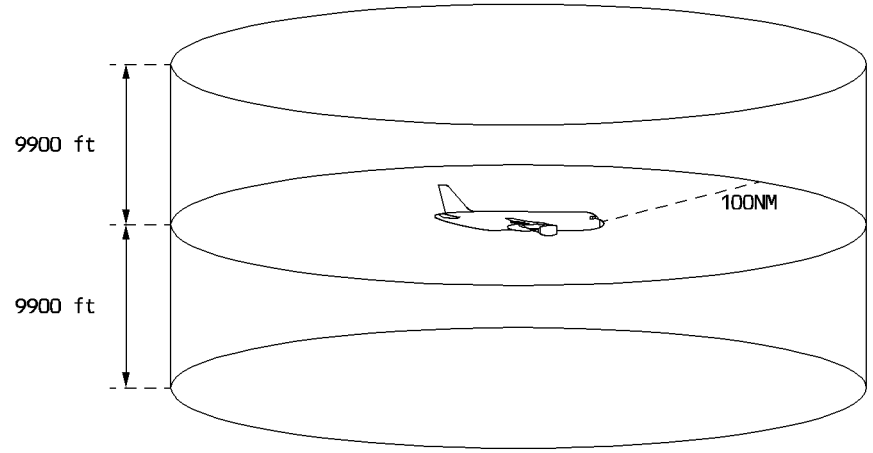
NFCS-01-3480-002-A100AA

DESCRIPTION

GENERAL

The Traffic alert and Collision Avoidance System (TCAS) :
- Detects any aircraft, that is equipped with transponders and is flying in the vicinity
- Displays potential and predicted collision targets
- Issues vertical orders to avoid conflict.

The TCAS is normally independent of the ground-based Air Traffic Control system.
The TCAS's detection capability is limited to intruders flying within a maximum range of 100 NM (depending on aircraft configuration and external conditions), and within a maximum altitude range of 9900 feet above and below the threatened aircraft.

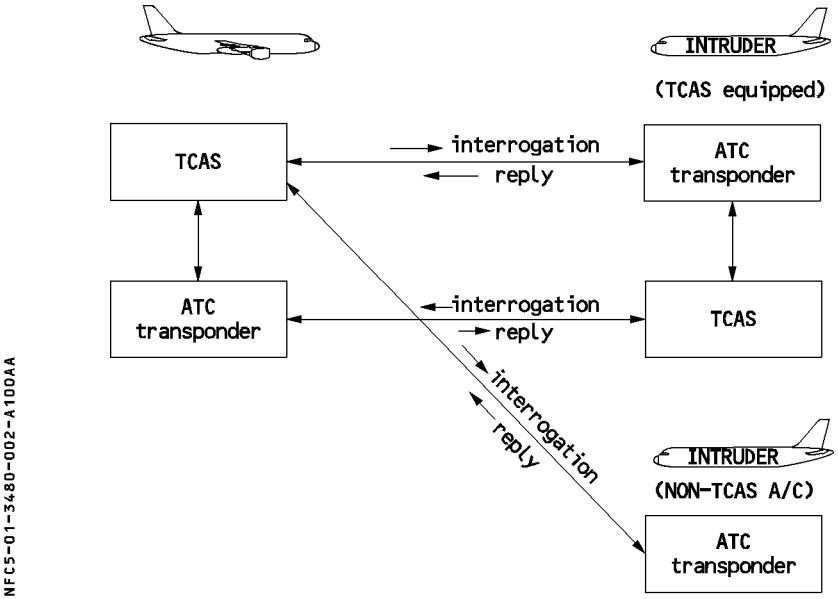


NFCS-01-3480-001-A210AA

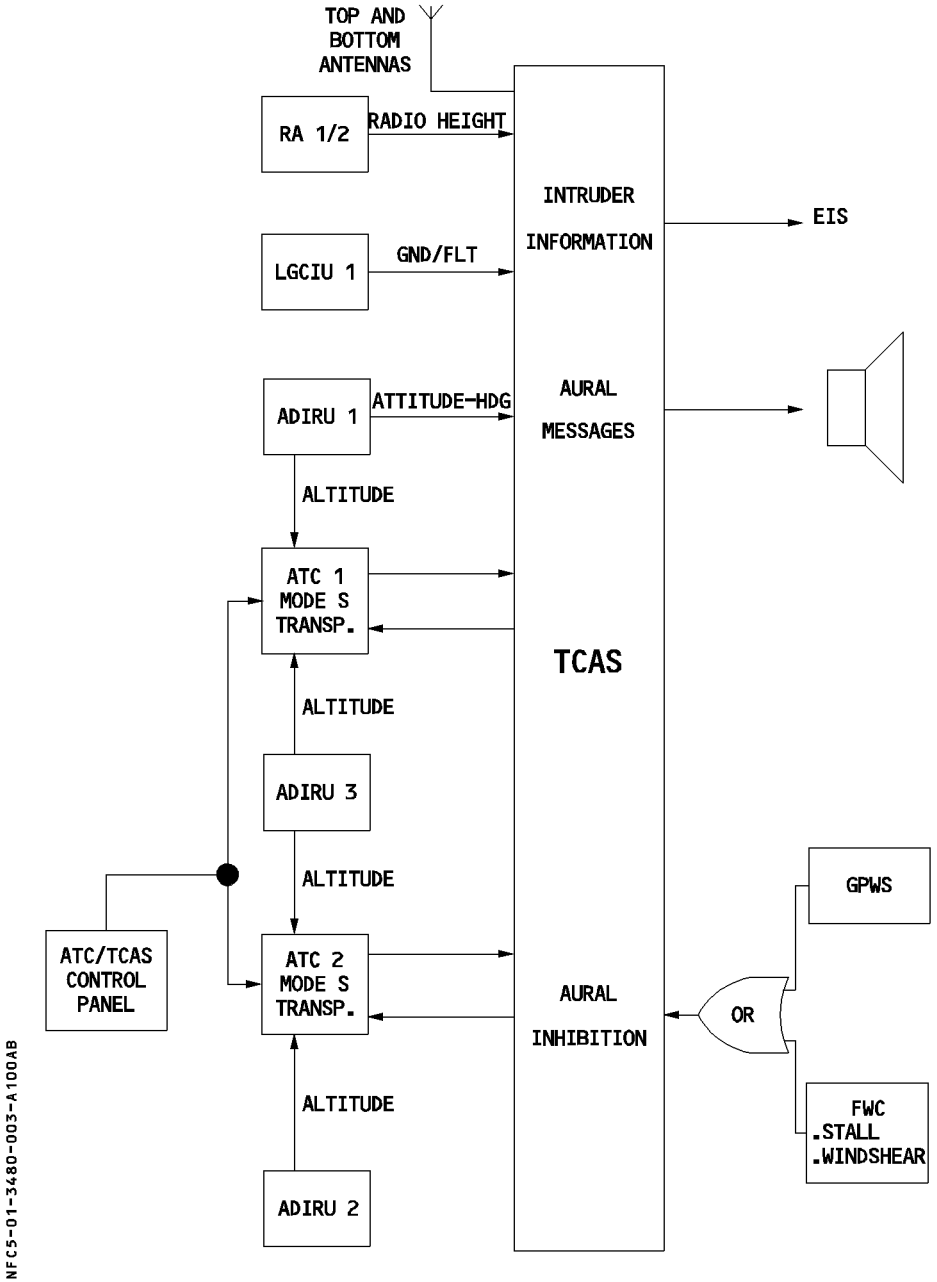
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- two mode S ATC transponders, one active the other in standby.
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  · interface between the ATC / TCAS control panel and the TCAS computer
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NFCS-01-3480-002-A100AA


TOP AND
BOTTOM
ANTENNAS
RA 1/2
RADIO HEIGHT
INTRUDER
INFORMATION
EIS
LGCIU 1
GND/FLT
ADIRU 1
ATTITUDE-HDG
AURAL
MESSAGES
ALTITUDE
ATC 1
MODE S
TRANSP.
TCAS
ALTITUDE
ADIRU 3
ALTITUDE
GPWS
ATC/TCAS
CONTROL
PANEL
ATC 2
MODE S
TRANSP.
AURAL
INHIBITION
OR
ALTITUDE
FWC
.STALL
.WINDSHEAR
ADIRU 2
NFC5-01-3480-003-A100AB

PRINCIPLE

The TCAS interrogates transponder of intruders. From the transponder replies, the TCAS determines for each intruder :
– its relative bearing
– its range and closure rate
– its relative altitude if available (ATC mode C or S)
Then the TCAS computes the intruder trajectory, the Closest Point of Approach (CPA) and the estimated time (TAU) before reaching the CPA.
Each time the relative position of the intruder presents a collision threat, aural and visual advisories are triggered.
TCAS optimizes vertical orders to ensure a sufficient trajectory separation and a minimal vertical speed variation considering all intruders.

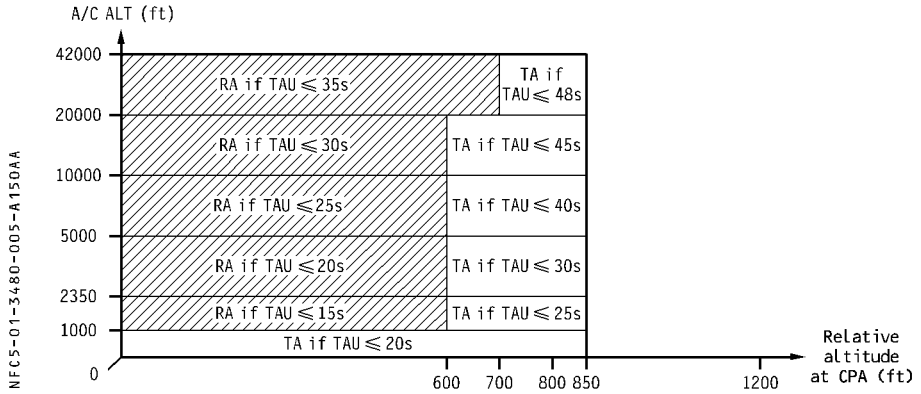
INTRUDER CLASSIFICATION

The intruders are classified in four levels :

LEVEL	INTRUDER POSITION	DISPLAYED INFORMATION
Proximate	– no collision threat – intruder in the vicinity of the a/c (closer than 6 NM laterally and ± 1200 ft vertically)	– ND : intruder position
Traffic Advisory (TA)	– potential collision threat – TAU is about 40 seconds	– ND : intruder position – Aural messages
Resolution Advisory (RA)	– real collision threat – TAU is about 25 seconds	– ND : intruder position – Aural messages – PFD : vertical orders · Maintain actual V/S (Preventive Advisory) or · Modify V/S (Corrective Advisory)
Other intruders (◁)	– no collision threat – any non proximate, TA, RA within the surveillance envelope (lateral range : closer than 30 NM. vertical range : Refer to 1.34.80 p 7)	– ND : intruder position

TA / RA THRESHOLDS

FOR INFO



TCAS MODES

TCAS has 2 modes of operation :

TA/RA : This mode allows the display of all the intruders.

TA : Can be selected by :

- the crew, on the ATC/TCAS panel, in case of aircraft degraded performance (engine failure, landing gear extended) or when operating near closely spaced runways, or
- automatically, if TA/RA is previously selected, and :
  - · The windshear (◁) message is triggered
  - · The stall message is triggered
  - · GPWS messages are triggered
  - · Aircraft is below 1000 ft AGL.

Consequently :

- All RAs are inhibited and converted into TAs
- the TA threshold is set to TAU ≤ 20 seconds, irrespective of the aircraft's altitude.
- No vertical speed advisories are indicated on the PFDs
- "TA ONLY" is displayed on the NDs

If windshear, stall or GPWS messages are triggered, or aircraft below 500 ft AGL, all the TCAS aural messages are suppressed.

ADVISORY INHIBITION

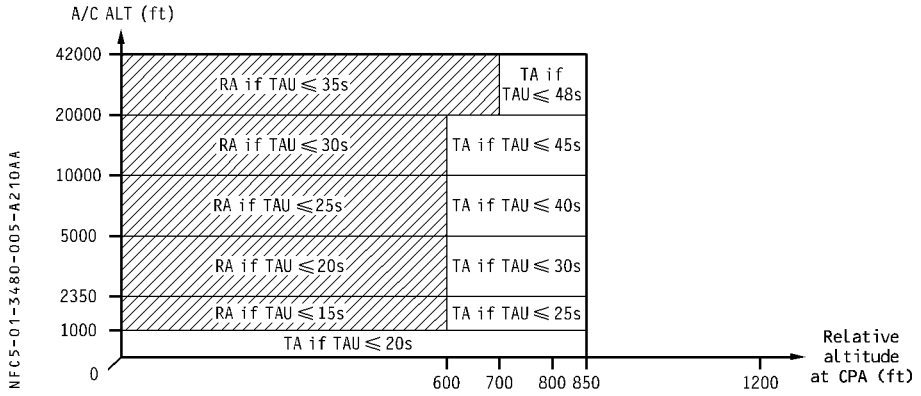
Some advisories are inhibited depending on the aircraft altitude :

- All intruders flying below 380 feet AGL when the own aircraft altitude is below 1700 feet AGL.
- All RA below 1100 feet in climb and 900 feet in descent. In this case, the RAs are converted into TAs.
- "Descend" type advisory below 1200 feet AGL at takeoff or 1000 feet AGL in approach.
- "Increase Descent" RA below 1450 feet.

R - All TA aural messages below 600 feet AGL in climb and below 400 feet AGL in descent.

TA / RA THRESHOLDS

FOR INFO



TCAS MODES

TCAS has two modes of operation :

TA/RA : This mode allows the display of all the intruders.

TA : Can be selected :

- By the crew, on the ATC/TCAS panel, in case of aircraft degraded performance (engine failure, landing gear extended), or when operating near closely-spaced runways, or
- Automatically, if TA/RA is previously selected, and :
  - · The windshear (◁) message is triggered
  - · The stall message is triggered
  - · GPWS messages are triggered
  - · Aircraft is below 1000 ft AGL.
- Automatically, when a hijacking alert has been initiated from the cockpit, via the remote ATC box.

Consequently :

- All RAs are inhibited and converted into TAs
- The TA threshold is set to TAU ≤ 20 seconds, irrespective of the aircraft's altitude.
- No vertical speed advisories are indicated on the PFDs.
- "TA ONLY" is displayed on the NDs

If windshear, stall, or GPWS messages are triggered, or aircraft below 500 ft AGL, all aural TCAS messages are suppressed.

ADVISORY INHIBITION

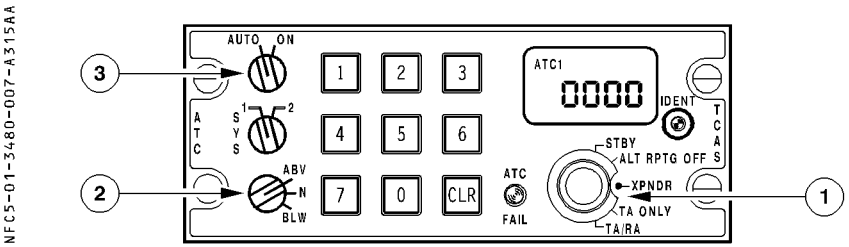
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R
- All TA aural messages below 600 feet AGL in climb and below 400 feet AGL in descent.

CONTROLS AND INDICATORS

ATC/TCAS PANEL



(1) Mode selector

TA/RA : Normal position.
TAs, RAs, proximate and other intruders are displayed.

TA ONLY : This mode should be used, in case of degraded aircraft performance (engine failure, landing gear extended, or approach on parallel runways). All RAs are converted into TAs. TAs, proximate and other intruders are displayed.

STBY : The TCAS and ATC are on standby.

XPNDR : – The TCAS is on standby.

R – On ground: The selected ATC Transponder only operates in the
R selective aircraft interrogation mode of Mode S.
R – In flight : The selected ATC Transponder operates.

(2) TRAFFIC selector

ABV : The altitude range is set to + 7000 feet above the aircraft, and – 2700 feet below the aircraft.

N : The altitude range is set to – 2700 feet below the aircraft, and + 2700 feet above the aircraft.

BLW : The altitude range is set to – 7000 feet below the aircraft, and + 2700 feet above the aircraft.

(3) AUTO/ON selector or THRT/ALL selector

ON (or ALL) : All intruders are displayed.

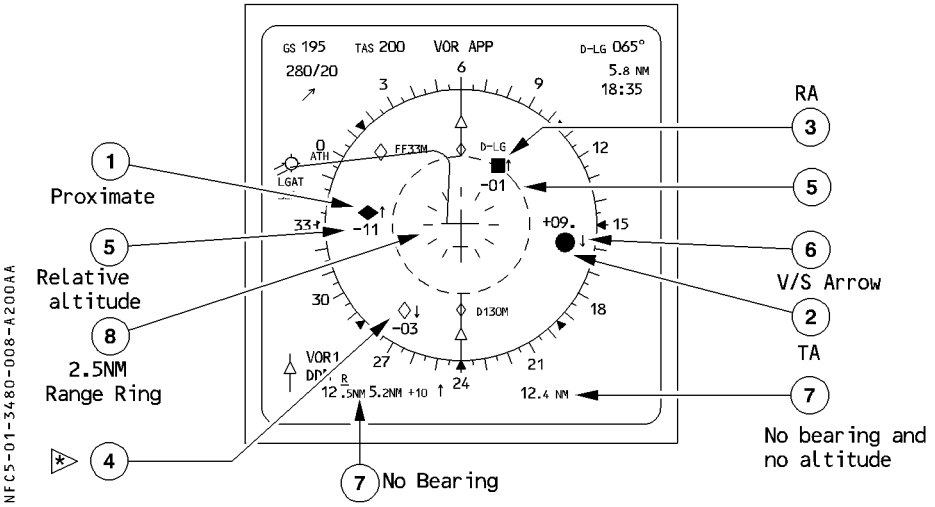
AUTO (or THRT) : Proximate and other intruders are only displayed, if a TA or RA is already presented.

Note : Some TCAS control panels are equipped with a THRT/ALL selector, instead of the AUTO/ON selector. The associated functions remain unchanged.

ND INDICATIONS

The traffic is displayed in all ROSE modes and ARC mode. Only the 8 most threatening intruders are displayed.

R



(1) Proximate intruder

Indicated by a white filled diamond.

(2) TA intruder

Indicated by an amber circle.
Associated with the TRAFFIC-TRAFFIC aural message.

(3) RA intruder

Indicated by a red square.
Associated with vertical orders displayed on the PFD and aural messages.

(4) Other intruders ◁

Indicated by a white empty diamond.

Note : If the range of an intruder is not available, the intruder is not displayed. An intruder may be partially displayed when its range is out of scale.

(5) Relative altitude

Indicated in hundred of feet above or below the symbol depending on the intruder position.

(6) Vertical speed arrow

Displayed only if the intruder V/S > 500 feet/minute
Relative altitude and vertical speed arrow are displayed in the same color as the associated intruder symbol.

Note : If the altitude of an intruder is not available, neither altitude nor vertical speed indications are displayed.

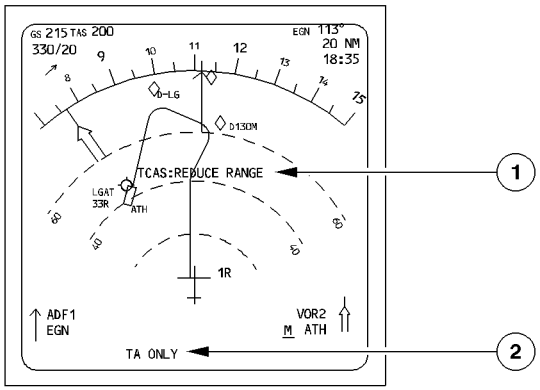
(7) No bearing intruder

If the bearing of TA or RA intruder is not available the following data is presented in digital form at the bottom of the ND :
– range
– relative altitude and vertical speed arrow if available.
Displayed amber or red according to threat level.

(8) Range ring

A 2.5 NM white range ring is displayed when a 10 or 20 NM range is selected.

TCAS MESSAGES



NFC5-01-3480-010-A110AA

(1) Mode and range messages

Following messages can be displayed to draw pilot's attention :

TCAS : REDUCE RANGE : displayed when a TA or RA is detected and ND range above 40 NM

TCAS : CHANGE MODE : displayed when a TA or RA is detected and ND mode is PLAN.

Displayed amber or red depending on the advisory level (TA or RA).
Flash 9 seconds then remain steady.

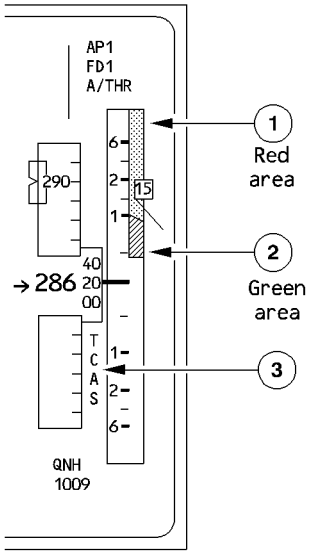
(2) TCAS operation messages

TCAS : displayed in amber in case of TCAS internal failure.
Flashes 9 seconds then remains steady.

R TA ONLY : displayed white when the TA mode is selected automatically, or manually
R by the flight crew.

PFD INDICATIONS

In case of RA detection, the vertical speed scale becomes rectangular and the PFD presents vertical orders on the vertical speed scale. The vertical speed scale background is normally grey, but may be partially replaced by green and/or red areas.



NFC5-01-3480-011-A205AA

(1) Red area

Indicates the vertical speed range, when there is a high risk of conflict.

(2) Green area

Indicates the recommended vertical speed range.

Note : — *The aircraft can also fly in the grey vertical speed range, without the risk of conflict (preventive RA).*
— *The color of the vertical speed needle and the digits corresponds to the appropriate area.*

(3) TCAS message

Appears in amber, when the TCAS cannot deliver RA data, or in case of an internal TCAS failure.

AURAL MESSAGES

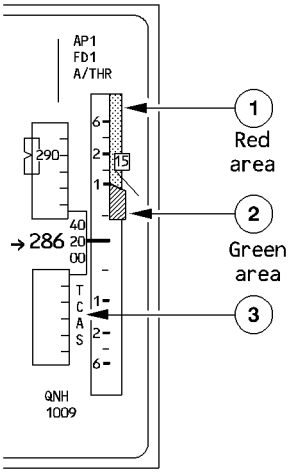
TA/RA detection is associated with the following messages :

"TRAFFIC TRAFFIC"	: Only in case of TA detection.
"CLIMB CLIMB"	: Climb at the vertical speed indicated by the green area on the PFD.
"CLIMB, CROSSING CLIMB" (twice)	: Same as above. Indicates that you will cross through the intruder altitude.
"INCREASE CLIMB" (twice)	: Triggered after the CLIMB message, if vertical speed is insufficient to achieve safe vertical separation.
"DESCEND DESCEND"	: Descend at the vertical speed indicated by the green area on the PFD.
"DESCEND, CROSSING DESCEND" (twice)	: Same as above. Indicates that you will cross through the intruder altitude.
"INCREASE DESCEND" (twice)	: Triggered after the DESCEND message, if the vertical speed is insufficient to achieve safe vertical separation.
"ADJUST VERTICAL SPEED, ADJUST"	: Adjust the vertical speed to that indicated on the green area of the PFD, reducing climb vertical speed or descent vertical speed, as appropriate.
"CLIMB CLIMB NOW" (twice)	: Triggered after the DESCEND message, if the intruder trajectory has changed.
"DESCEND DESCEND NOW" (twice)	: Triggered after the CLIMB message, if the intruder trajectory has changed.
"MONITOR VERTICAL SPEED"	: Ensure that the vertical speed remains outside the red area. Triggered only once, in case of preventive RA.
"MAINTAIN VERTICAL SPEED, MAINTAIN"	: Maintain the vertical speed indicated on the green area of the PFD.
"MAINTAIN VERTICAL SPEED, CROSSING MAINTAIN"	: Maintain the vertical speed indicated on the green area of the PFD. Indicates that you will cross through the intruder altitude.
"CLEAR OF CONFLICT"	: The range inreases and separation is adequate. Return to assigned clearance.

R

PFD INDICATIONS

In case of RA detection, the vertical speed scale becomes rectangular and the PFD presents vertical orders on the vertical speed scale. The vertical speed scale background is normally grey, but may be partially replaced by green and/or red areas.



NFCS-01-3480-011-A210AA

(1) Red area

Indicates the vertical speed range, when there is a high risk of conflict.

(2) Green area

Indicates the recommended vertical speed range. It is wider than the red area.

Note : — *The aircraft can also fly in the grey vertical speed range, without the risk of conflict (preventive RA).*
— *The color of the digits corresponds to the appropriate area.*
— *In case of RA detection, the vertical speed needle that is normally green, becomes white.*

(3) TCAS message

Appears in amber, when the TCAS cannot deliver RA data, or in case of an internal TCAS failure.

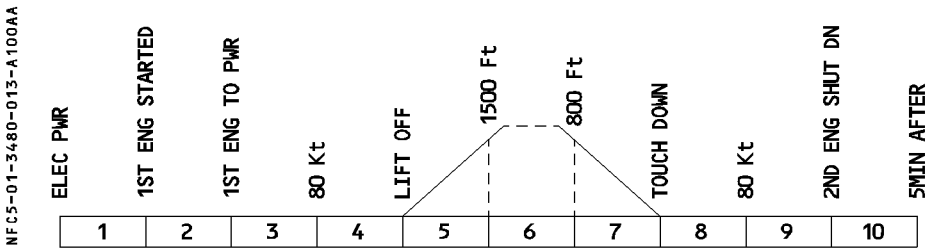
AURAL MESSAGES

TA/RA detection is associated with the following messages :

"TRAFFIC TRAFFIC"	: Only in case of TA detection.
"CLIMB CLIMB"	: Climb at the vertical speed indicated by the green area on the PFD.
"CLIMB, CROSSING CLIMB" (twice)	: Same as above. Indicates that you will cross through the intruder altitude.
"INCREASE CLIMB" (twice)	: Triggered after the CLIMB message, if vertical speed is insufficient to achieve safe vertical separation.
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"DESCEND, CROSSING DESCEND" (twice)	: Same as above. Indicates that you will cross through the intruder altitude.
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"MAINTAIN VERTICAL SPEED, MAINTAIN"	: Maintain the vertical speed indicated on the green area of the PFD.
"MAINTAIN VERTICAL SPEED, CROSSING MAINTAIN"	: Maintain the vertical speed indicated on the green area of the PFD. Indicates that you will cross through the intruder altitude.
"CLEAR OF CONFLICT"	: The range inreases and separation is adequate. Return to assigned clearance.

R

WARNINGS AND CAUTIONS



E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
TCAS FAULT in case of TCAS internal failure	SINGLE CHIME	MASTER CAUT	NIL	Flag on PFD and ND	3, 4, 5, 7

MEMO DISPLAY

TCAS STBY is displayed green when :
- ATC STBY or TCAS STBY is selected by the crew, or
- ALT RPTG is selected at off, or
- both ATC or both RA are failed.

BUS EQUIPMENT LIST

R

		NORM		EMER ELEC		
		AC	DC	AC ESS	DC ESS	HOT
ADIRU	ADIRU 1			X		HOT 2 *
	AOA RESOLVER 1			X		
	ADIRU 2	AC2				HOT 2 ** during 5 mn
	AOA RESOLVER 2	AC2				
	ADIRU 3	AC1				HOT 1 ***
	AOA RESOLVER 3	AC1				
STD BY INST	HORIZON				X	
	ALTIMETER				SHED	
	COMPASS				X	
NAVAIDS	VOR 1			X		
	VOR 2	AC2				
	MMR 1			X		
	MMR 2	AC2				
	ADF 1			SHED		
	ADF 2 ◁	AC2				
	DDRMI			X		
	DME 1			SHED		
	DME 2	AC2				
RADIO ALTIMETER	RA 1	AC1				
	RA 2	AC2				
ATC	ATC 1			SHED		
	ATC 2	AC2				
GPWS		AC1				
WEATHER RADAR	WX 1	AC1				
	WX 2	AC2				
TCAS ◁		AC1				

* Backup supply.
** Backup supply for 5 minutes.
*** Backup supply, when the ATT HDG is in the CAPT 3 position.
Backup supply for 5 minutes, when the ATT HDG is in the NORM or F/03 position.

BUS EQUIPMENT LIST

		NORM		EMER ELEC		
		AC	DC	AC ESS	DC ESS	HOT
ADIRU	ADIRU 1			X		HOT 2 *
	AOA RESOLVER 1			X		
	ADIRU 2	AC2				HOT 2 ** during 5 mn
	AOA RESOLVER 2	AC2				
	ADIRU 3	AC1				HOT 1 ***
	AOA RESOLVER 3	AC1				
STD BY INST	HORIZON				X	HOT 1 *
	ALTIMETER				SHED	
	COMPASS				X	
NAVAIDS	VOR 1			X		
	VOR 2	AC2				
	MMR 1			X		
	MMR 2	AC2				
	ADF 1			SHED		
	ADF 2 ◁	AC2				
	DDRMI			X		
	DME 1			SHED		
	DME 2	AC2				
RADIO ALTIMETER	RA 1	AC1				
	RA 2	AC2				
ATC	ATC 1			SHED		
	ATC 2	AC2				
GPWS		AC1				
WEATHER RADAR	WX 1	AC1				
	WX 2	AC2				
TCAS ◁		AC1				

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** Backup supply for 5 minutes.
*** Backup supply, when the ATT HDG is in the CAPT 3 position.
Backup supply for 5 minutes, when the ATT HDG is in the NORM or F/03 position.

35.00 CONTENTS

35.10 GENERAL

35.20 FIXED OXYGEN SYSTEM FOR COCKPIT
– DESCRIPTION 1
– CONTROLS AND INDICATORS 4

35.30 FIXED OXYGEN SYSTEM FOR CABIN
– DESCRIPTION 1
– CONTROLS AND INDICATORS 3

35.40 PORTABLE OXYGEN SYSTEM

35.50 ELECTRICAL SUPPLY

DESCRIPTION

The oxygen system consists of :
- a fixed oxygen system for the cockpit
- a fixed oxygen system for the cabin
- a portable oxygen system.

R The oxygen system supplies adequate breathing oxygen to the crew and passengers in case of depressurization or presence of smoke or toxic gas.

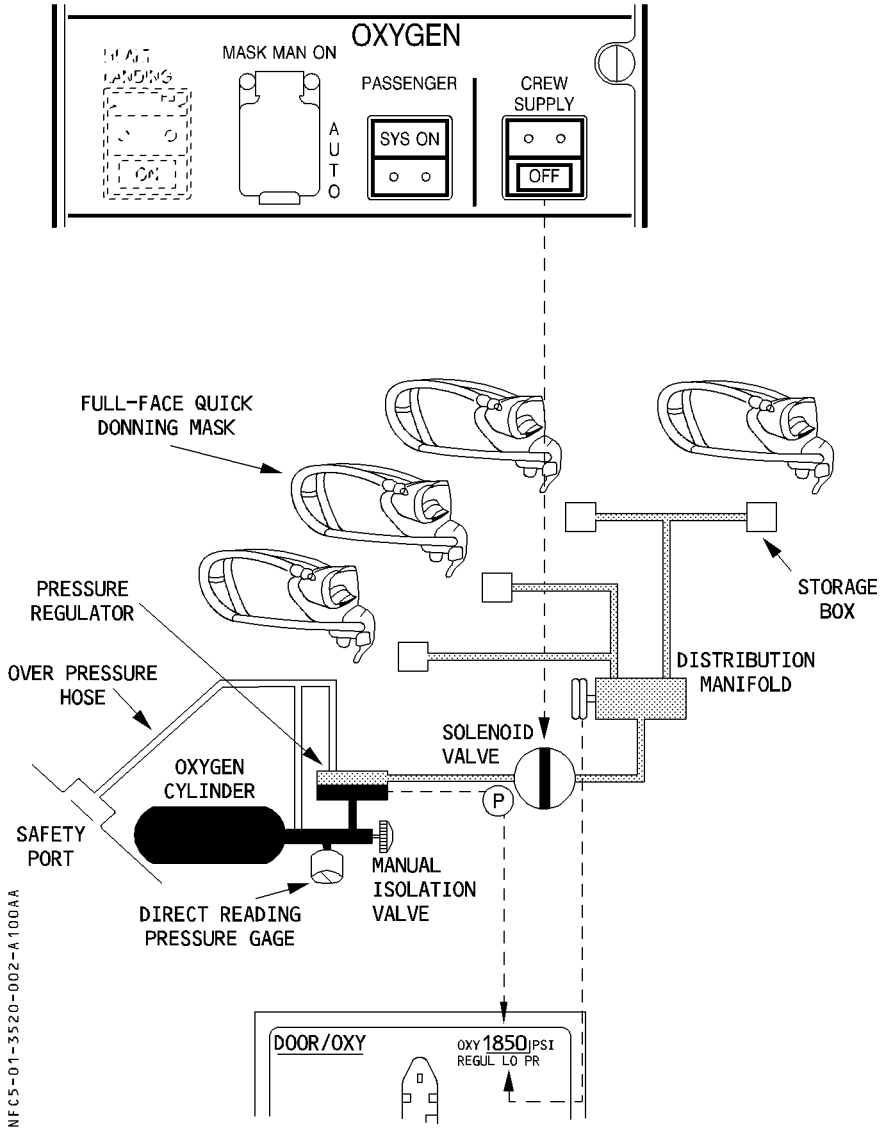
DESCRIPTION

The cockpit's fixed oxygen system consists of :
- A high-pressure cylinder, in the left-hand lower fuselage.
- A pressure regulator, connected directly to the cylinder that delivers oxygen, at a pressure suitable for users.
- Two overpressure safety systems to vent oxygen overboard, through a safety port, if the pressure gets too high.
- A supply solenoid valve that allows the crew to shut off the distribution system.
- Three (or four, as installed) full-face quick-donning masks, stowed in readily-accessible boxes adjacent to the crewmembers' seats (one at each seat).

OPERATION

The crewmember squeezes the red grips to pull the mask out of its box, and this action causes the mask harness to inflate.
A mask-mounted regulator supplies a mixture of air and oxygen or pure oxygen, or performs emergency pressure control. With the regulator set to NORMAL, the user breathes a mixture of cabin air and oxygen up to the cabin altitude at which the regulator supplies 100 % oxygen. The user can select 100 %, in which case the regulator supplies pure oxygen at all cabin altitudes.
If the situation calls for it, the user can use the emergency overpressure rotating knob and receive pure oxygen at positive pressure.
The storage box contains a microphone lead, with a quick-disconnect, for connection to the appropriate mask microphone cable.

R *Note : Each mask may have a removable film that protects the visor against scratches.*
R *This strip is optional and may be removed from the mask at any time.*


OXYGEN
MASK MAN ON
PASSENGER
CREW SUPPLY
SYS ON
OFF
A U T O
FULL-FACE QUICK DONNING MASK
PRESSURE REGULATOR
OVER PRESSURE HOSE
OXYGEN CYLINDER
SAFETY PORT
DIRECT READING PRESSURE GAGE
MANUAL ISOLATION VALVE
SOLENOID VALVE
P
STORAGE BOX
DISTRIBUTION MANIFOLD
DOOR/OXY
OXY 1850 PSI
REGUL LO PR
NFCS-01-3520-002-A100AA

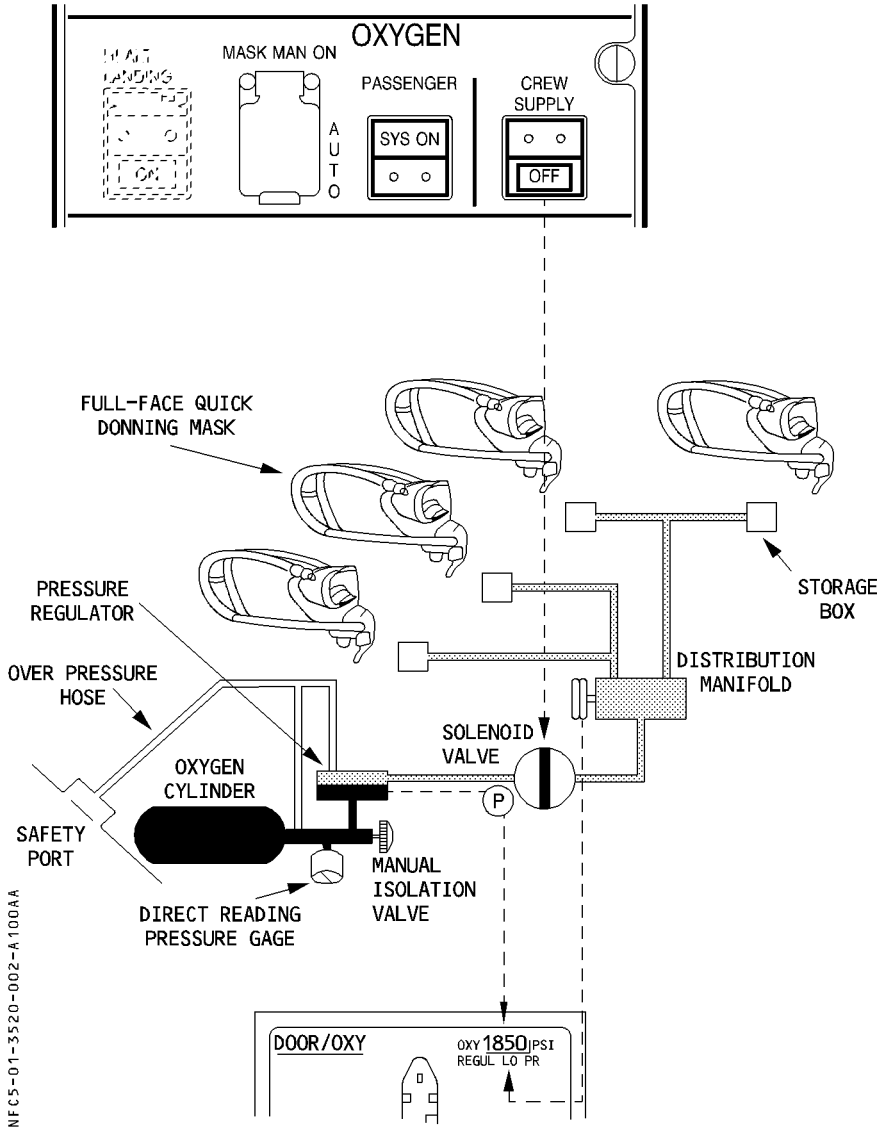
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- Two overpressure safety systems to vent oxygen overboard, through a safety port, if the pressure gets too high.
- A supply solenoid valve that allows the crew to shut off the distribution system.
- Four full-face quick-donning masks, stowed in readily-accessible boxes adjacent to the crewmembers' seats (one at each seat).

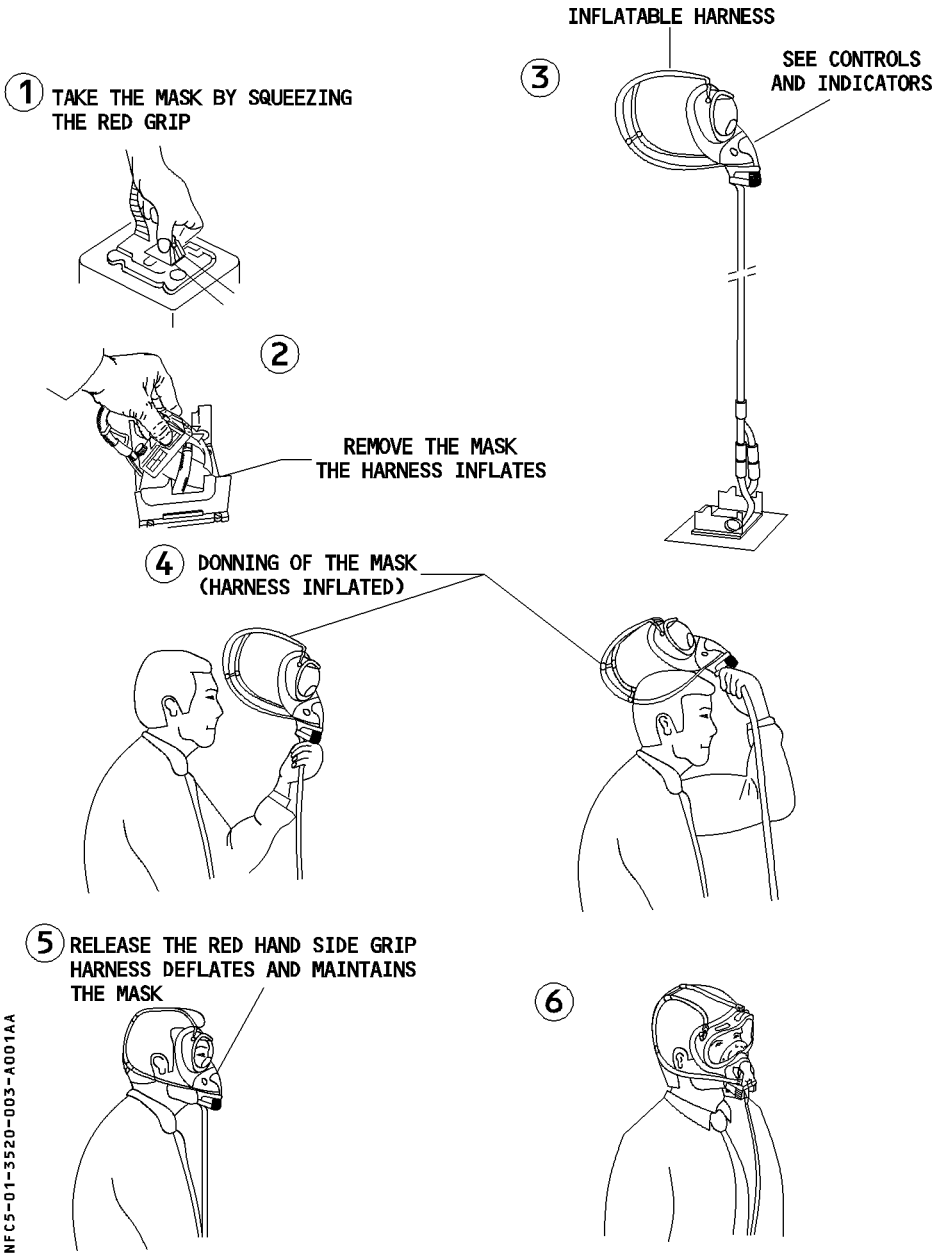
OPERATION

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A mask-mounted regulator supplies a mixture of air and oxygen or pure oxygen, or performs emergency pressure control. With the regulator set to NORMAL, the user breathes a mixture of cabin air and oxygen up to the cabin altitude at which the regulator supplies 100 % oxygen. The user can select 100 %, in which case the regulator supplies pure oxygen at all cabin altitudes.
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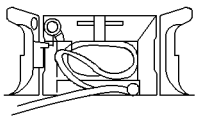

OXYGEN
MASK MAN ON
PASSENGER
CREW SUPPLY
SYS ON
OFF
A U T O
FULL-FACE QUICK DONNING MASK
PRESSURE REGULATOR
OVER PRESSURE HOSE
STORAGE BOX
DISTRIBUTION MANIFOLD
SOLENOID VALVE
OXYGEN CYLINDER
P
SAFETY PORT
MANUAL ISOLATION VALVE
DIRECT READING PRESSURE GAGE
DOOR/OXY
OXY 1850 PSI
REGUL LO PR
NFCS-01-3520-002-A100AA

MASK SETTING

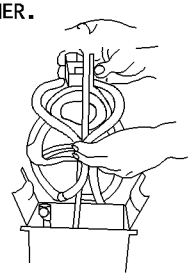


R
R
MASK STOWAGE

(1) - COIL THE HOSE, AND PLACE IT IN THE BOTTOM OF THE STOWAGE BOX.

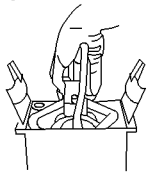


(2) - POSITION THE REMAINING HOSE IN THE MIDDLE OF THE MASK.
- FOLD THE TWO HARNESS PORTIONS TOGETHER.

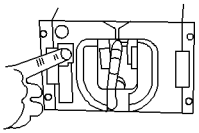


NFC5-01-3520-004-A001AA

(3) - PLACE THE MASK IN THE STOWAGE BOX.
- MAKE SURE THE MASK REGULATOR IS FULLY SEATED AGAINST THE STOP IN THE STOWAGE BOX.



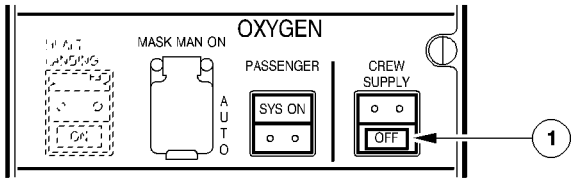
(4) - CLOSE THE DOORS, THEN FULLY PRESS THE "RESET TEST" BUTTON.
- ONCE THE "RESET TEST" BUTTON IS RELEASED, CHECK THAT THE "OXY ON" FLAG COMPLETELY DISAPPEARS.
- PRESS THE EMERGENCY PRESSURE SELECTOR, AND CHECK THAT THE BLINKER REMAINS BLACK.



CONTROLS AND INDICATORS

OVERHEAD PANEL

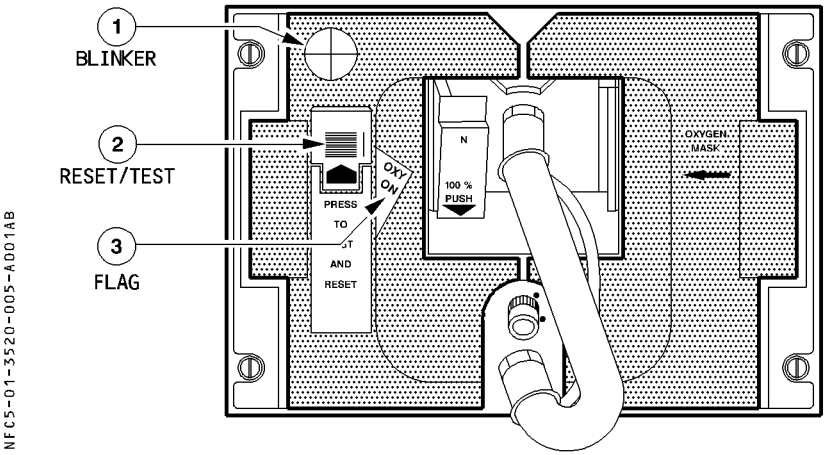
NFC5-01-3520-004-B001AA



(1) CREW SUPPLY pushbutton

This pushbutton controls the solenoid valve.
On : The valve is open, and supplies low pressure oxygen to the masks (normal position in flight).
OFF : The valve is closed, and the white light comes on.

STOWAGE BOX



NFC5-01-3520-005-A001AB

(1) Blinker flowmeter (yellow)

This indicator flashes when oxygen is flowing.

(2) RESET / TEST control slide

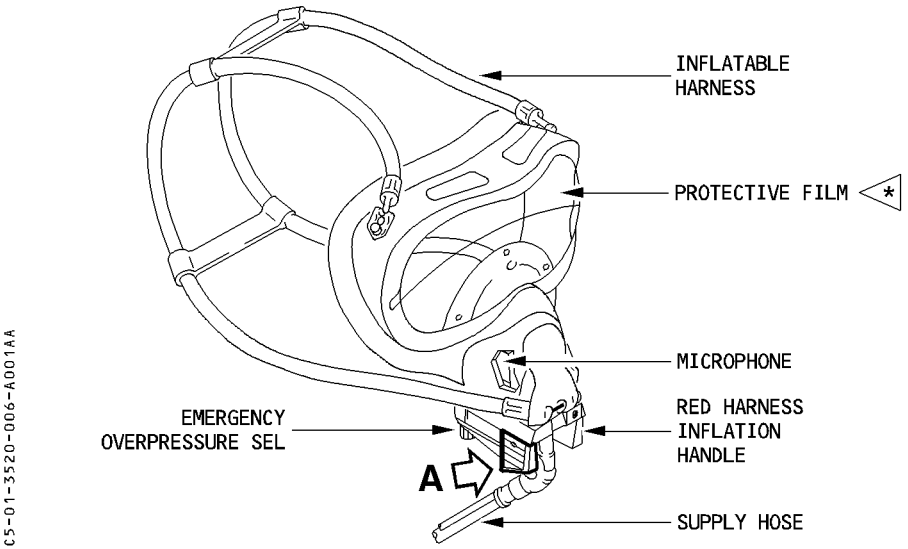
The crewmember presses the slide, and pushes it in the direction of the arrow to test : the operation of the blinker ; the regulator supply ; system sealing downstream of the valve ; and the regulator sealing and system operation. Pressing the RESET control
R slide, after the oxygen mask has been used, cuts off the oxygen, and the mask microphone.

(3) OXY ON flag

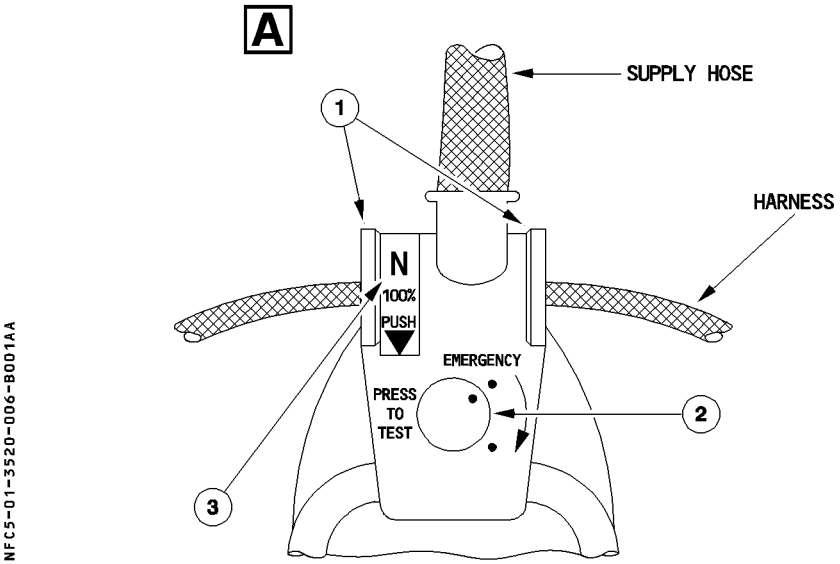
R As soon as the left flap door opens, the mask is supplied with oxygen and, once it closes
R (mask still supplied with oxygen), the "OXY ON" flag appears.

R

CREW OXYGEN MASK



PRESSURE REGULATOR



(1) Red grips

Squeezing the right-hand side grip unlocks the two-flap door, and permits the harness to inflate.

(2) EMERGENCY pressure selector

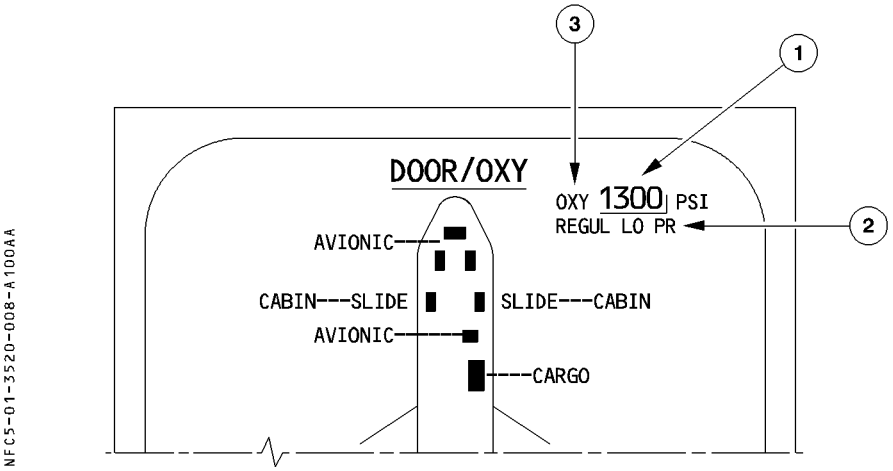
This selector creates an overpressure, which eliminates condensation and prevents smoke, smell, or ashes from entering the mask.
- Pressing this knob generates an overpressure for a few seconds.
- Turning the knob, in the direction of the arrow, generates a permanent overpressure.

Note : Overpressure supply is automatically started, when cabin altitude exceeds 30,000 feet.

(3) N/100 % selector

R Pushing the button up from underneath releases it, and it pops up to the N (normal) position. Pressing it again returns it to 100 %.
100 % : The mask delivers 100 % oxygen.
N : The mask delivers a mixture of air and oxygen, the content of which varies with cabin altitude. When cabin altitude goes above 35000 feet, the air inlet closes and the wearer breathes 100 % oxygen.

DOOR/OXY ECAM PAGE



(1) OXY high pressure indication

It is in green, when the pressure is ≥ 800 psi.
It pulses in green, when the pressure is < 800 psi (the DOOR/OXY page is automatically displayed).
It is in amber, when the pressure is < 400 psi.
An amber half frame appears, when oxygen pressure is < 1500 psi.
In this case, the flight crew must check that the remaining quantity is not below the minimum (refer to OPERATING LIMITATIONS, 3.01.35).

(2) REGUL LO PR indication

It is in amber, if oxygen pressure on the low-pressure circuit is low (50 psi).

(3) OXY indication

It is normally in white.
It becomes amber, when :
– Pressure goes below 400 psi.
– Low oxygen pressure is detected.
– The overhead panel's OXYGEN CREW SUPPLY pushbutton is OFF.

(1) Red grips

Squeezing the right-hand side grip unlocks the two-flap door, and permits the harness to inflate.

(2) EMERGENCY pressure selector

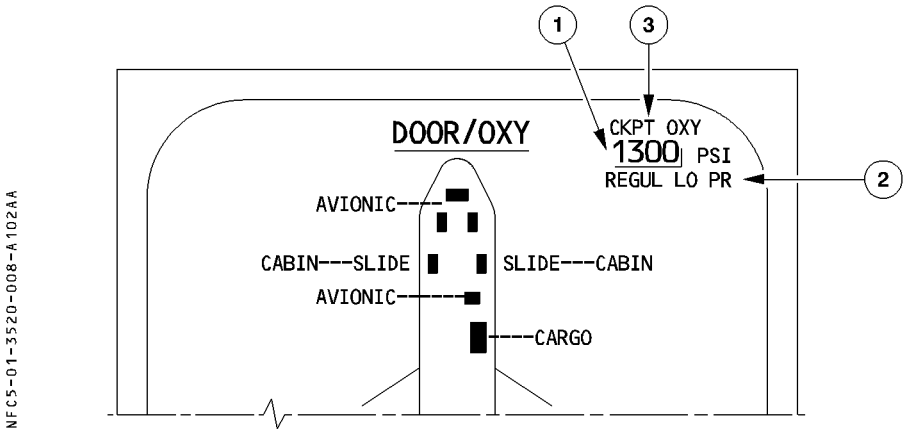
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- Pressing this knob generates an overpressure for a few seconds.
- Turning the knob, in the direction of the arrow, generates a permanent overpressure.

Note : Overpressure supply is automatically started, when cabin altitude exceeds 30,000 feet.

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(2) REGUL LO PR indication

It is in amber, if oxygen pressure on the low-pressure circuit is low (50 psi).

(3) CKPT OXY indication

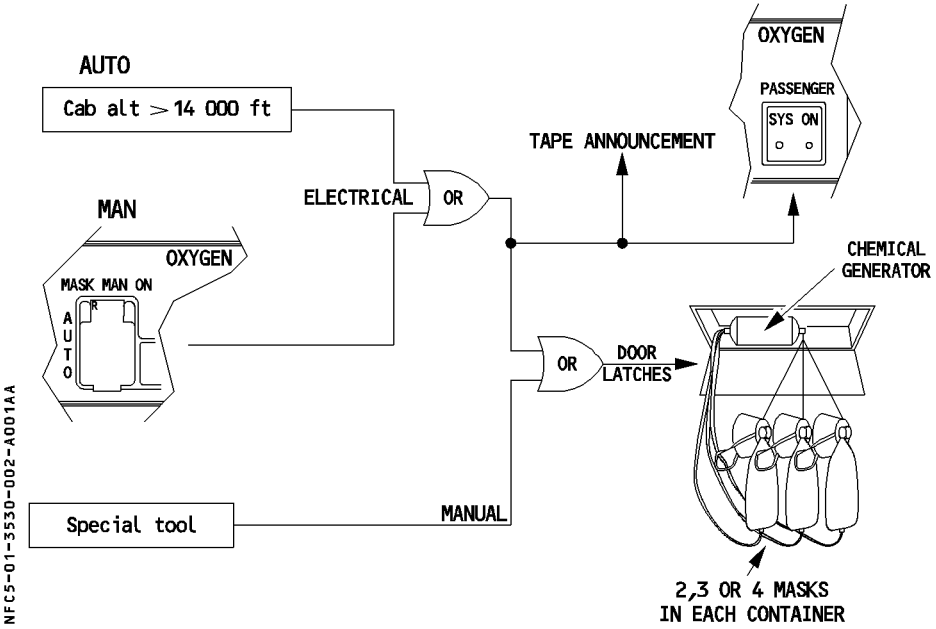
It is normally in white.
It becomes amber, when :
– Pressure goes below 400 psi.
– Low oxygen pressure is detected.
– The overhead panel's OXYGEN CREW SUPPLY pushbutton is OFF.

DESCRIPTION

The cabin's fixed oxygen system supplies oxygen to the occupants, in case of cabin depressurization.
Chemical generators produce the oxygen. Each generator feeds a group of 2, 3, or 4 masks. Generators and masks are in containers above the passenger seats, in the lavatories, in each galley (◁), and at each cabin crew station.

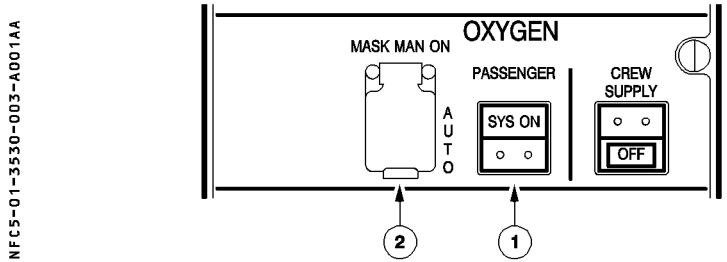
OPERATION

R Each container has an electrical latching mechanism that opens automatically to allow the masks to drop, if the cabin pressure altitude exceeds 14000 feet (+ 250, – 750 feet). The flight crew can override the automatic control.
When the masks are released, the passenger address system automatically broadcasts prerecorded instructions for their use.
The generation of oxygen begins when the passenger pulls the mask towards the passenger seat. The chemical reaction used for oxygen generation creates heat. Therefore, the smell of burning or smoke, and cabin temperature increase, may be associated with the normal operation of the oxygen generators.The mask receives pure oxygen under positive pressure for about 15 minutes, until the generator is exhausted.
A reset is available for the rearming of the system after the masks are restowed. A manual release tool allows crewmembers to manually open the doors in case of electrical failure.


AUTO
Cab alt > 14 000 ft
ELECTRICAL
OR
MAN
OXYGEN
MASK MAN ON
A
U
T
O
R
Special tool
MANUAL
TAPE ANNOUNCEMENT
OXYGEN
PASSENGER
SYS ON
CHEMICAL
GENERATOR
OR
DOOR
LATCHES
2,3 OR 4 MASKS
IN EACH CONTAINER
NFC5-01-3530-002-A001AA

CONTROLS AND INDICATORS

OVERHEAD PANEL



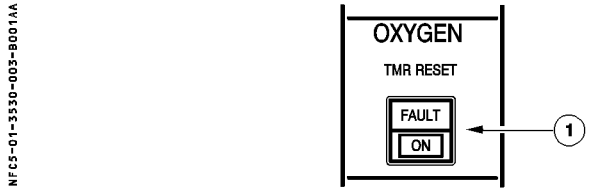
(1) PASSENGER SYS ON light

This light comes on in white, when the control for the oxygen mask doors is activated, and it remains on until the TMR RESET pushbutton is pressed (see maintenance panel, below).

(2) MASK MAN ON pushbutton

The guard keeps this button in the AUTO position.
AUTO : The mask doors open automatically, when the cabin altitude exceeds 14000 feet.
Pressed : The mask doors open.

OVERHEAD MAINTENANCE PANEL



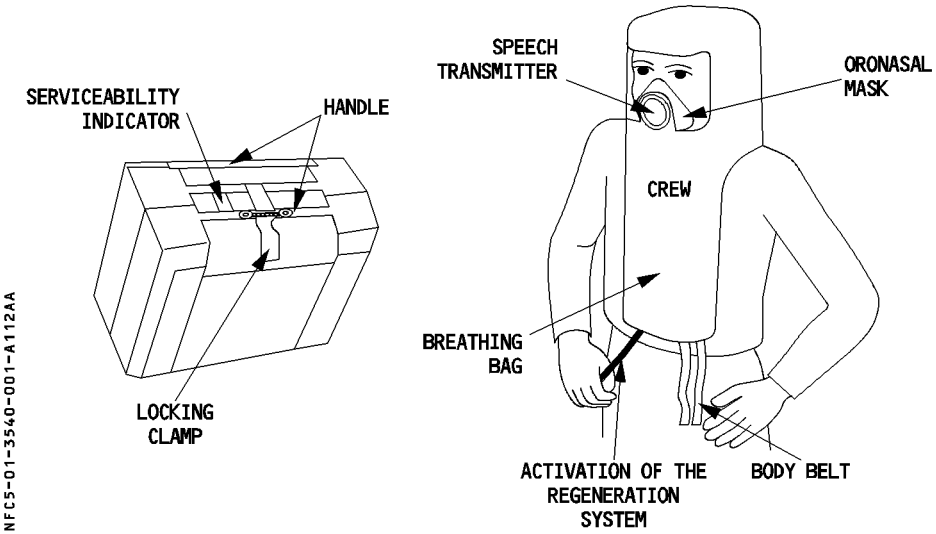
(1) TMR RESET pushbutton

The maintenance crew uses this pushbutton to reset the control circuit, after the system has operated.
ON : The PASSENGER SYS ON light goes off.
R FAULT : This light comes on in white, when the door latch solenoids are energized for more than 30 seconds.

DESCRIPTION

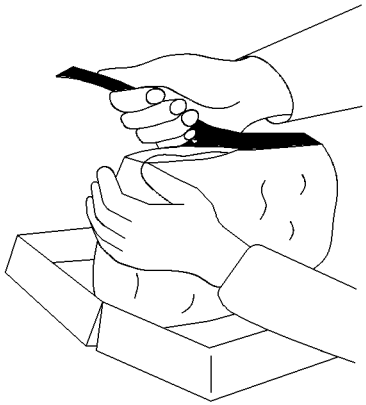
FLIGHT CREW'S PORTABLE OXYGEN SYSTEM

The smoke hood on the left back side of the cockpit protects the eyes and respiratory system of one member of the flight crew while he is fighting a fire, or if smoke or noxious gases enter the cabin, or if the cabin loses pressure.
The smoke hood uses a chemical air regeneration system, which is in the breathing key. An oronasal mask allows the hood's wearer to inhale regenerated air, and it returns the exhaled breath to the regeneration system.
The hood is serviceable as long as the yellow indicator on the case is not broken. The hood should work satisfactorily for at least 20 minutes.

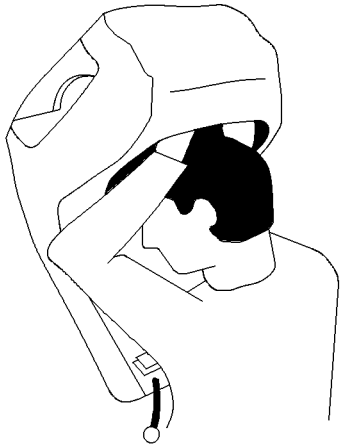


USING THE HOOD

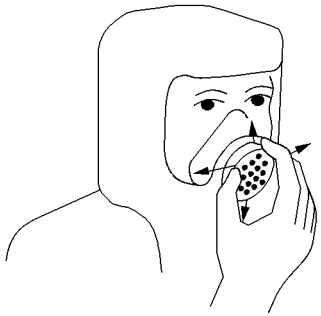
1 REMOVE UNIT FROM CASE AND REMOVE THE HOOD FROM THE PROTECTIVE BAG BY TEARING OFF THE STRIP.



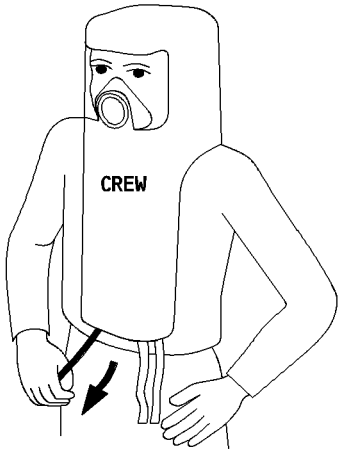
2 ENLARGE THE NECK SEAL AND PULL THE HOOD OVER YOUR HEAD.



3 CORRECTLY ADJUST THE INNER MASK.



4 PULL DOWN THE LANYARD TO ACTIVATE THE AIR REGENERATION SYSTEM.



NFC5-01-3540-002-A112AB

BUS EQUIPMENT LIST

FOR INFO

R

		NORM			EMER ELEC		
		AC	DC	DC BAT	AC ESS	DC ESS	HOT
CREW OXY CTL						SHED	
PAX OXYGEN	ACTUATION				SHED		
	AUTOCONTROL					SHED	

36.00 CONTENTS

36.10 DESCRIPTION
– GENERAL 1
– ENGINE BLEED SYSTEM 2
– APU BLEED AIR SUPPLY 6
– CROSS BLEED 7
– LEAK DETECTION 8
– OPERATION FOLLOWING FAILURES 10

36.20 CONTROLS AND INDICATORS
– OVERHEAD PANEL 1
– ECAM BLEED PAGE 3
– WARNINGS AND CAUTIONS 6
– MEMO DISPLAY 7

36.30 ELECTRICAL SUPPLY

GENERAL

The pneumatic system supplies high-pressure air for :
– air conditioning
– engine starting
– wing anti-icing
– water pressurization
– hydraulic reservoir pressurization

High-pressure air has three sources :
– engine bleed systems
– APU load compressor
– HP ground connection

A crossbleed duct interconnects the engine bleed systems and receives air from the APU and ground sources when appropriate.

A valve mounted on the crossbleed duct allows the left side (engine 1) and right side (engine 2) to be interconnected.

Two Bleed Monitoring Computers (BMC1 and BMC2), the overhead control panel, and the ECAM control and monitor the operation of the pneumatic system.

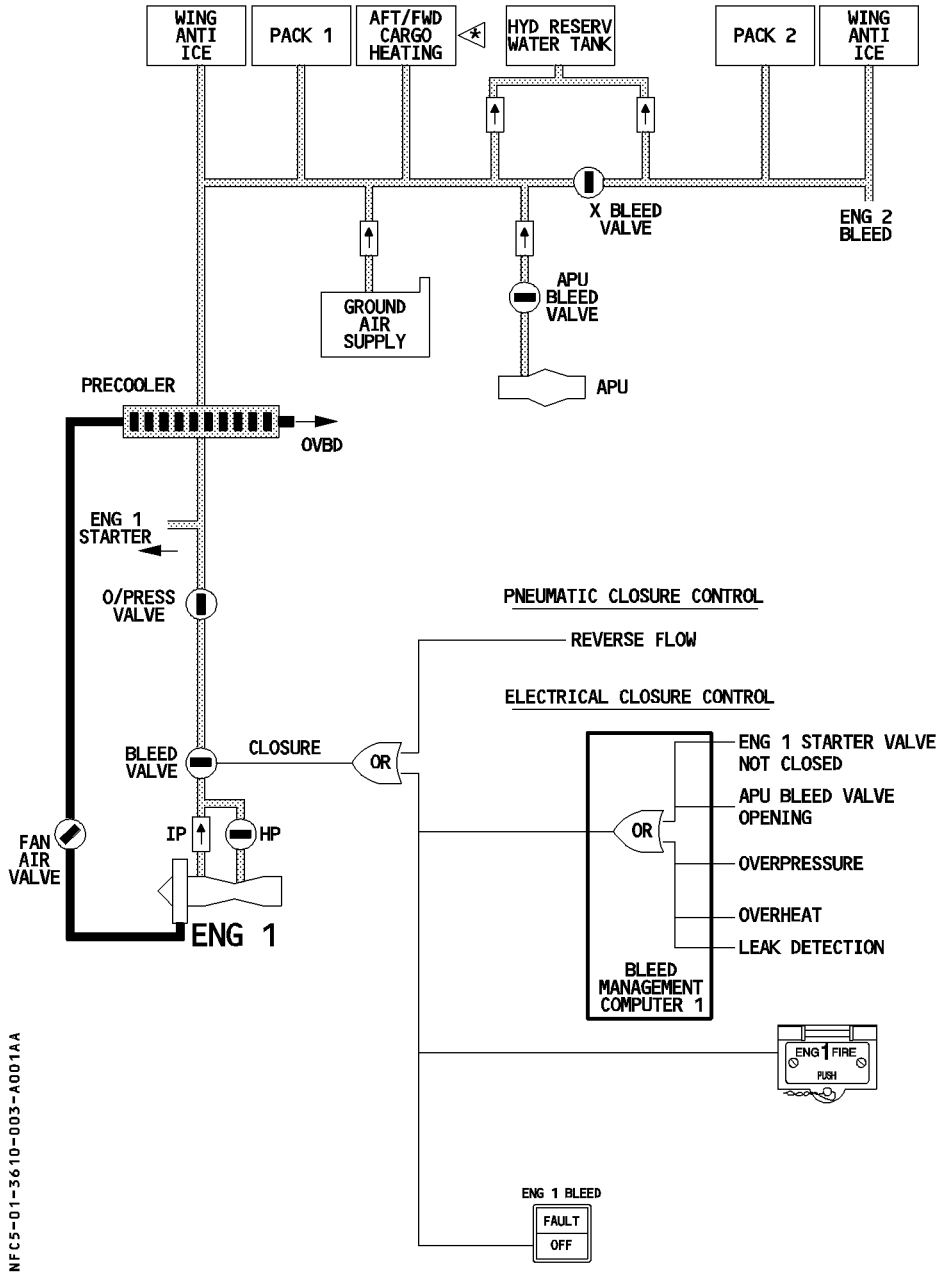
A leak detection system detects any overheating in the vicinity of hot air ducts.

ENGINE BLEED SYSTEM

GENERAL

The aircraft has two similar engine bleed air systems.
Each system is designed to :
– select the compressor stage to use as a source of air
– regulate the bleed air temperature
– regulate the bleed air pressure.
A Bleed Monitoring Computer (BMC) controls and monitors each system.
Each BMC receives information about bleed pressure and temperature and valve position.
Each is connected with :
– other systems using air or information from the bleed system
– the other BMC.
Each supplies indications and warnings to the ECAM and CFDS.
If one BMC fails, the other one takes over most of the monitoring functions.
Each bleed valve is pneumatically operated and controlled electrically by its associated BMC.

FOR INFO


WING ANTI ICE
PACK 1
AFT/FWD CARGO HEATING
HYD RESERV WATER TANK
PACK 2
WING ANTI ICE
X BLEED VALVE
ENG 2 BLEED
GROUND AIR SUPPLY
APU BLEED VALVE
APU
PRECOOLER
OVBD
ENG 1 STARTER
O/PRESS VALVE
PNEUMATIC CLOSURE CONTROL
REVERSE FLOW
ELECTRICAL CLOSURE CONTROL
BLEED VALVE
CLOSURE
OR
ENG 1 STARTER VALVE NOT CLOSED
APU BLEED VALVE OPENING
OR
OVERPRESSURE
OVERHEAT
LEAK DETECTION
BLEED MANAGEMENT COMPUTER 1
FAN AIR VALVE
IP
HP
ENG 1
ENG 1 FIRE
PUSH
ENG 1 BLEED
FAULT
OFF
NFC5-01-3610-003-A001AA

AIR BLEED SELECTION

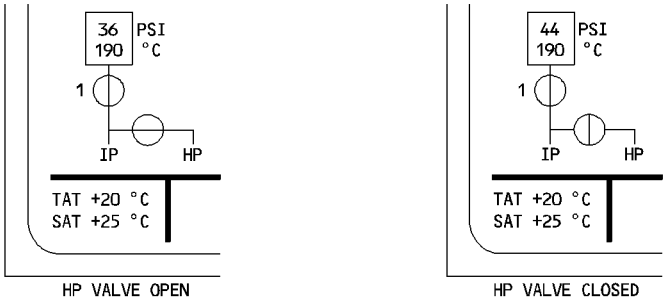
Air is normally bled from the intermediate pressure stage (IP) of engine's high-pressure (HP) compressor to minimize fuel penalty.
At low engine speed, when the pressure and temperature of the IP air are too low, the system bleeds air from the HP stage and maintains it at 36 ± 4 psi.
An intermediate pressure check valve downstream of the IP port closes to prevent air from the HP stage from being circulated to the IP stage.

FOR INFO

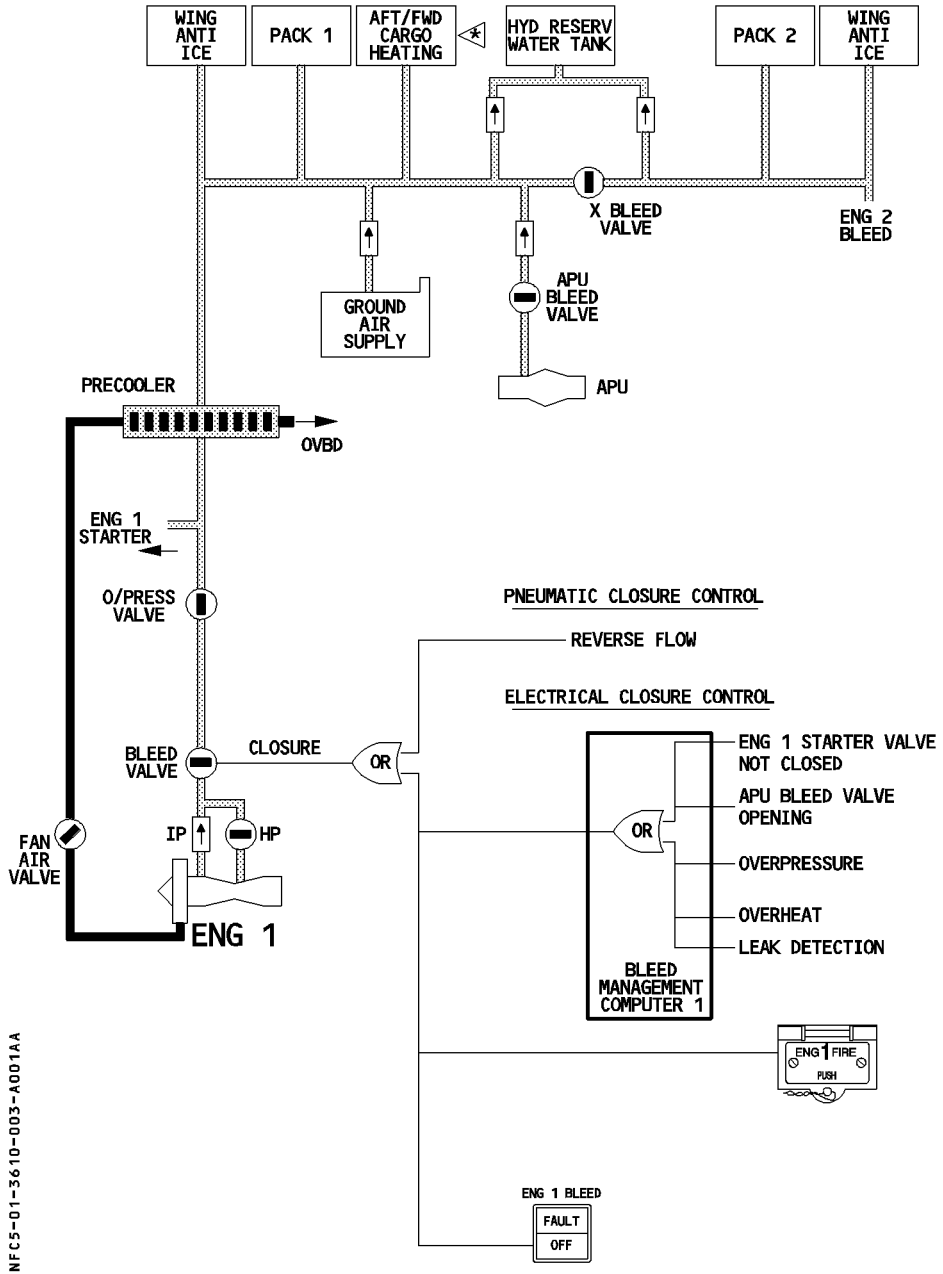
The HP valve closes automatically
- *pneumatically*
  - *in case of low upstream pressure*
  - *in case of excessive upstream pressure*
- *electrically when the bleed valve is closed electrically.*

ECAM INDICATION

NFC5-01-3610-004-A110AA



FOR INFO


WING ANTI ICE
PACK 1
AFT/FWD CARGO HEATING
HYD RESERV WATER TANK
PACK 2
WING ANTI ICE
X BLEED VALVE
ENG 2 BLEED
GROUND AIR SUPPLY
APU BLEED VALVE
APU
PRECOOLER
OVBD
ENG 1 STARTER
O/PRESS VALVE
PNEUMATIC CLOSURE CONTROL
REVERSE FLOW
ELECTRICAL CLOSURE CONTROL
BLEED VALVE
CLOSURE
OR
ENG 1 STARTER VALVE NOT CLOSED
APU BLEED VALVE OPENING
OR
OVERPRESSURE
OVERHEAT
LEAK DETECTION
BLEED MANAGEMENT COMPUTER 1
FAN AIR VALVE
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ENG 1 FIRE
PUSH
ENG 1 BLEED
FAULT
OFF
NFC5-01-3610-003-A001AA

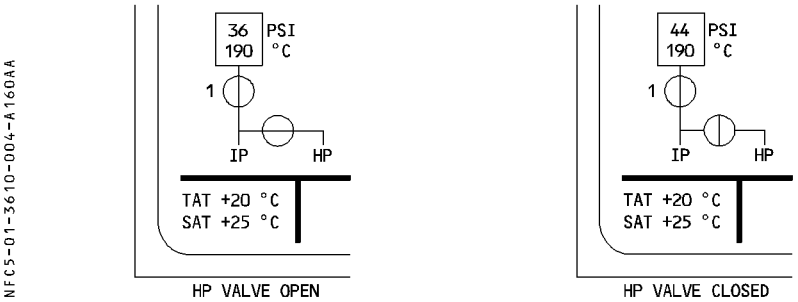
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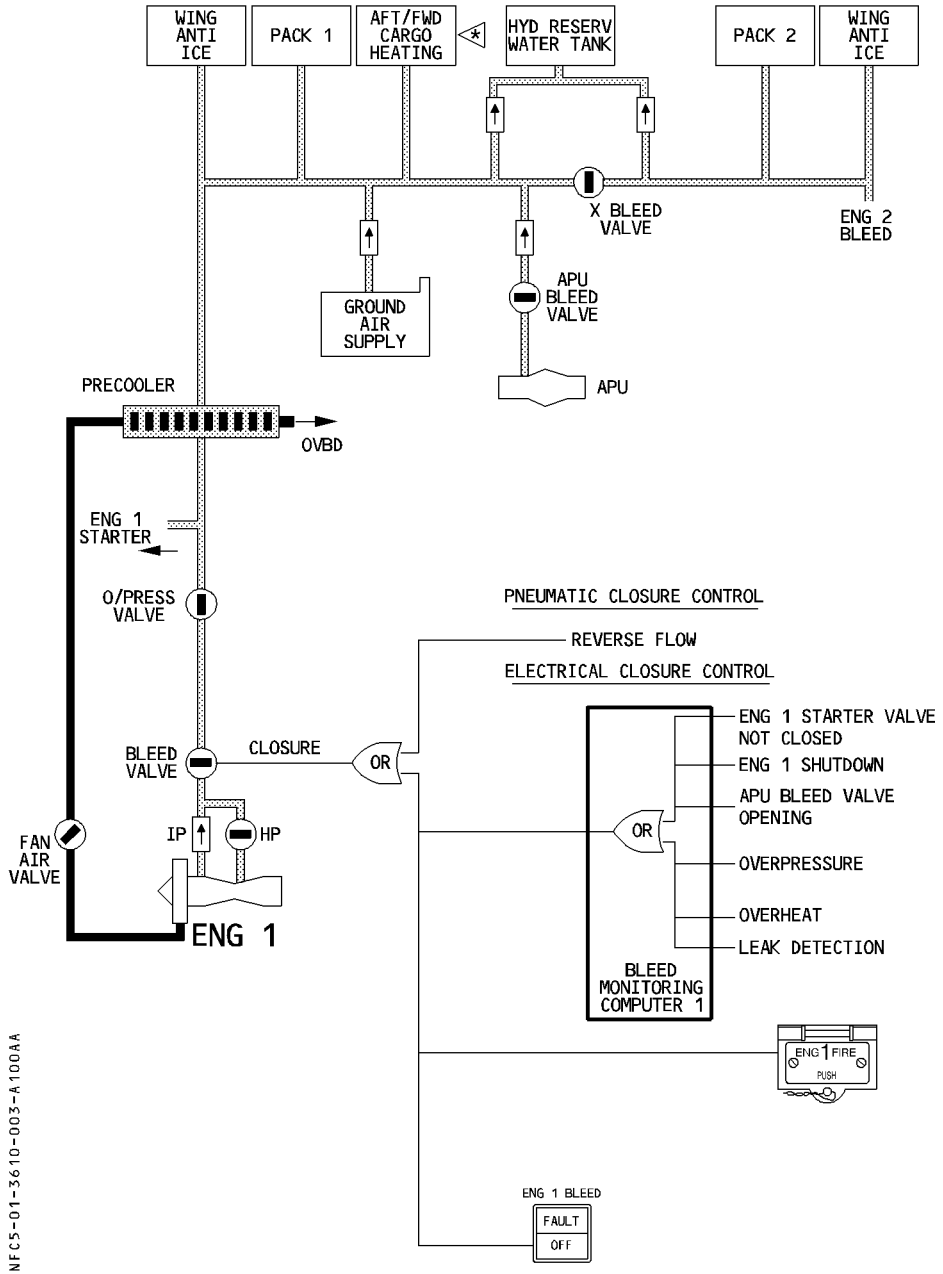
FOR INFO

The HP valve closes automatically
- *pneumatically*
  - *in case of low upstream pressure*
  - *in case of excessive upstream pressure*
- *electrically :*
  - *when the bleed valve is closed electrically*
  - *in case of overpressure upstream of the HP valve with wing anti-ice off, two packs on and aircraft altitude above 15000 feet.*

ECAM INDICATION



FOR INFO


WING ANTI ICE
PACK 1
AFT/FWD CARGO HEATING
HYD RESERV WATER TANK
PACK 2
WING ANTI ICE
X BLEED VALVE
ENG 2 BLEED
GROUND AIR SUPPLY
APU BLEED VALVE
APU
PRECOOLER
OVBD
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O/PRESS VALVE
PNEUMATIC CLOSURE CONTROL
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OR
ENG 1 STARTER VALVE NOT CLOSED
ENG 1 SHUTDOWN
APU BLEED VALVE OPENING
OR
OVERPRESSURE
OVERHEAT
LEAK DETECTION
FAN AIR VALVE
IP
HP
ENG 1
BLEED MONITORING COMPUTER 1
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PUSH
ENG 1 BLEED
FAULT
OFF
NFC5-01-3610-003-A100AA

AIR BLEED SELECTION

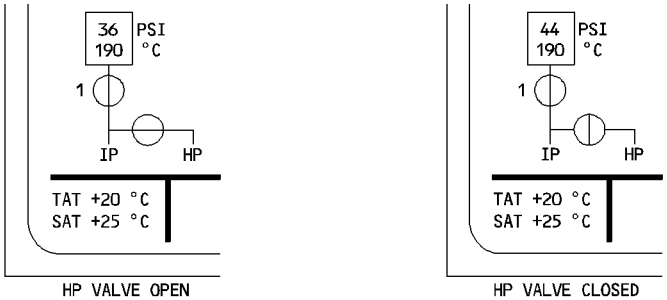
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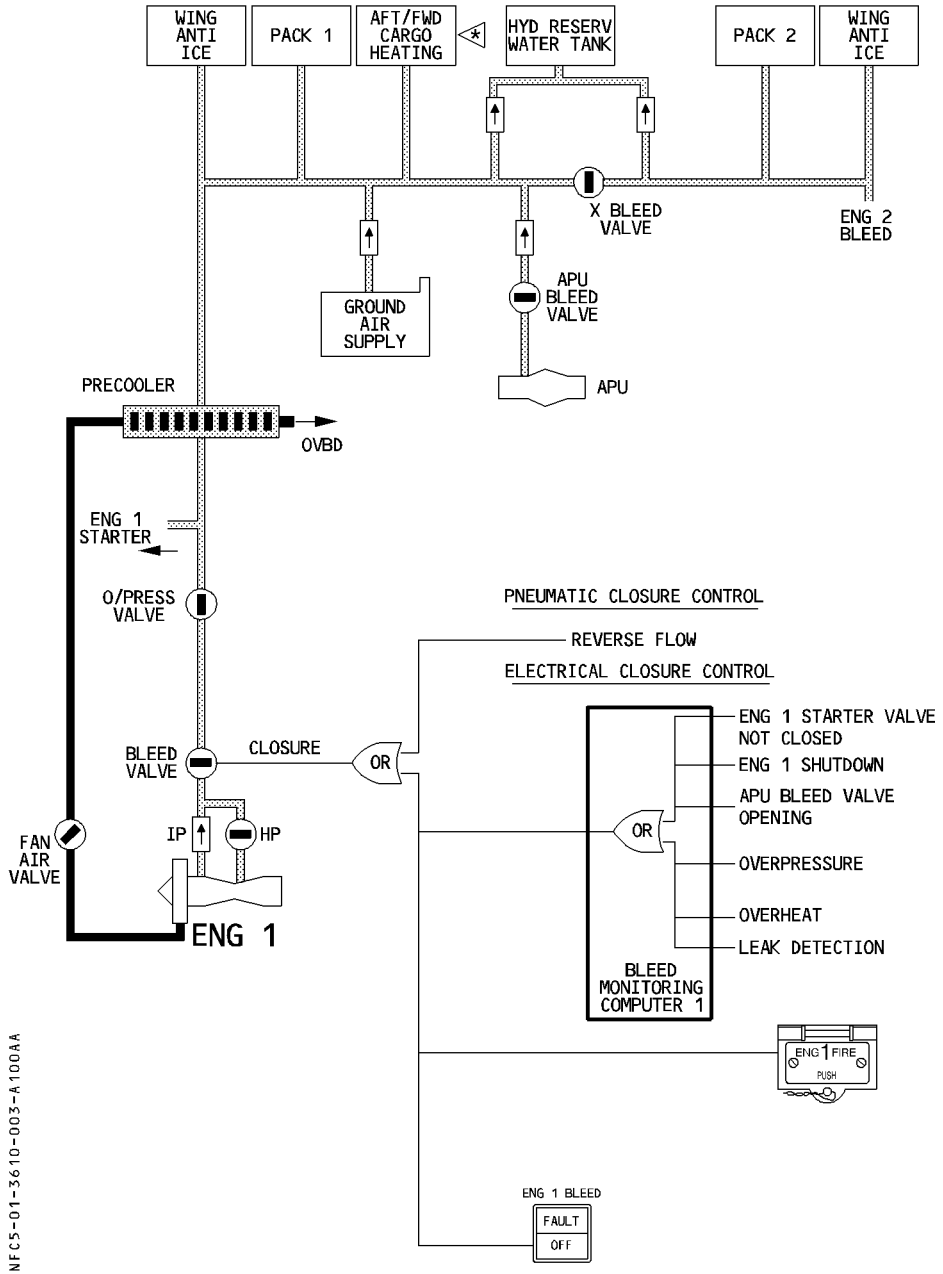
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ECAM INDICATION

NFC5-01-3610-004-A110AA



FOR INFO


WING ANTI ICE
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AFT/FWD CARGO HEATING
HYD RESERV WATER TANK
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WING ANTI ICE
X BLEED VALVE
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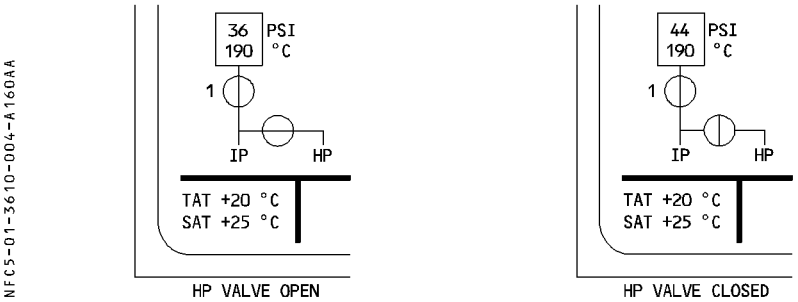
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FOR INFO

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  - *in case of overpressure upstream of the HP valve with wing anti-ice off, two packs on and aircraft altitude above 15000 feet.*

ECAM INDICATION



PRESSURE REGULATION AND LIMITATION

The bleed valve, which is downstream of the junction of HP and IP ducting, acts as a shut-off and pressure regulating valve.
It maintains delivery pressure at 45 ± 5 psi.

Note : Bleed pressure may fluctuate between 38 and 56 psi (with a maximum peak to peak pressure of 16 psi) particularly at high engine power (takeoff or climb) up to FL100.

The bleed valve is fully closed :
- pneumatically :
  - if upstream pressure goes below 8 psi
  - if there is return flow
- electrically by means of
  - the BLEED pushbutton switch (switched OFF)
  - the ENG FIRE pushbutton (pushed)
  - the Bleed air Monitoring Computer (BMC) in the following cases :
    - overtemperature
    - overpressure
    - leak
    - open starter valve
    - APU bleed being ON.

If pressure regulation fails, the overpressure valve closes when the pressure goes over 85 psi.

R *Note : If APU Bleed is ON and the crossbleed valve is SHUT, the Engine bleed valve 2, remains open.*

TEMPERATURE REGULATION AND LIMITATION

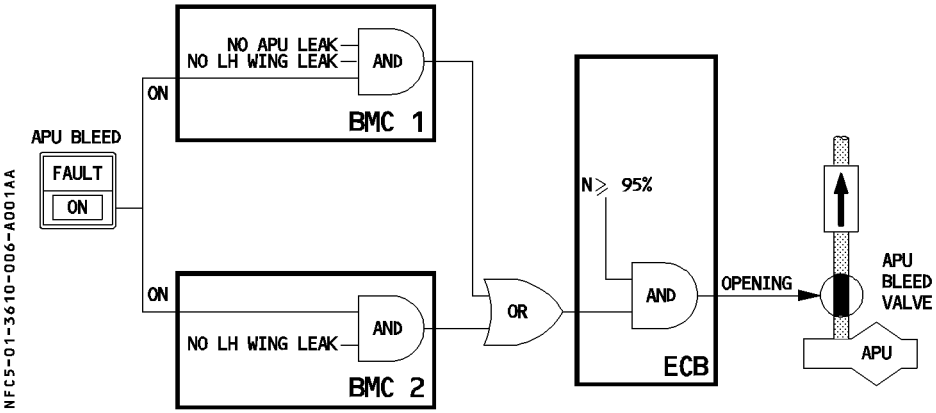
A precooler downstream of the bleed valve regulates the temperature of the bleed air.
The precooler is an air-to-air heat exchanger that uses cooling air bleed from the engine fan to regulate the temperature to approximately 200° C.
The fan air valve controls fan air flow.
A spring keeps the fan air valve closed in the absence of pressure.

APU BLEED AIR SUPPLY

Air from the APU load compressor is available on the ground and in flight.
The APU bleed valve operates as a shut-off valve to control APU bleed air. It is electrically controlled and pneumatically operated.
The APU BLEED pushbutton switch on the AIR COND panel controls the APU bleed valve. When the flight crew selects ON with the pushbutton, APU bleed air supplies the pneumatic system if the APU speed is above 95 %. This opens the crossbleed valve and closes the engine bleed automatically.
A check valve near the crossbleed duct protects the APU when bleed air comes from another source.

APU BLEED VALVE OPENING LOGIC

FOR INFO



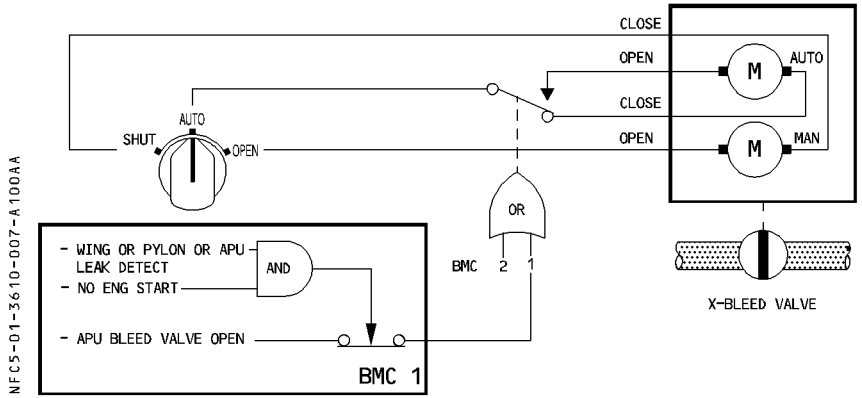
Note : 1. Leak detection are disregarded during an engine start.
2. APU leak detection is lost if BMC1 is lost.

CROSSBLEED

A crossbleed valve on the crossbleed duct allows the air supply systems of the two engines to be isolated or interconnected.
On the AIR COND panel, a rotary selector controls the crossbleed valve electrically.
Two electric motors, one for automatic mode and one for manual mode, control the valve.
In automatic mode, the crossbleed valve opens when the system uses APU bleed air. It closes, if the system detects an air leak (except during engine start).

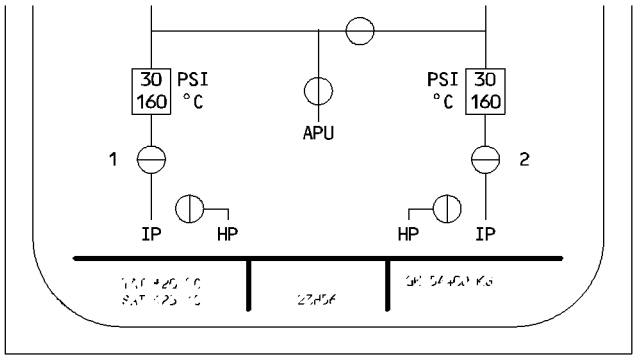
X-BLEED VALVE CONTROL LOGIC

FOR INFO



ECAM INDICATION

R

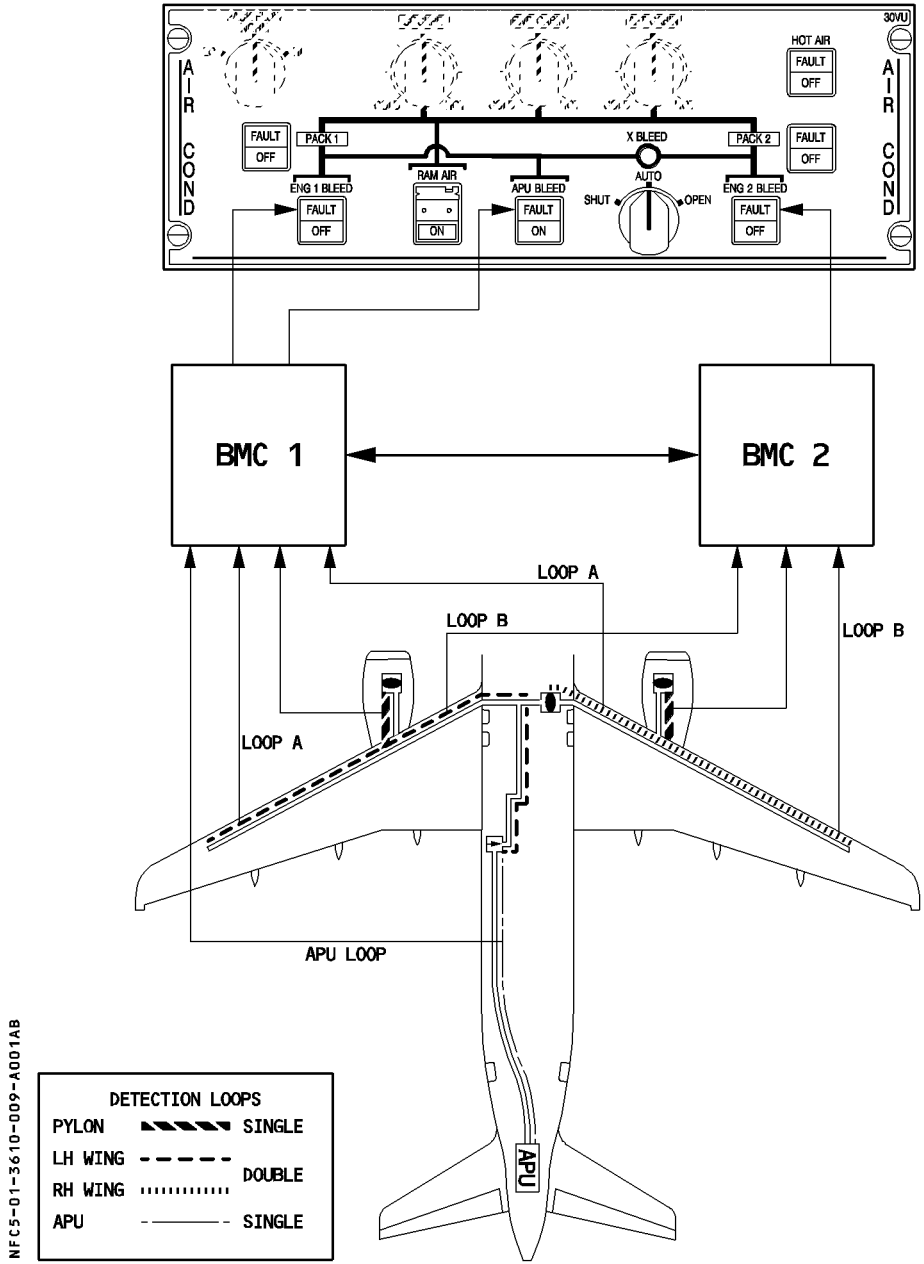


X-BLEED VALVE OPEN.AIR SUPPLIED FROM APU

LEAK DETECTION

Leak detection loops detect any overheating near the hot air ducts in the fuselage, pylons, and wings.
For the pylon and APU, the sensing elements are tied to form a single loop and for the wing, a double loop.
When the two wing loops detect a leak, or when one loop detects the leak and the other one is inoperative, they activate a wing leak signal.
BMC1 and BMC2 each contain identical control logic for the system.

- A wing leak signal causes :
  - the bleed valve on the related side to close automatically
  - the associated FAULT light on the AIR COND panel to come on
  - the x-bleed valve to close automatically (except during an engine start)
  - the APU bleed valve to close automatically (if it is open, and if the leak concerns the left wing) (except during engine start)
- A pylon leak signal causes :
  - the bleed valve on the related side to close automatically
  - the FAULT light for the related engine on the AIR COND panel to come on
  - the x-bleed valve to close automatically (except during an engine start).
- An APU leak signal causes :
  - the APU bleed valve to close automatically (except during engine start).
  - the FAULT light the APU BLEED pushbutton switch on the AIR COND panel to come on
  - the x-bleed valve to close automatically (except during an engine start).



NFC5-01-3610-009-A001AB

OPERATION FOLLOWING FAILURES

BMC FAILURE

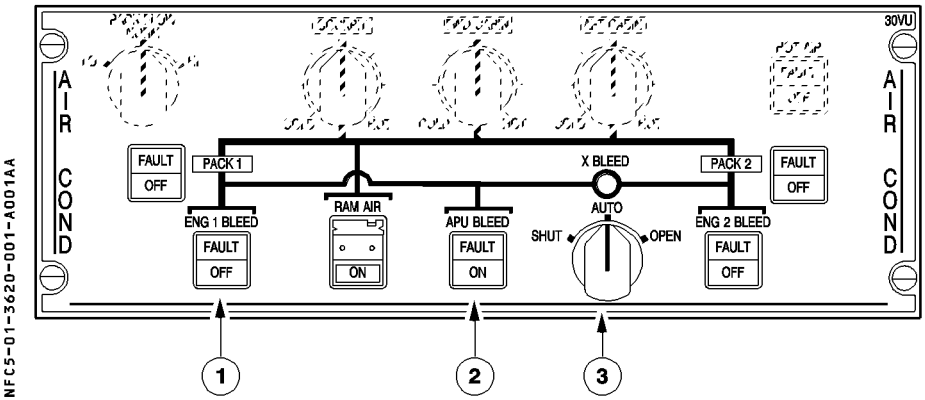
If one BMC fails, the adjacent BMC takes over the monitoring of the bleed system to issue the following ECAM warnings if necessary :

- overpressure
- overtemperature
- wing leak.

Nevertheless, the associated FAULT light on the AIR COND panel is lost, and the associated bleed valve does not close automatically.

ENG BLEED LEAK warning is lost for the associated engine, as is also the APU BLEED LEAK warning if BMC1 has failed.

OVERHEAD PANEL



NFC5-01-3620-001-A001AA

(1) ENG 1 and ENG 2 BLEED pb sw

On : Bleed valve opens if :
- Upstream pressure is above 8 psi.
- APU BLEED pushbutton switch is off or APU bleed valve is closed.
- There is no onside wing or pylon leak, and no overpressure or overtemperature has been detected.
- The ENG FIRE pushbutton has not been popped out.
- The engine start valve is closed.

FAULT lt : This amber light comes on, and an ECAM caution appears, if :
- There is an overpressure downstream of the bleed valve.
- There is a bleed air overheat.
- There is a wing or engine leak on the related side.
- The bleed valve is not closed during engine start.
- The bleed valve is not closed with APU bleed ON.

It goes out when the ENG BLEED pushbutton switch is OFF if the fault has disappeared.

OFF : The bleed valve and HP valve close. The white OFF light comes on.

(2) APU BLEED pb sw

ON : The APU valve opens if N > 95 % and there is no leak in the APU or in the left side bleed. (If there is a leak on the right side, the x-bleed valve closes.)
The blue ON light comes on.

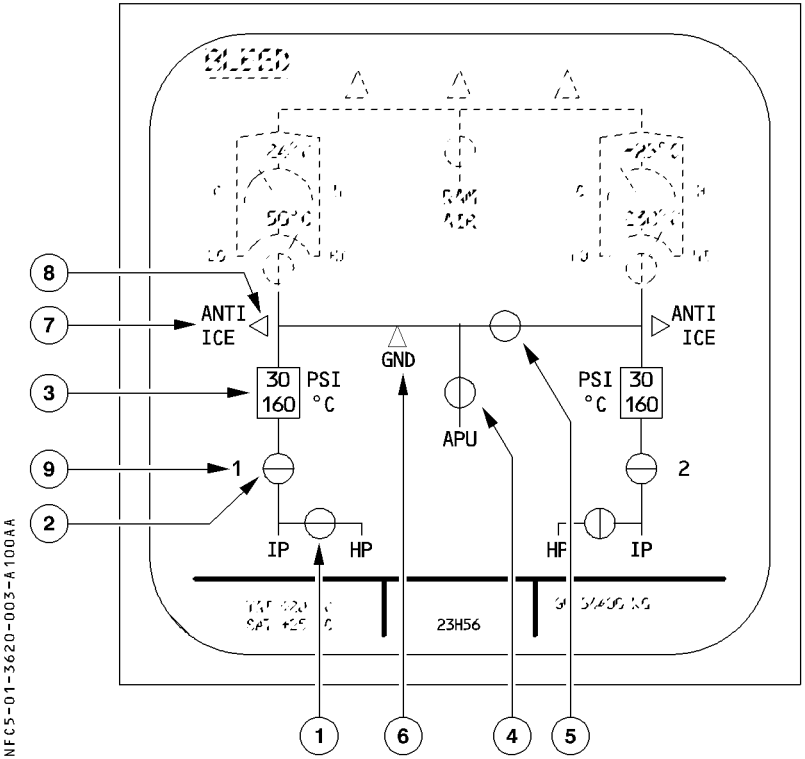
Off : The APU valve closes.

FAULT light : This amber light comes on, and an ECAM caution appears, when the system detects an APU leak.

③ X-BLEED selector sw

AUTO : The crossbleed valve is open if the APU bleed valve is open.
The crossbleed valve is closed if the APU bleed valve is closed or, in case of a wing, pylon, or APU leak (except during engine start).
OPEN : The crossbleed valve is open.
CLOSE : The crossbleed valve is closed.

ECAM BLEED PAGE



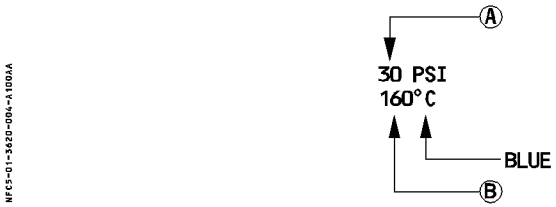
(1) HP VALVES

Cross line - green : HP valve normally fully closed
In line - green : HP valve not fully closed
Cross line - amber : HP valve not in commanded (closed) position

(2) ENGINE BLEED VALVES

In line - green : BLEED valve normally open
Cross line - green : BLEED valve normally fully closed
In line - amber : BLEED valve not in commanded (open) position
Cross line - amber : BLEED valve not in commanded (closed) position

(3) ENGINE BLEED INDICATIONS



(A) Precooler inlet pressure
It is normally in green.
It becomes amber, if under 4 psi, or if overpressure is detected by the BMC (threshold between 57 and 60 psi).

(B) Precooler outlet temperature
It is normally in green.
It becomes amber, if the BMC detects an overheat or low temperature.
Overheat : Temperature exceeds :
– 290° C for more than 5 seconds, or
– 270° C for more than 15 seconds, or
– 257° C for more than 55 seconds
Low temperature is detected, if the temperature is lower than 150° C.

R *Note : When the engines are at idle, and depending on the ambient temperature, the precooler outlet temperature may be below 150° C.*

(4) APU BLEED VALVE

Crossline – Green	:	The APU valve is not fully open, and the APU master switch is ON.
In line – Green	:	The APU valve is fully open, and the APU master switch is ON.
R Crossline – Amber	:	The APU valve is fully closed, the APU master switch is ON,
R		and the APU bleed switch is ON for more than 10 seconds.

(5) CROSSBLEED VALVE

Crossline – Green	:	The crossbleed valve is normally closed.
In line – Green	:	The crossbleed valve is normally open.
Crossline – Amber	:	The crossbleed valve is not in the commanded (closed) position.
In line – Amber	:	The crossbleed valve is not in the commanded (open) position.
Transit – Amber	:	The crossbleed valve is in transit.

(6) GND HP ground connection indication

△ GND : displayed in white when the aircraft is on ground.

(7) ANTI ICE indication

It is displayed in white, when the WING pushbutton on the ANTI-ICE panel is ON.

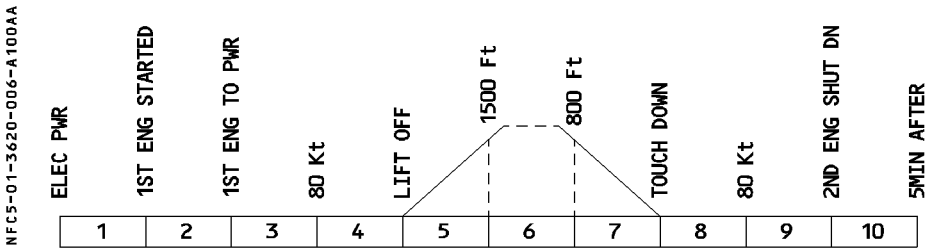
(8) Arrow

◁– : – It is normally not displayed, when the corresponding valve is closed.
– It is normally displayed in green, when the corresponding valve is open.
– It becomes amber, when the
· Valve is open and air pressure is low or high, or
· Valve is open on ground for more than 10 seconds.

(9) Engine identification (1-2)

It is normally in white.
It becomes amber, when engine N2 is below idle.

WARNINGS AND CAUTIONS



E / WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
ENG 1 (2) BLEED FAULT engine 1 (2) running and bleed air pressure > 57 psig (+ 3/– 0) or temperature : > 257°C for more than 55 sec or > 270°C for more than 15 sec or > 290°C for more than 5 sec	SINGLE CHIME	MASTER CAUT	BLEED	ENG BLEED FAULT lt	1, 3, 4, 5, 7, 8, 10
L (R) WING LEAK temperature > 124°C detected by the loops					3, 4, 5, 7, 8
ENG 1 (2) BLEED LEAK temperature > 204°C detected by the loop and engine 1 (2) running					
ENG 1 (2) BLEED NOT CLSD bleed valve not automatically closed during engine start or with APU bleed selected					
BLEED 1 (2) OFF one engine bleed switched off with no fault				ENG BLEED OFF lt	1, 3, 4, 5, 7, 8, 9, 10
APU BLEED FAULT APU available and APU bleed valve position disagrees with selected position.				NIL	3, 4, 5, 7, 8
APU BLEED LEAK temperature > 124°C detected by the loop				APU BLEED FAULT lt	
ENG 1 (2) BLEED ABNORM PR regulated pressure is abnormal				NIL	1, 3, 4, 5, 7, 8, 10

E / WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
ENG 1 (2) (1+2) BLEED LO TEMP one (both) engine bleed below 150°C in flight with wing anti ice ON	SINGLE CHIME	MASTER CAUT	BLEED	NIL	3, 4, 5, 8
X BLEED FAULT position disagree with selected position					3, 4, 5, 7, 8
ENG 1 (2) HP VALVE FAULT HP valve is abnormally closed	NIL	NIL			
BLEED MONITORING FAULT Both BMC faulty					
L(R) WING LEAK DET FAULT Both detection loops inop in one wing					

MEMO DISPLAY

APU BLEED appears in green if the APU is available and the APU BLEED pushbutton switch is ON.

E / WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
ENG 1 (2) (1+2) BLEED LO TEMP one (both) engine bleed below 150°C in flight with wing anti ice ON	SINGLE CHIME	MASTER CAUT	BLEED	NIL	3, 4, 5, 8
X BLEED FAULT position disagree with selected position					3, 4, 5, 7, 8
ENG 1 (2) HP VALVE FAULT HP valve is abnormally closed	NIL	NIL			
BLEED MONITORING FAULT Both BMC faulty					
L(R) WING LEAK DET FAULT Both detection loops inop in one wing					
BLEED MONIT SYS 1(2) FAULT One BMC faulty			NIL		3, 4, 5, 6, 7, 8
ENG 1(2) LEAK DET FAULT Detection loop inop in pylon					

MEMO DISPLAY

APU BLEED appears in green if the APU is available and the APU BLEED pushbutton switch is ON.

BUS EQUIPMENT LIST

		NORM		EMER ELEC		
		AC	DC	AC ESS	DC ESS	HOT
BMC	1				SHED	
	2		DC2			
BLEED VALVES, HP VALVES AND FAN AIR VALVES	ENG 1				SHED	
	ENG 2		DC2			
X-BLEED VALVE	AUTO CONTROL		DC2			
	MANUAL CONTROL				SHED	

38.00 CONTENTS

38.10 DESCRIPTION

– GENERAL 1
– POTABLE WATER 2
– WASTEWATER SYSTEM 3
– TOILET SYSTEM 4

38.20 ELECTRICAL SUPPLY

– BUS EQUIPMENT LIST 1

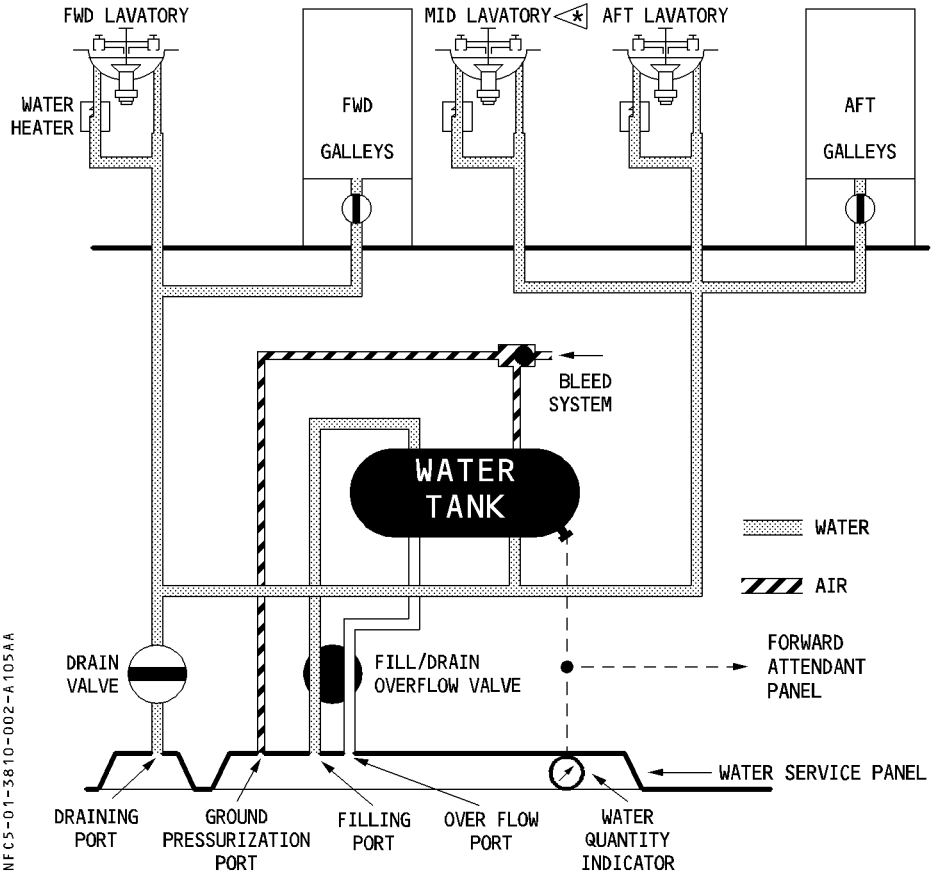
GENERAL

The water and waste system :
– distributes potable water to the toilets and the galleys.
– disposes waste water.
– stores toilet wastes.
The system is insulated to prevent water leaks and ice build up.
The water and waste control panel is on the forward cabin attendant's panel.

POTABLE WATER

Potable water is stored in a 200-liters tank (135-liters ◁) in the left hand side wall behind the aft cargo compartment.
While airborne, the aircraft uses bleed air to pressurize the water system ; on the ground it uses air from the service panel pressure port.
Potable water is piped to the galleys and lavatories. Manual shutoff valves isolate the forward, mid ◁ and aft washbasins from the water system. These valves, easily identifiable by OPEN and SHUT legends, are under washbasins or toilet bowls.
The system can be filled or drained from the service panel at the bottom of the fuselage. Indicators on the forward attendant's panel and the aft service panel show how much water the water tank contains.

FOR INFO



GENERAL

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– distributes potable water to the toilets and the galleys.
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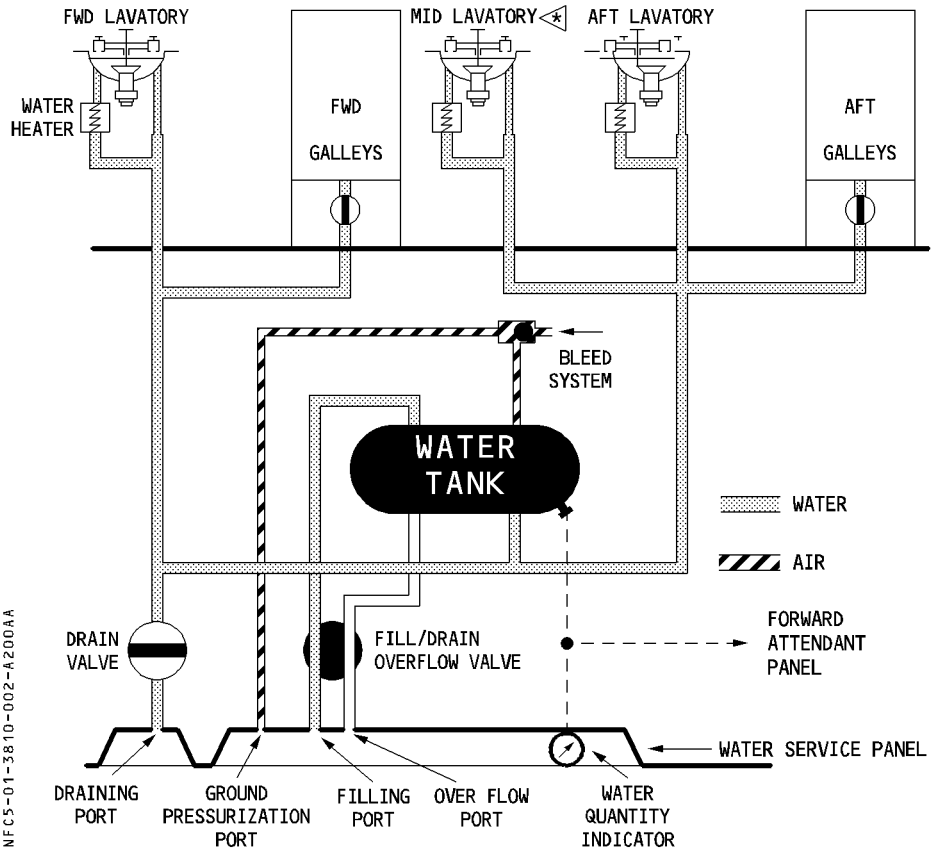
Potable water is stored in a 200-liters tank in front of the wing box behind the forward cargo compartment.

While airborne, the aircraft uses bleed air to pressurize the water system ; on the ground it uses air from the service panel pressure port.

R Potable water is piped to the galleys and lavatories. Manual shutoff valves isolate the forward, mid ◁ and aft washbasins from the water system. These valves, easily identifiable by OPEN and SHUT legends, are under washbasins or toilet bowls.

The system can be filled or drained from the service panel at the bottom of the fuselage. Indicators on the forward attendant's panel and the aft service panel show how much water the water tank contains.

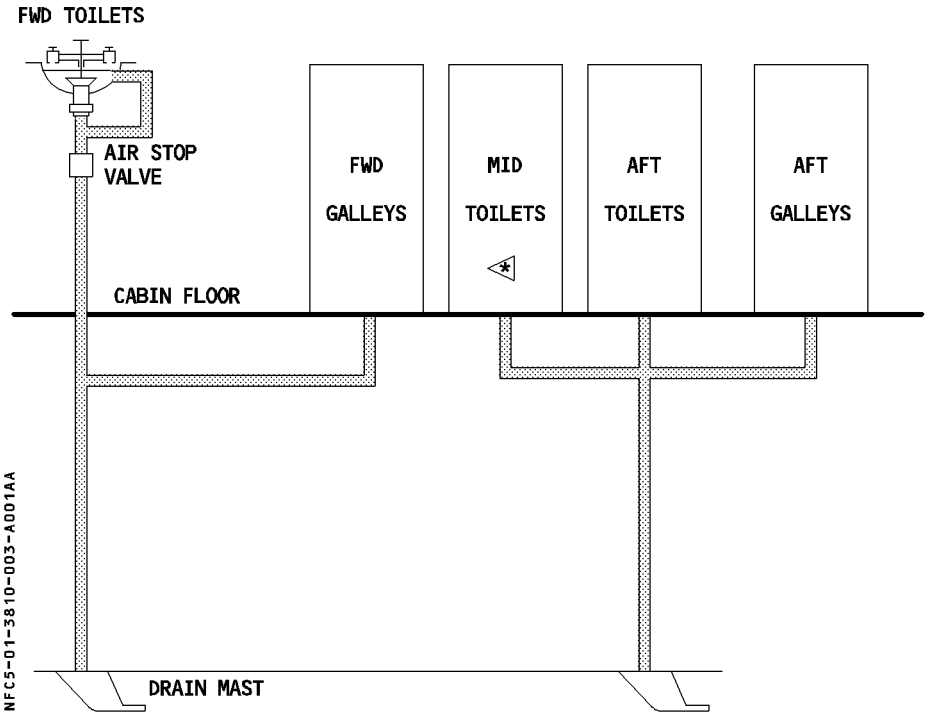
FOR INFO



WASTEWATER SYSTEM

Wastewater from the galleys and from the sinks in the lavatories drains overboard through two anti-iced drain masts.
The forward mast drains wastewater from the forward cabin; the aft mast drains it from the aft cabin.
Differential pressure discharges the wastewater in flight, and gravity does so on the ground.

FOR INFO



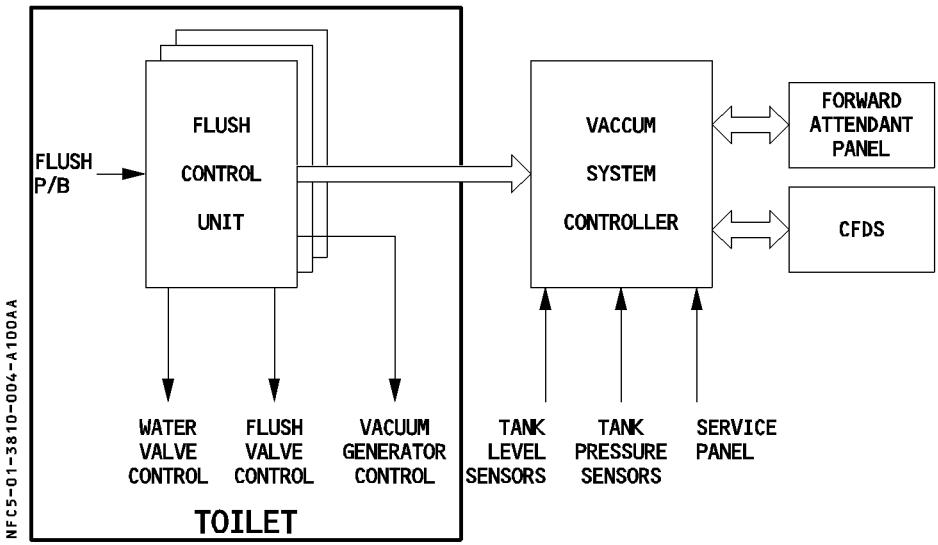
TOILET SYSTEM

Differential pressure forces waste from the toilet bowls into the waste storage tank. On ground, and at altitudes below 16000 feet, a vacuum generator produces the necessary pressure differential.
Clear water from the potable water system flushes the toilets.
A flush control unit, within each toilet, controls the flush sequence.
In case of an electrical failure in the flush valve, personnel can use a manual flush control
R under the toilet bowl.
The Vacuum System Controller (VSC) furnishes operational information, such as the waste level in the storage tank, to the Flight Attendants' panel, and maintenance information and a test program to the Centralized Fault Display System.

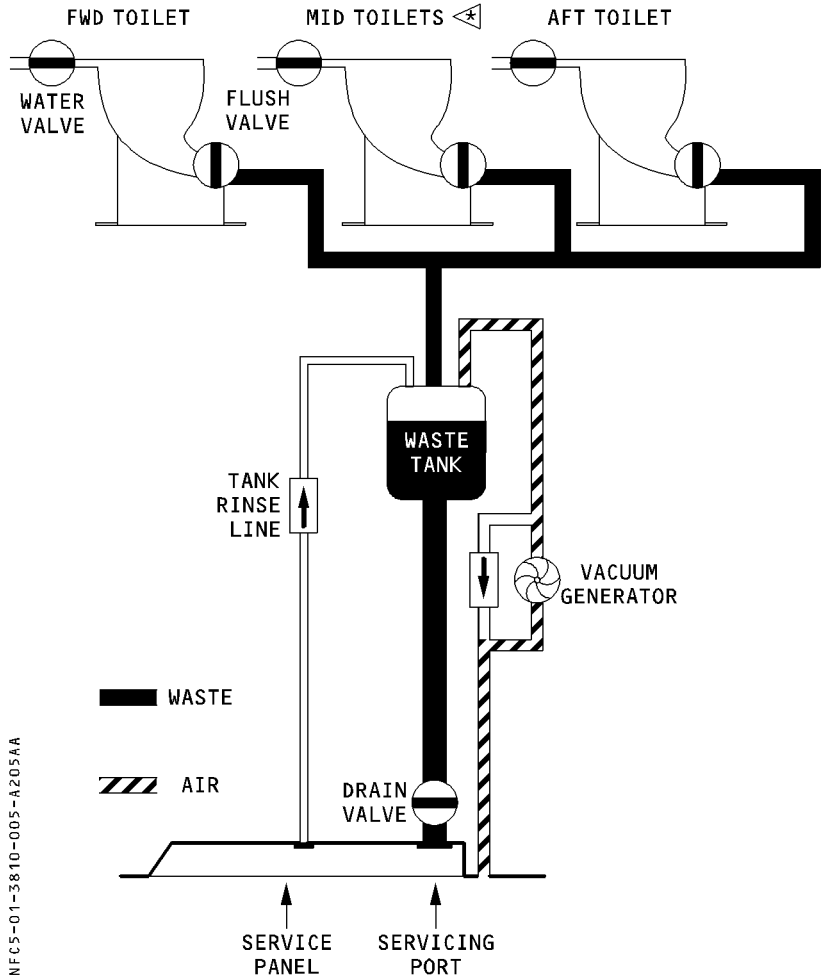
Note : To restart an inoperative toilet, a Flight Attendant may attempt to reset the VSC as follows :
VACUUM SYS C/B (on 2001 VU, aft cabin C/B panel) . . . . . PULL for 30 seconds.
VACUUM SYS C/B (on 2001 VU, aft cabin C/B panel) . . . . . PUSH

The waste tank has a usable capacity of 170 liters.
Ground personnel services the waste tank via a single service panel under the fuselage.
A manual shut-off valve isolates an inoperative toilet.

ARCHITECTURE



SCHEMATIC


FWD TOILET
MID TOILETS
AFT TOILET
WATER VALVE
FLUSH VALVE
WASTE TANK
TANK RINSE LINE
VACUUM GENERATOR
WASTE
AIR
DRAIN VALVE
SERVICE PANEL
SERVICING PORT
NFCS-01-3810-005-A205AA

BUS EQUIPMENT LIST

	NORM			EMER ELEC		
	AC	DC	DC BAT	AC ESS	DC ESS	HOT
POTABLE WATER SYS		GND/FLT				
WATER HEATER	AC2					
WATER DRAINING		GND/FLT				
VACUUM GENERATOR	AC2					
PRESSURIZED WATER SYS	AC2					
FLUSH CONTROL UNITS		GND/FLT				
VACUUM SYS CONTROLLER		GND/FLT				

45.00 CONTENTS

45.10 DESCRIPTION

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45.20 SYSTEM OPERATION

– MAINTENANCE MENU 1
– LAST OR CURRENT LEG REPORT 2
– LAST OR CURRENT LEG ECAM REPORT 2
– PREVIOUS LEGS REPORT 4
– AVIONICS STATUS 4
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– GMT/DATE INITIALIZATION 7
– BACK UP MODE 8
– ACARS PRINT PROGRAM ◁ 9

R **45.25 DATA LOADING** ◁

45.30 PRINTER ◁

R **45.40 ELECTRICAL SUPPLY**

GENERAL

The purpose of the Centralized Fault Display System (CFDS) is to make the maintenance task easier by displaying fault messages in the cockpit and permitting the flight crew to make some specific tests.
There are two levels of maintenance :
at the line stop : removal and replacement of equipment
at the main base : troubleshooting

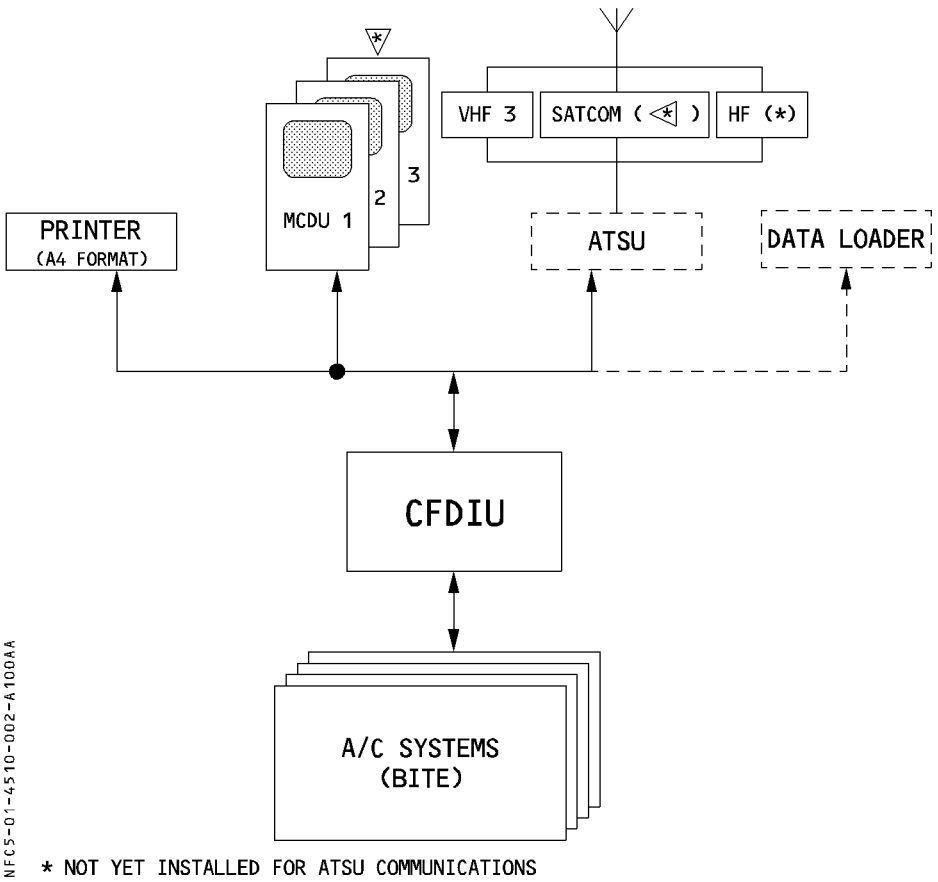
COMPONENTS

The CFDS includes :
– the BITE (Built-In Test Equipment) for each electronic system
– a central computer, the Centralized Fault Display Interface Unit (CFDIU)
– two MCDUs (Multipurpose Control and Display Units), used also for FMGS (Flight Management and Guidance System), AIDS (Aircraft Integrated Data System), and ACARS (Aircraft Communication And Reporting System, if installed), which work with the CFDIU to display information or initiate tests
– one printer.
If a main channel of the CFDIU fails, the backup channel takes over.

MODES OF OPERATION

The CFDS operates in two main modes :
– the NORMAL mode or REPORTING mode (in flight)
– the INTERACTIVE mode or MENU mode (on ground).
In NORMAL mode, the CFDS records and displays the failure messages transmitted by each system BITE.
In INTERACTIVE mode, the CFDS allows any BITE to be connected with the MCDU in order to display the maintenance data stored and formatted by the BITE or to initiate a test.

ARCHITECTURE



* NOT YET INSTALLED FOR ATSU COMMUNICATIONS

FAILURE/FAULT CLASSIFICATION

The Centralized Fault Display System (CFDS) identifies the faulty system and puts any failures or faults into one of three classes :

Class 1: Failures indicated to the flight crew by means of the ECAM, or other flight
R deck effect. They must be repaired or entered in the MEL (Minimum Equipment List) before the aircraft can depart.

Class 2: Faults indicated to maintenance personnel by the CFDS, and which trigger a MAINT status entry on the maintenance part of the ECAM status page. The aircraft can operate with these faults, but they must be repaired within 10 days.

Class 3: Faults indicated to maintenance personnel by the CFDS, but which do not trigger a MAINT status. The operator may have these faults corrected at his convenience.

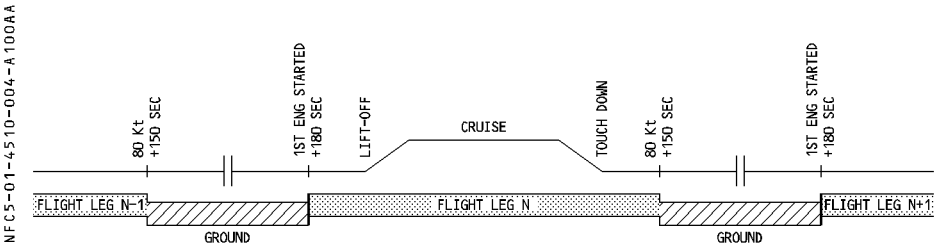
R

Failure/fault classes	Class 1	Class 2	Class 3
Operational consequences	YES	NO	NO
Indication to the flight crew	YES Automatically displayed : – Warning or caution messages on Engine Warning Display – Flag or indication in the flight deck.	YES Available on the ECAM status page.	NO
Dispatch consequences	Refer to MEL may be : "GO" "GO IF" "NO GO"	No need to refer to MEL except for the message – AIR BLEED For all the other class 2 messages, "GO" without conditions. Can be left uncorrected for 10 days.	MEL not applicable
Indication to the maintenance team	YES Automatically print out at the end of each flight : Fault messages on the CFDS Post Flight Report.		YES Available on request through system report/Test

FUNCTIONS OF THE CENTRALIZED FAULT DISPLAY SYSTEM (CFDS)

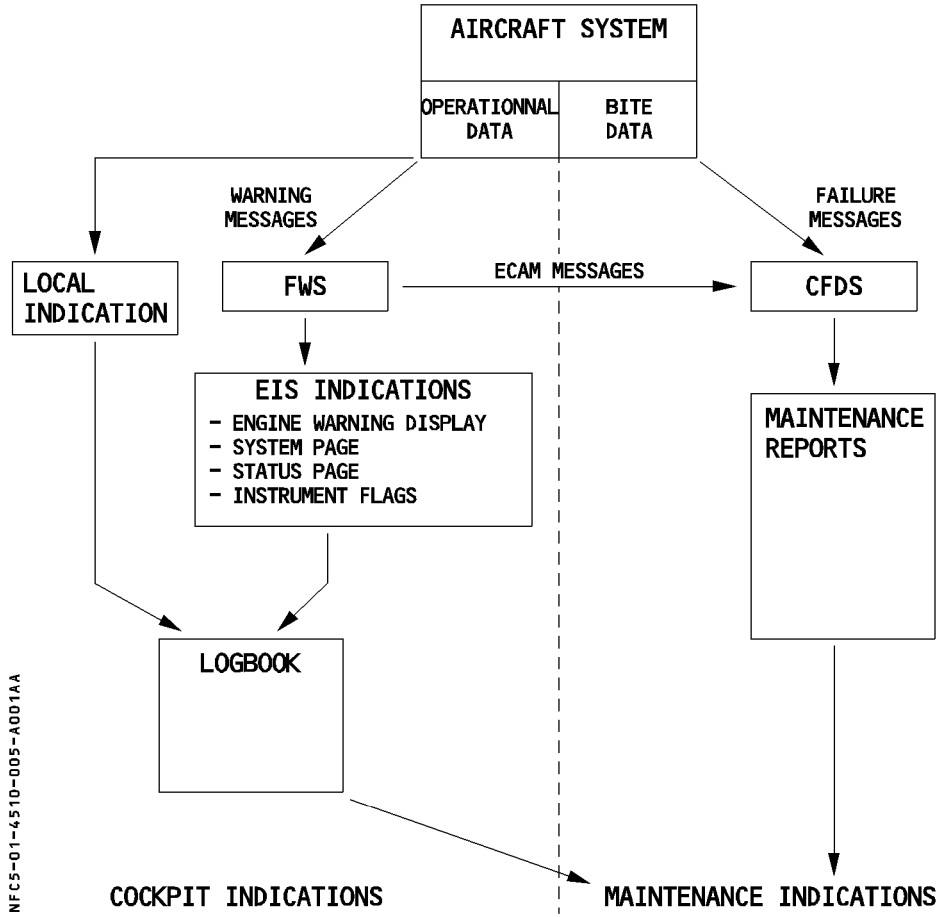
The main functions of the CFDS are :

- obtaining and storing messages transmitted by the connected system BITEs, or by the Flight Warning Computer (Warning and Caution titles)
- Detailing the maintenance phases



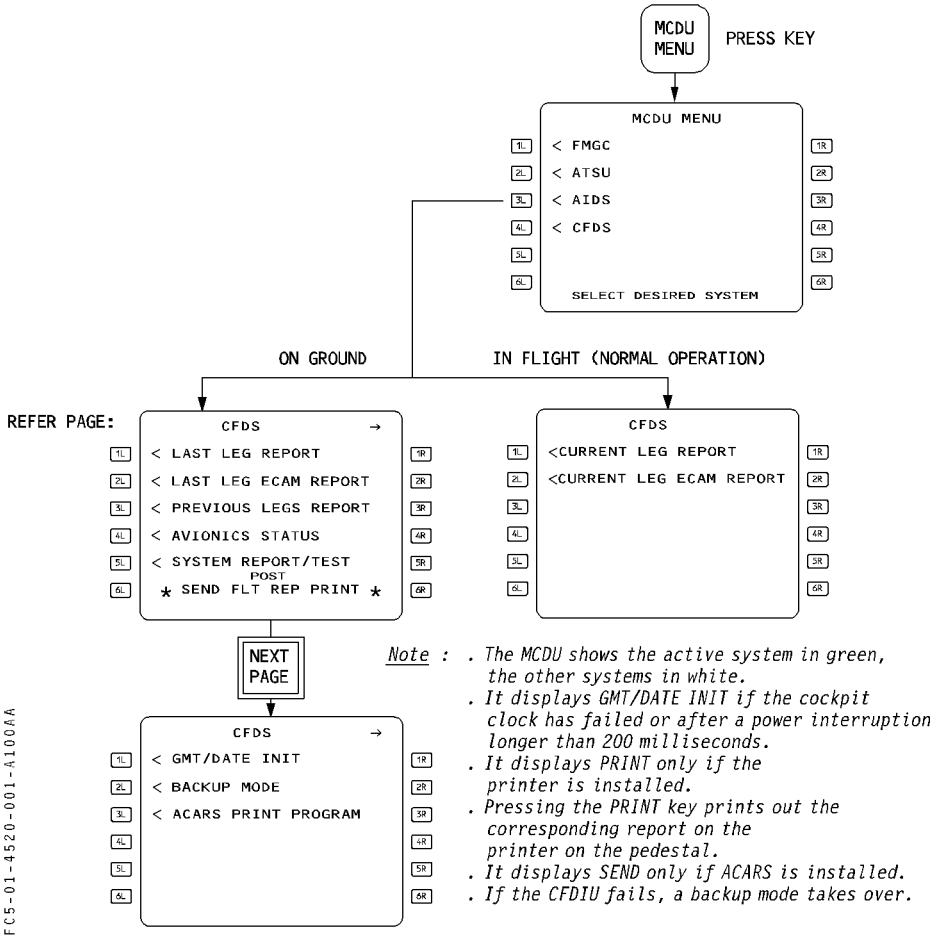
- Presenting maintenance reports :
  - Last leg report
  - Last leg ECAM report
  - Previous leg report
  - Avionics status
  - System report test
  - Post-flight report.

COCKPIT/CFDS INTERFACE



MAINTENANCE MENU

The CFDS uses menus displayed on the MCDU. The operator selects functions or reports from these menus.
Pressing the MCDU MENU key and then selecting CFDS brings up the MAINTENANCE MENU page (different pages for the aircraft in flight and the aircraft on the ground).

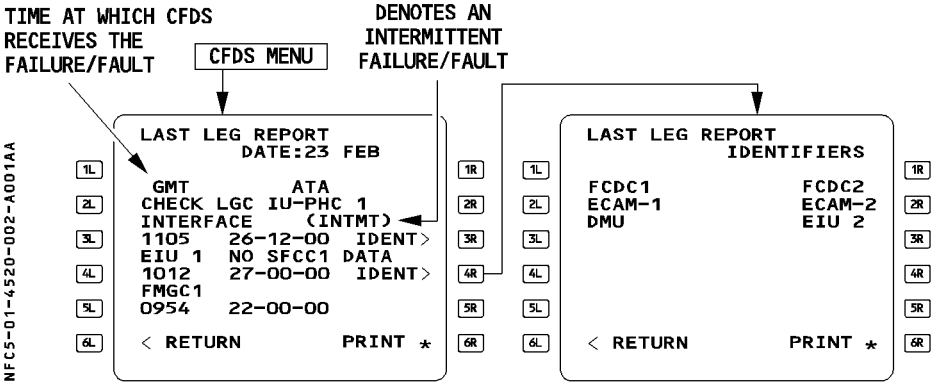


Note :
- *The MCDU shows the active system in green, the other systems in white.*
- *It displays GMT/DATE INIT if the cockpit clock has failed or after a power interruption longer than 200 milliseconds.*
- *It displays PRINT only if the printer is installed.*
- *Pressing the PRINT key prints out the corresponding report on the printer on the pedestal.*
- *It displays SEND only if ACARS is installed.*
- *If the CFDIU fails, a backup mode takes over.*

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LAST (or CURRENT) LEG REPORT

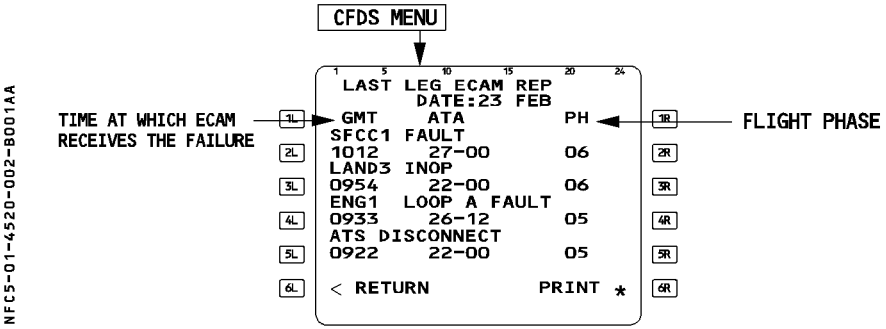
The LAST LEG REPORT (on the ground) or the CURRENT LEG REPORT (in flight), list all class 1 failures and class 2 faults and all system failure and system fault messages received by the CFDS during the last flight leg or the current flight leg. Pressing the IDENT key displays a list of the systems (called identifiers) affected by the failure or fault, which helps the pilot or maintenance person to identify the failure or fault.



LAST (or CURRENT) LEG ECAM REPORT

In flight : The CURRENT LEG ECAM REPORT displays the primary and independent warning (class I) messages and MAINTENANCE STATUS (class II) messages of the current flight leg.

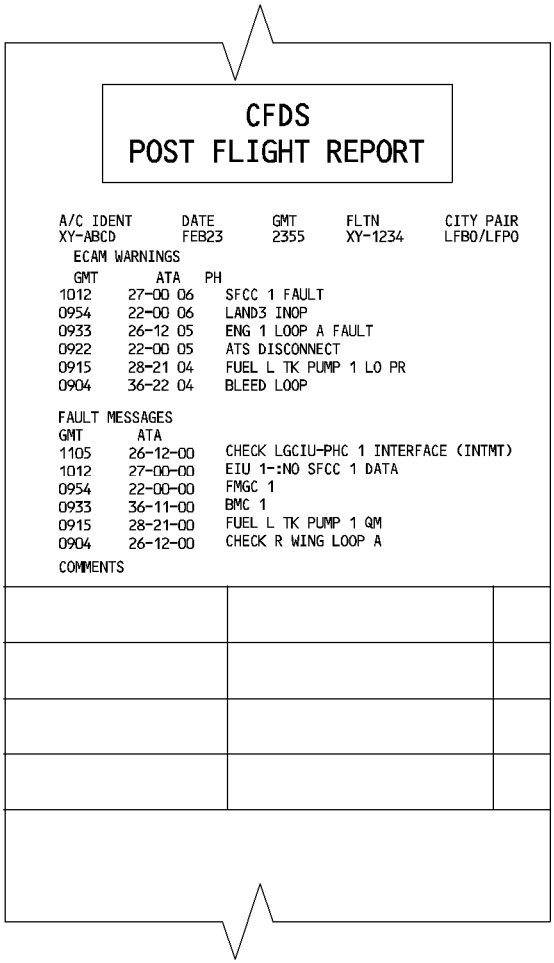
On the ground : The LAST LEG ECAM REPORT displays the primary and independent warning (class I) messages plus MAINTENANCE STATUS (class II) messages of the last flight leg.



Note : This screen displays PRINT only if the printer is installed.

POST FLIGHT REPORT PRINT

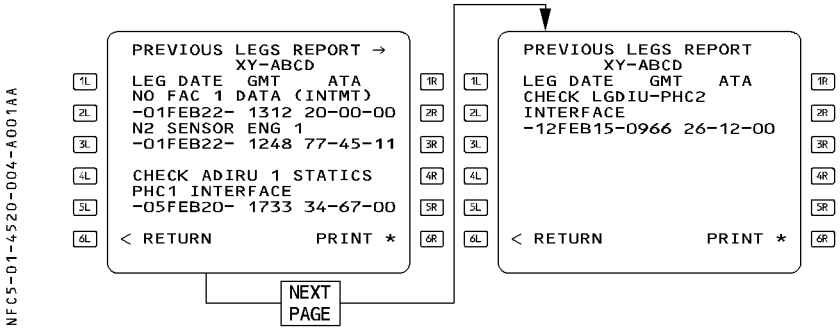
At the end of a flight, LAST LEG and LAST LEG ECAM REPORTS are printed out automatically after landing (30 seconds after reaching 80 knots). The flight or ground crew can also print them out by selecting POST FLIGHT REP PRINT.
The report first lists the ECAM warnings, then the FAULT messages.



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PREVIOUS LEGS REPORT

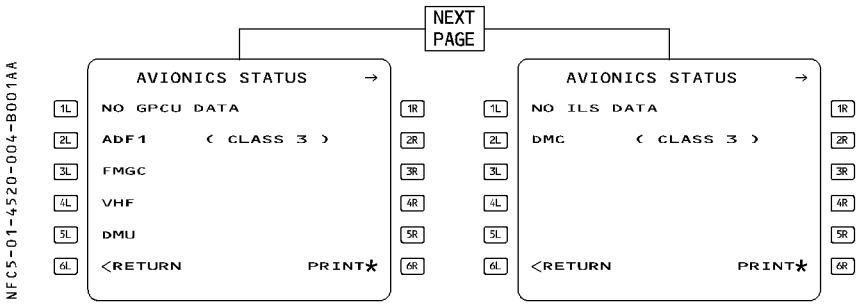
This report gives access to the POST FLIGHT REPORTS of the previous 63 flight legs.



On ground, the Operator can print copies of the screen. If ACARS is installed, the Operator can send the flight report (see the POST FLIGHT REPORT paragraph).

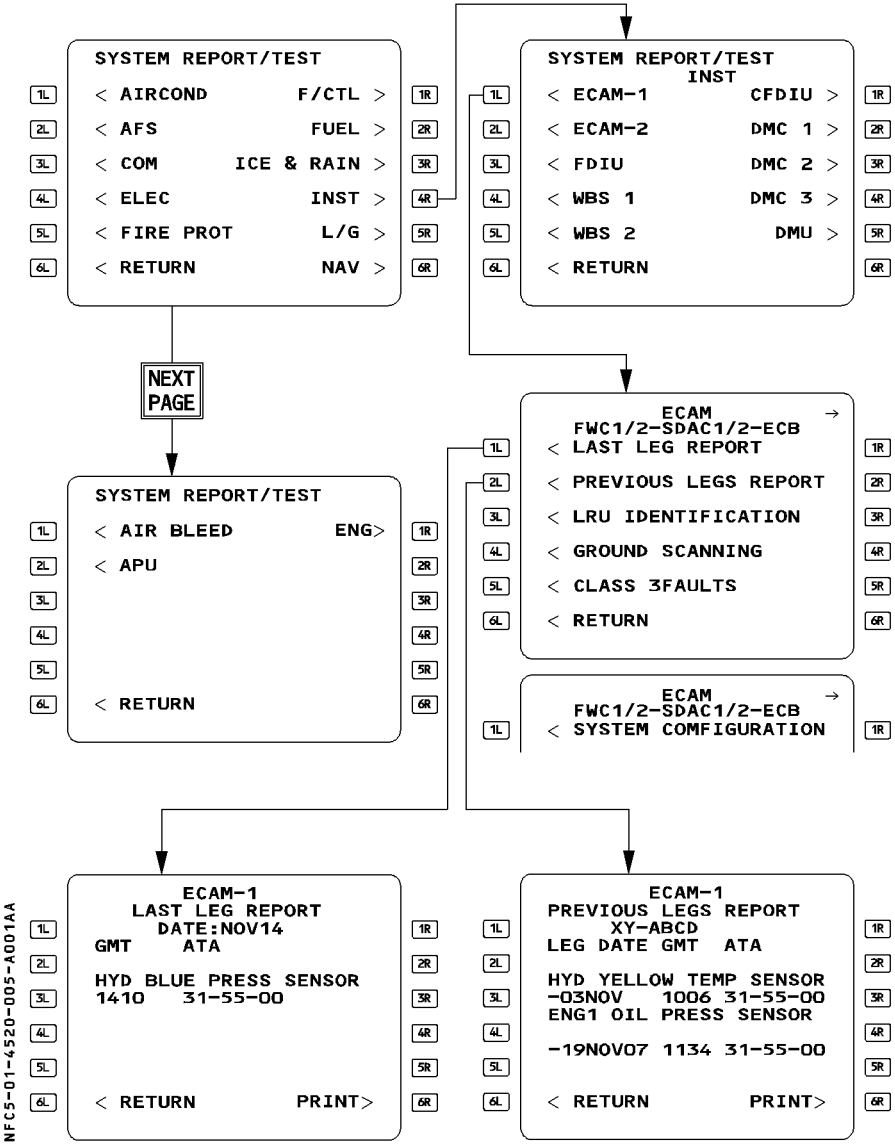
AVIONICS STATUS

R This screen displays the list of systems affected by a failure or fault. If a system is affected
R by at least a Class 3 fault, CLASS 3 appears beside it. The display is continuously updated.



SYSTEM REPORT/TEST

This screen gives the operator access to all electronic systems. The CFDIU enters into interactive dialogue with the selected system.



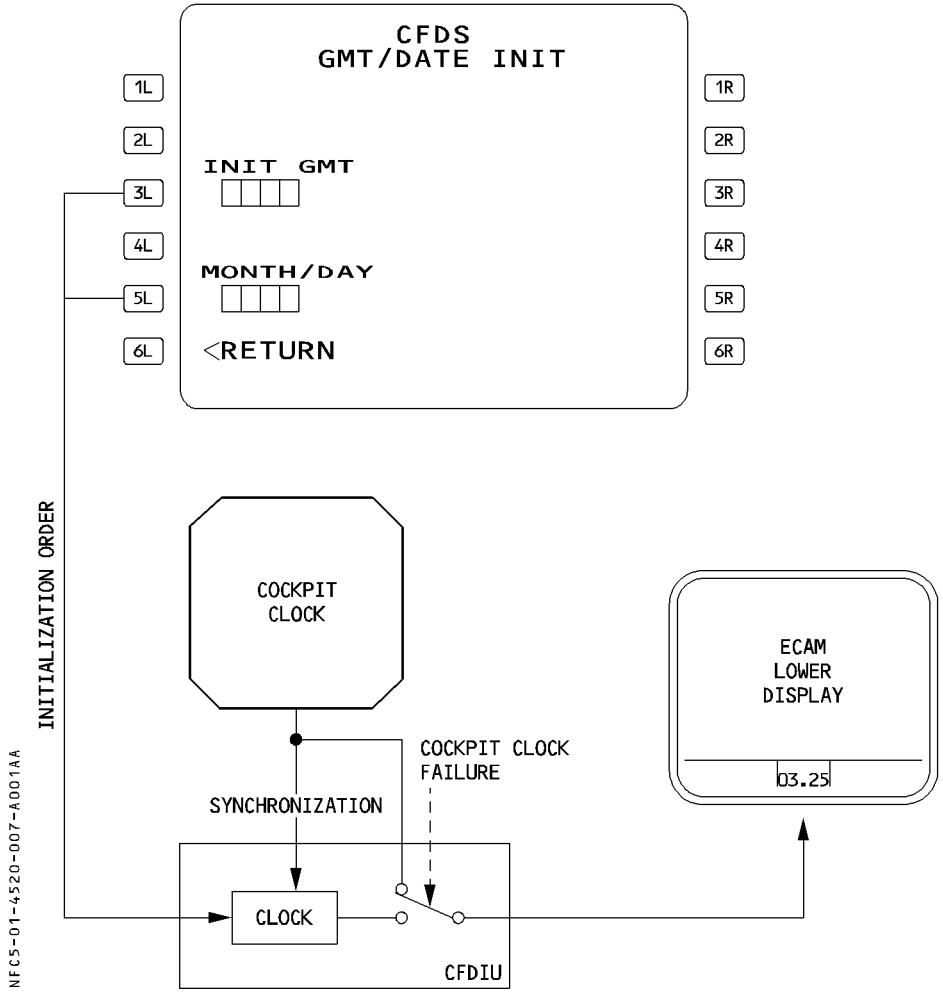
In the above example, the operator has called up menus of the selected systems :

- LAST or PREVIOUS LEG REPORT presents the list of Line-Replaceable Units (LRUs) affected by a failure.
- LRU IDENTIFICATION contains the part numbers of all LRUs in the system.
- GND SCANNING runs the flight monitoring on the ground and indicates the faulty LRU.
- CLASS 3 FAULTS lists class 3 faults detected by the system during the last flight leg.
- SYSTEM CONFIGURATION presents the system configuration in a digital form.

Note : These screens (except LAST or PREVIOUS LEG REPORT) are not shown above.

GMT/DATE INITIALIZATION

R A CFDIU clock is synchronized with the cockpit clock in order to keep GMT (UTC) displayed on the ECAM lower display (except in flight Phases 1 and 2, if the weight and balance system is installed). If the cockpit clock fails, the CFDIU clock continues to display GMT
R (UTC) on the ECAM lower display.
If electrical power is interrupted for more than 200 milliseconds, the crew initializes GMT
R (UTC) and the DATE via the MCDU :
R – Write GMT (UTC) in the scratchpad, then press the “INIT GMT” key.
– Do the same for the month and day.
R



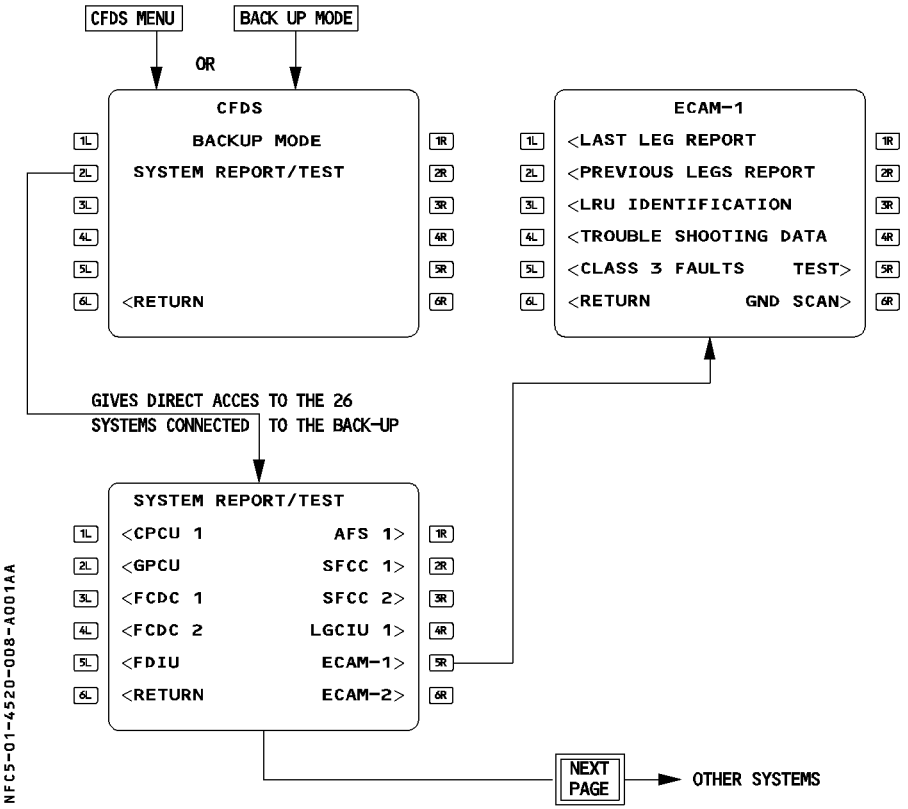
BACK UP MODE

If the CFDIU's main channel fails, the backup channel allows the CFDS to operate in backup mode :

- on the ground only
- through MCDU1 (or MCDU3, if installed)
- in one mode of operation only : SYSTEM REPORT/TEST
- without the PRINTER or ACARS.

The system changes over from main channel to backup channel :

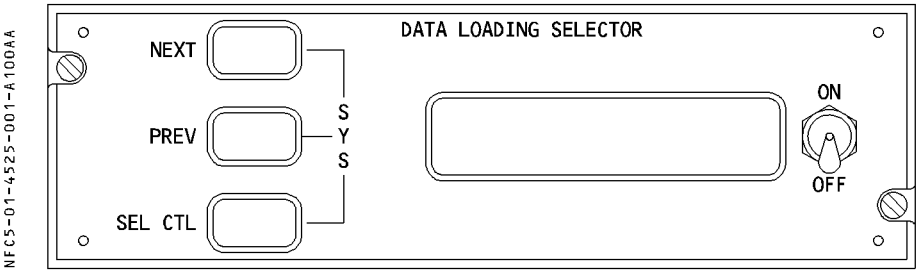
- Automatically in case of an important failure (power supply, for example). In this case, when the operator selects CFDS on the MCDU MENU, it displays the BACKUP MODE page.
- Manually if the operator selects BACKUP MODE on the CFDS menu after a minor failure.



DESCRIPTION

With the data loading system, it is possible to upload databases and operational software, or to download system reports from various onboard computers.
The data transfer is performed via 3.5 inch disks and a portable data loader, or (◁) the aircraft fixed Multipurpose Disk Drive Unit (MDDU).

DATA LOADING SELECTOR on the OVERHEAD panel

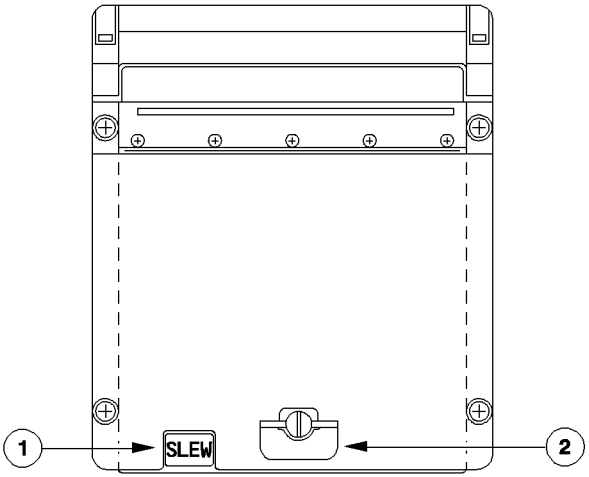


When the data loading selector is ON, the 3 keys (NEXT, PREV, SEL CTRL) enable the display and selection of various applicable aircraft systems (FMGC, TCAS ◁ etc...).

GENERAL

The printer prints reports from the following systems (if installed) : ACARS, AIDS, FMGC, CFDIU and EVMU. It prints these on paper, and does so either on the ground or in flight. The printer is installed at the rear of the pedestal on the right side.

SYSTEM DESCRIPTION



NFCS-01-4530-001-A001AA

(1) SLEW sw :

The SLEW switch is used to feed paper after having loaded a new roll.

(2) PRINTER DOOR LATCH :

The printer door latch locks the door used for loading paper.

BUS EQUIPMENT LIST

	NORM		EMER ELEC		
	AC	DC	AC ESS	DC ESS	HOT
CFDS		DC1			

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– COCKPIT ARRANGEMENT 2

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– INTRODUCTION 1
– DOWNLINK AND UPLINK MESSAGES 2
– DATALINK/VOICE TRANSFER ON VHF 3 5
– DATALINK/VOICE TRANSFER ON HF1 ◁ 7
– SCRATCHPAD MESSAGES ON THE COMM MENU 8

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– REMOTE APPLICATIONS 1

R **46.40 CNS/ATM**

R **46.60 WARNING AND CAUTIONS**

R **46.70 ELECTRICAL SUPPLY**

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46.30 AOC APPLICATIONS
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– REMOTE APPLICATIONS 1

46.40 COMMUNICATION NAVIGATION SURVEILLANCE (CNS)/ AIR TRAFFIC MANAGEMENT (ATM)
– INTRODUCTION 1
– CONTEXT MANAGEMENT APPLICATION (CMA) 2
– CONTROLLER PILOT DATALINK COMMUNICATIONS (CPDLC) . . 2

46.55 CNS/ATM CONTROLS/INDICATORS
– GLARESHIELD 1
– DATA COMMUNICATION DISPLAY UNITS (DCDU) 2
– MULTIPURPOSE CONTROL AND DISPLAY UNIT (MCDU) 7

46.60 WARNINGS AND CAUTIONS 1

46.70 ELECTRICAL SUPPLY
– BUS EQUIPMENT LIST 1

INTRODUCTION

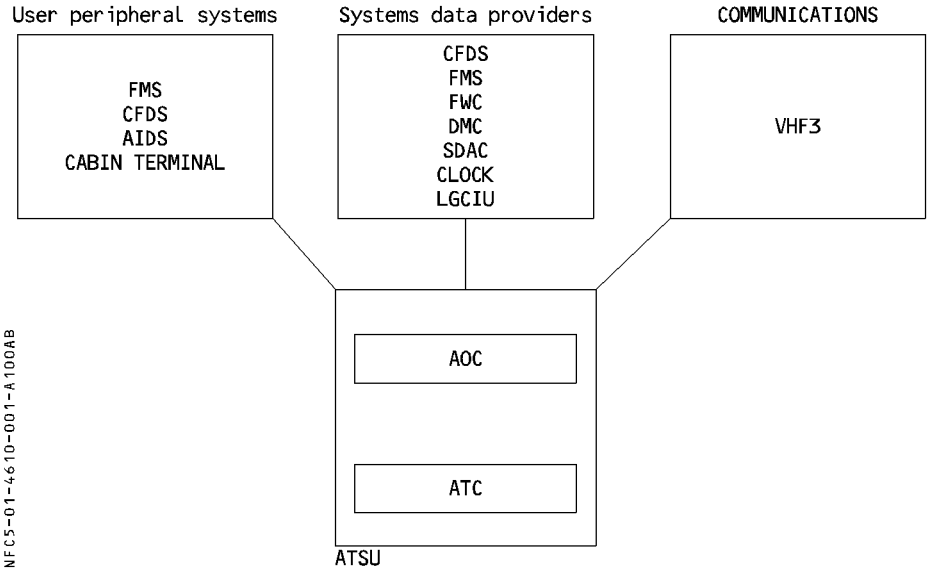
The information system manages the datalink communication and provides the crew with information coming from the airline.
It consists mainly of an Air Traffic Service Unit (ATSU).
The ATSU manages :

- The Air-Ground communications through the appropriate communication media (VHF data radio or HF data radio (*)).
- The exchange of information between the aircraft and the airline according to the Airline Operational Control (AOC) applications defined in the ATSU.
- The information display via the MCDU.
- The appropriate warning for crew information.

The ACARS functions are included in the ATSU.
* Not yet installed.

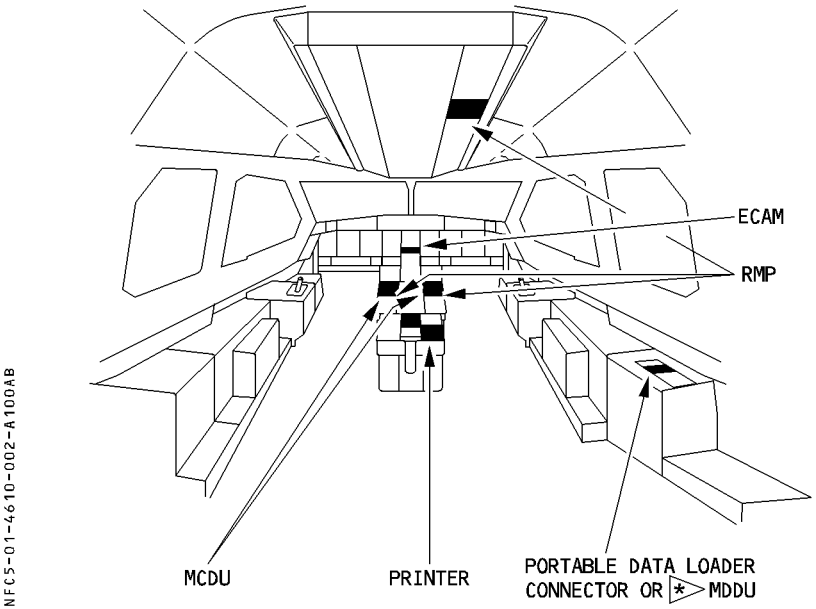
SYSTEM ARCHITECTURE

The ATSU is connected to the following systems :



The ATSU supports uplink and downlink messages.
They may be either automatically or manually handled, with or without information to the crew.

COCKPIT ARRANGEMENT



The pilot interface consists of :
- The MCDU to handle the AOC functions.
- The PRINTER to print any type of messages.
- The ECAM for operational information.
- The RMP to allow frequencies tuning.

INTRODUCTION

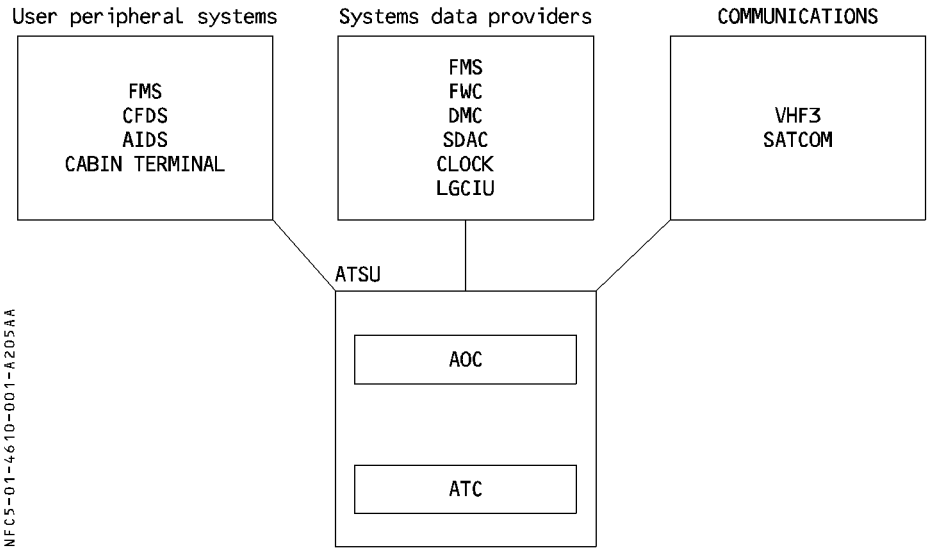
The information system manages the datalink communication and provides the flight crew with information coming from the airline and from the Air Traffic Control (ATC).
The information system consists mainly of an Air Traffic Service Unit (ATSU), two Data-link Control and Display Units (DCDU*) located on the left and right central panels, and two illuminated pushbuttons (*) "ATC MSG".
The ATSU manages :

- The Air-Ground communications through the appropriate communication media (SATCOM ◁ or VHF data radio or HF data radio ◁).
- The exchange of information between the aircraft and :
  - The Operator according to the Airline Operational Control (AOC) applications defined in the ATSU, or
  - The Air Traffic Control.
- The information display via the MCDU and the DCDU (*).
- The appropriate warning for flight crew information.

The ACARS functions are included in the ATSU.

SYSTEM ARCHITECTURE

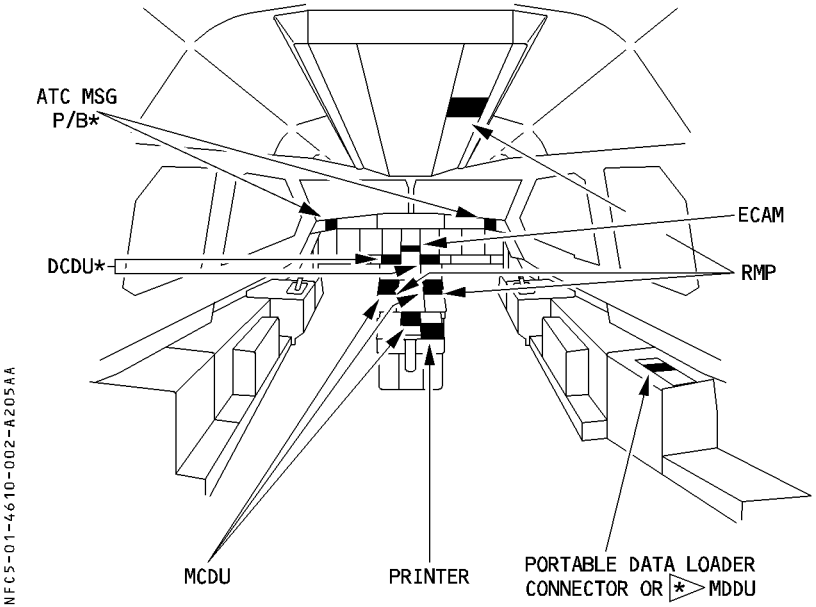
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The ATSU supports uplink and downlink messages.
They may be either automatically or manually handled, with or without information to the crew.

The ATSU supports uplink and downlink messages.
They may be either automatically or manually handled, with or without information to the flight crew.

COCKPIT ARRANGEMENT



The pilot interface has :
- The DCDU (*) to display any ATC messages (up and down link)
- The "ATC MSG" (*) pushbuttons to alert the flight crew of any ATC uplink arrival (*) associated with a dedicated chime (*)
- The MCDU to handle the AOC and ATC functions and the data transfer with DCDU (*).
- The PRINTER to print any type of messages.
- The ECAM for operational information.
- The RMP to allow frequencies tuning.

* Not yet installed.

INTRODUCTION

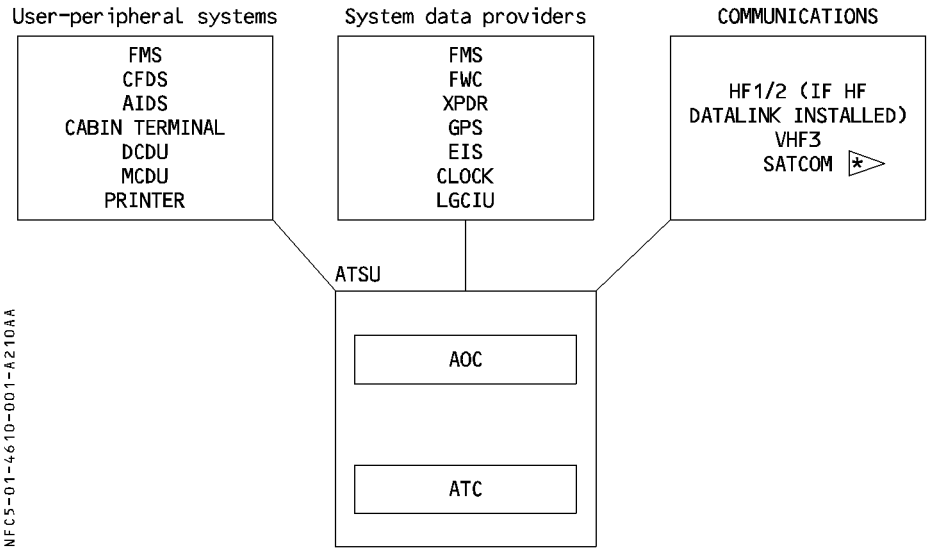
The information system manages datalink communications and provides the crew with information coming from the airline and from the Air Traffic Control (ATC).
The information system mainly consists of an Air Traffic Service Unit (ATSU), two Datalink Control and Display Units (DCDU), located on the left and right central panels, and two illuminated "ATC MSG" pushbuttons.
The ATSU manages :

- Air-Ground communications via the appropriate communication media (SATCOM ◁ or VHF data radio or HF data radio ◁).
- The exchange of information between the aircraft and :
  - The airline, according to Airline Operational Control (AOC) applications, defined in the ATSU, or
  - Air Traffic Control.
- The information display, via the MCDU and the DCDU.
- The appropriate warning for crew information.

The ACARS and ATN functions are included in the ATSU.

SYSTEM ARCHITECTURE

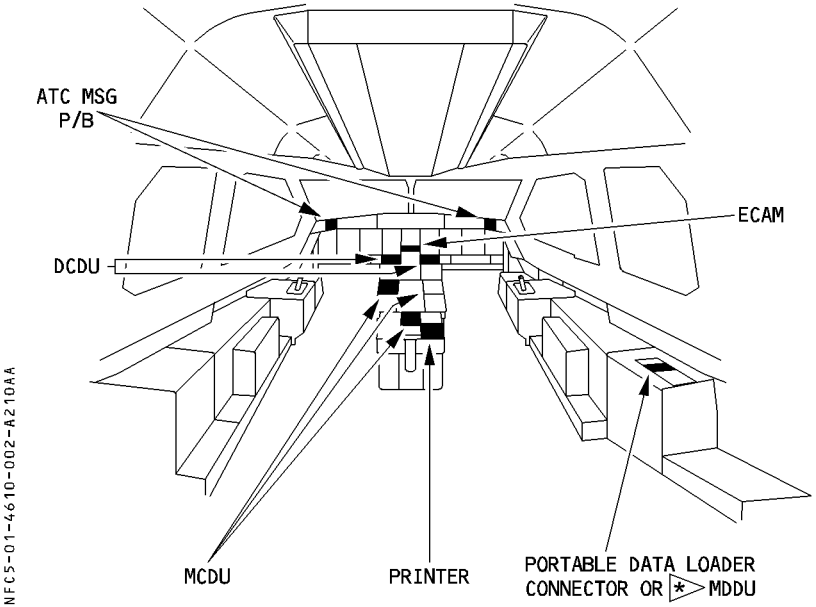
The ATSU is connected to the following systems :



NFC5-01-4610-001-A210AA

The ATSU supports uplink and downlink messages.
They may be either automatically or manually handled, with or without information to the crew.

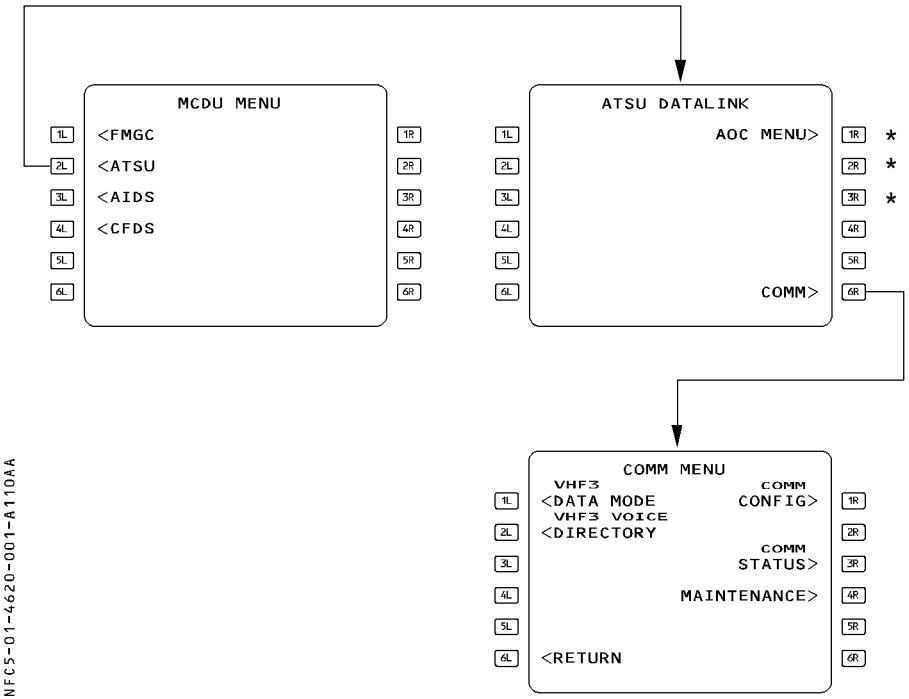
COCKPIT ARRANGEMENT



The pilot interface consists of :
- The DCDU, to display any up and downlink ATC messages.
- The "ATC MSG" pushbuttons, to alert the crew of any ATC uplink arrivals, associated with a dedicated chime.
- The MCDU, to handle the AOC and ATC functions and data transfer with the DCDU for ATC.
- The PRINTER, to print any type of messages.
- The ECAM, for operational information.

INTRODUCTION

Air-Ground communications are managed, by the ATSU communication function, either:
– Automatically without pilot action, or
– Manually, using MCDU pages and/or RMPs.
The pilot controls communications via the MCDU's COMM MENU page.



NFCS-01-4620-001-A110AA

* These fields are customized according to AOC programming.

DOWNLINK AND UPLINK MESSAGES

DOWNLINK MESSAGES

Aircraft to ground messages (downlink) comprise maintenance, monitoring, operational, performance and cabin data.
Reports generated by a peripheral (CFDS, AIDS, FMS, CABIN TERMINAL) system can be automatically downlinked by the ATSU, depending on each airline's AOC programming.

UPLINK MESSAGES

Ground to aircraft messages (uplink) either contain crew information (wind for example) or data, to be uploaded into the FMS (Flight plan, for example). Uplinks can also contain requests for transmission of specific downlink reports.
Messages are indicated to the crew by :

- "COMPANY MSG" memo (in green) on the ECAM, or
- "COMPANY CALL" memo (in green) on the ECAM, or
- "COMPANY ALERT" memo (pulses green for 180 seconds, then remains steady, and is associated with a buzzer for 1 second) on the ECAM, or
- The MCDU MENU light comes on, if the MCDU is not in the mode where the uplink message can be displayed, or
- A hard copy from the cockpit printer, depending on the airline's AOC programming.

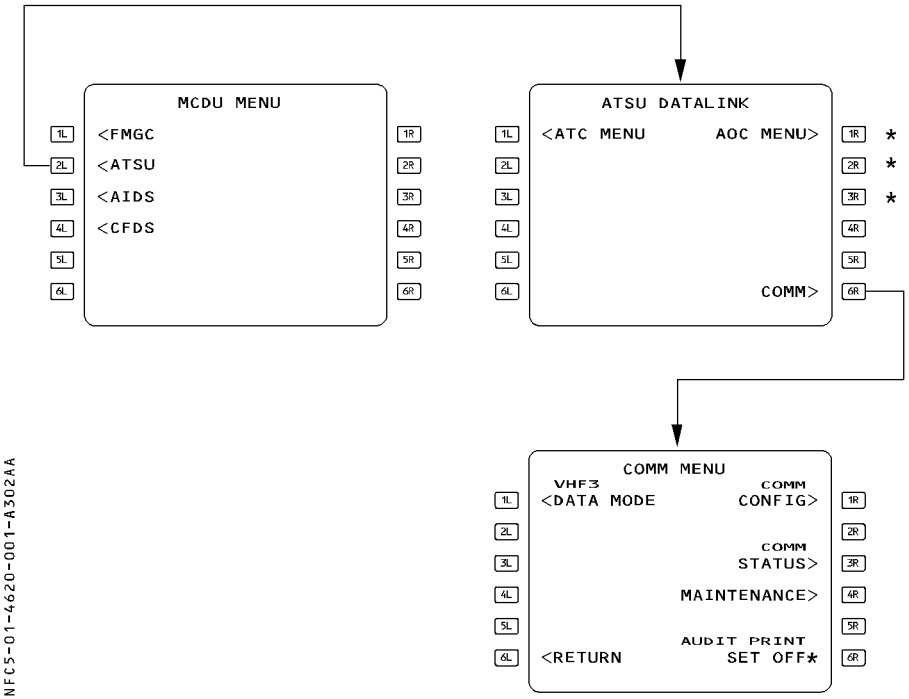
Note : A steady green "COMPANY DATALINK STBY" memo is displayed, when the AOC datalink air-ground communication is temporarily unavailable, but not lost.

INTRODUCTION

The ATSU Communication Function manages communications between aircraft and ground. This is achieved :

– Automatically, without pilot action, or
– Manually, using the MCDU pages and/or RMP.

The pilot controls communications from the MCDU's COMM MENU page.



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* These fields are customized according to the airline's AOC programming.

DOWNLINK AND UPLINK MESSAGES

DOWNLINK MESSAGES

Aircraft to ground messages (downlink) include : Maintenance, monitoring, operational, performance and cabin data, and ATC messages. A report that is generated by a peripheral system (CFDS, AIDS, FMS, CABIN TERMINAL) can be automatically-downlinked by ATSU, depending on the airline's AOC programming.

UPLINK MESSAGES

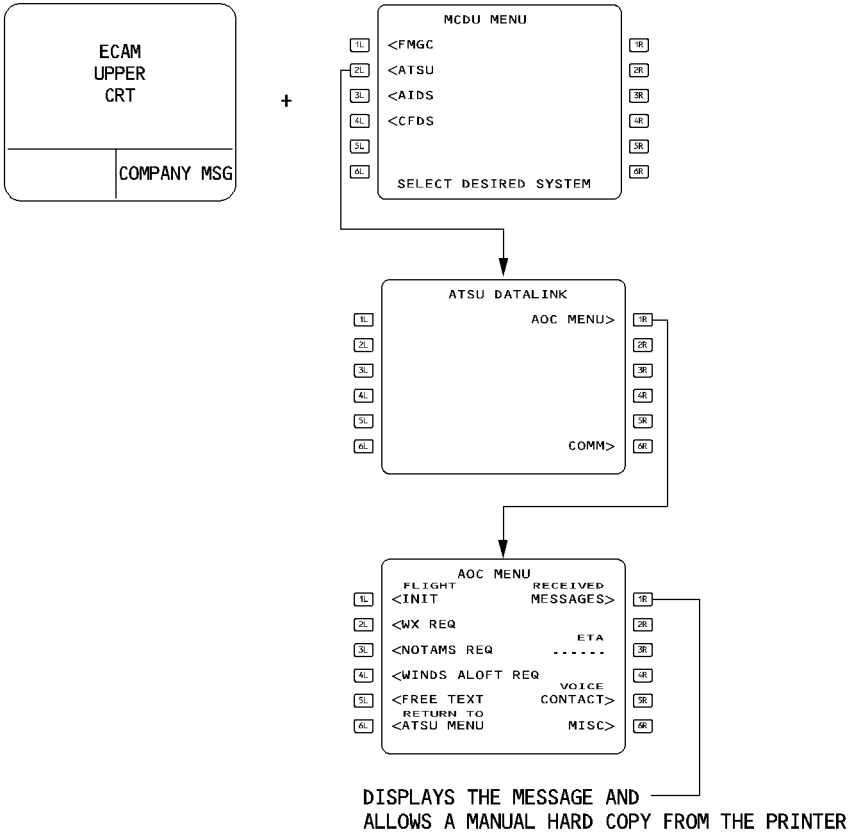
Ground to aircraft messages (uplink) contain either crew information (wind, for example), or data to be uploaded into the FMS (Flight plan, for example). Uplinks can also include requests for the transmission of specific downlink reports.
Messages are indicated (this does not include ATC messages) to the crew by a :

- "COMPANY MSG" memo, in green on the ECAM memo, or
- "COMPANY ALERT" memo (pulses green for around 3 minutes, then remains steady, and is associated with a buzzer sound for 1 second) on the ECAM memo, or
- "COMPANY CALL" memo, in green on the ECAM memo, or
- MCDU MENU light comes on, if the MCDU is not in the mode where the uplink message can be displayed, or
- Hardcopy on the cockpit printer, depending on the airline's AOC programming.

Note : 1. A steady green "DATALINK STBY" memo is displayed in case of communications loss between aircraft and ground.
2. The way to access to those COMPANY CALL messages is not presented, since they are accessed via the AOC MENU page, which is customized according to the airline's AOC programming.

Depending on the memo displayed on the ECAM, the uplink message indications are available, as in the following examples :

– For a "COMPANY MSG" ECAM memo :

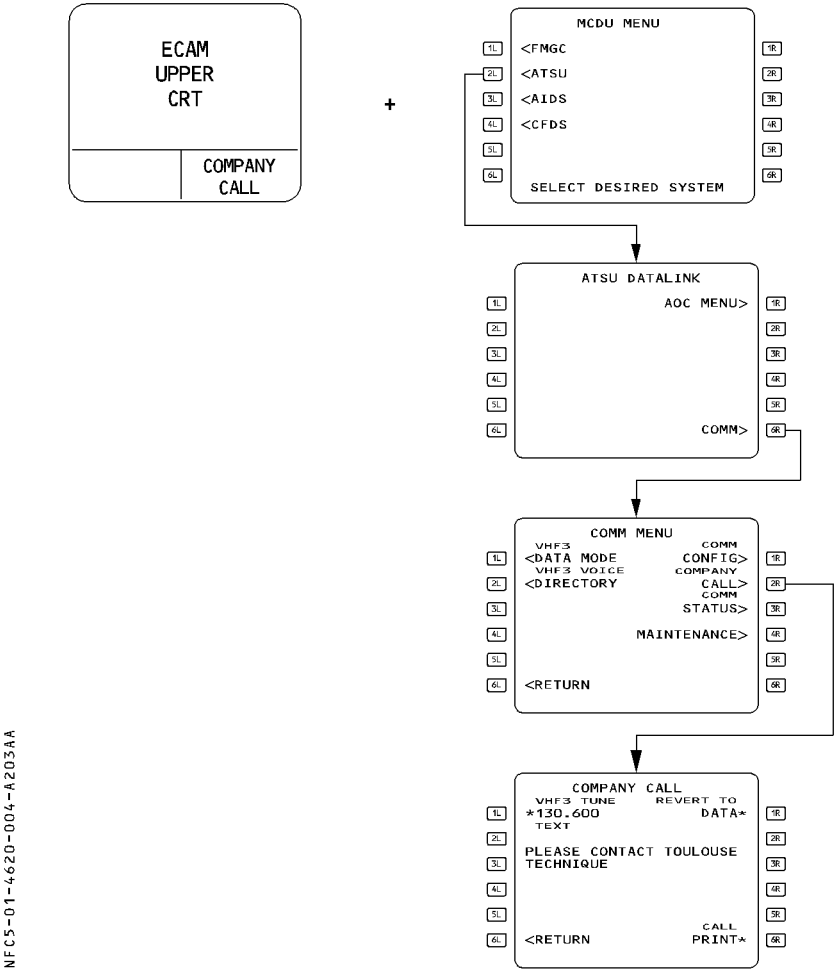


NFC5-01-4620-003-A203AA

On the AOC MENU page, pressing the [1R] key displays the received message and clears the ECAM memo.

Note : 1. The AOC MENU page is customized, according to AOC programming.
2. A "COMPANY ALERT" ECAM memo is processed in the same way.

– For a "COMPANY CALL" ECAM memo :

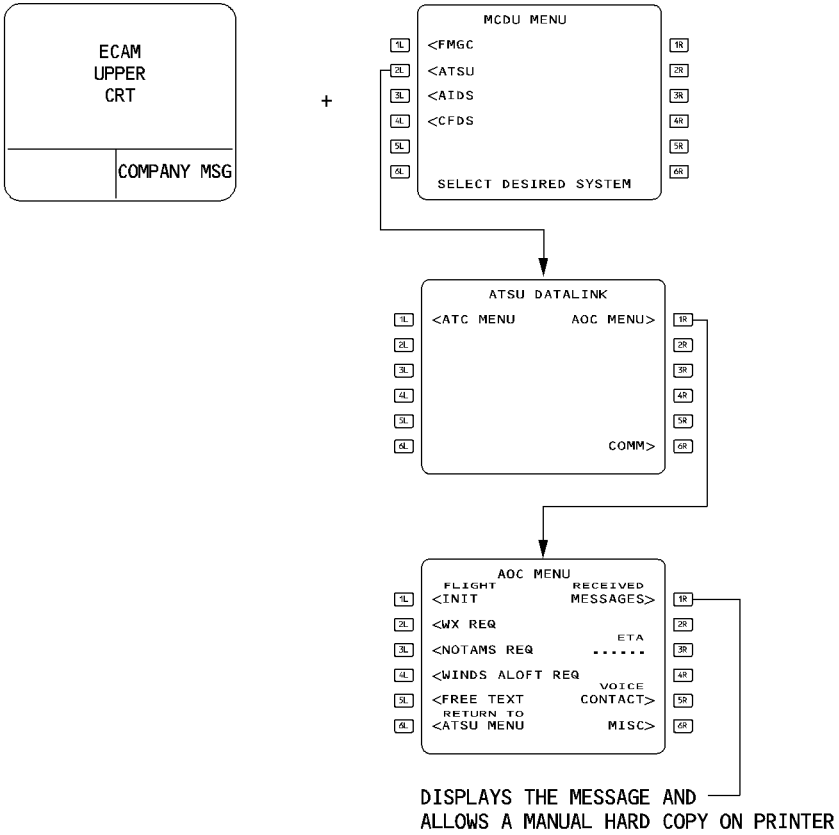


NFC5-01-4620-004-A203AA

On the MCDU's COMPANY CALL page :
Pressing the [1L] key clears the COMPANY CALL memo, and activates the VHF voice frequency on the VHF3 associated with the memo.
When in VHF3 voice mode, pressing the [1R] key reverts VHF3 to DATALINK mode.

Depending on the memo displayed on ECAM the uplink message indications are available as in the following examples :

– For a “COMPANY MSG” or a “COMPANY ALERT” ECAM memo :



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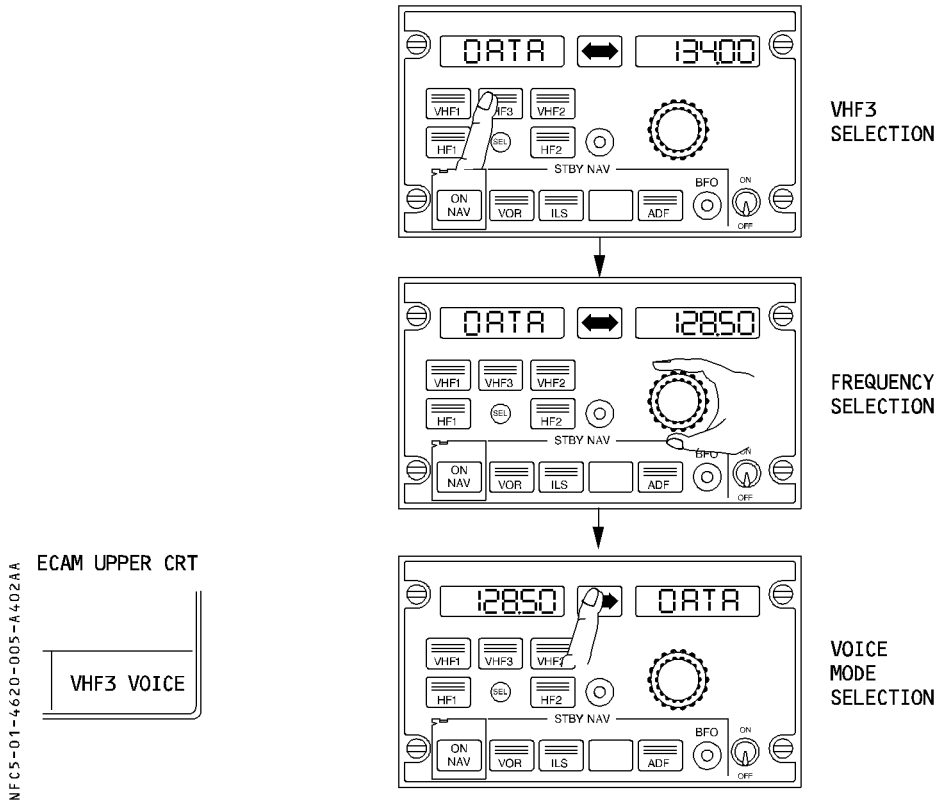
On the AOC MENU page, pressing the [1R] key displays the received message and clears the ECAM memo.

Note : AOC MENU page is customized according to the airline's AOC programming.

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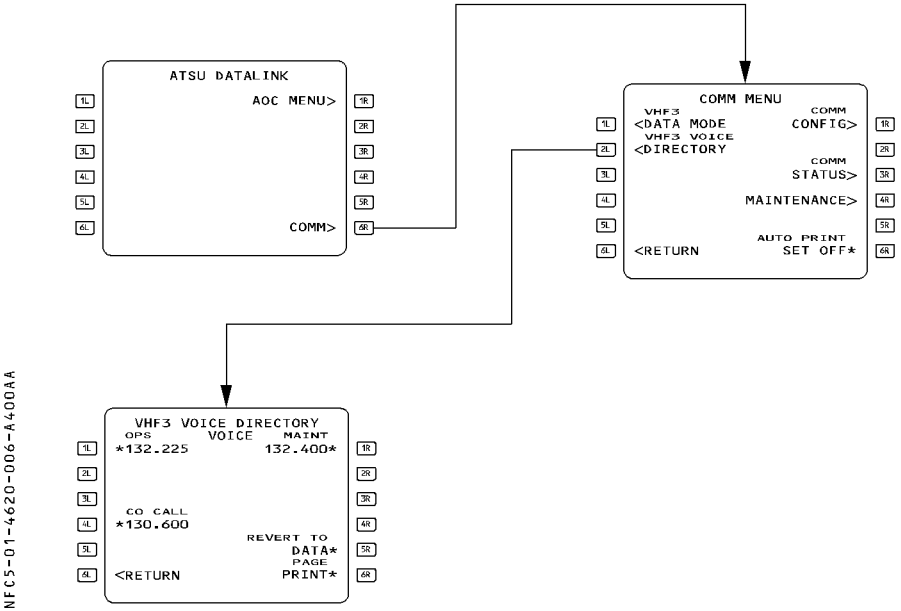
DATALINK/VOICE TRANSFER ON VHF3

VHF 3 can be used in voice mode, in case of a :
– VHF 1, or VHF 2 failure
– COMPANY CALL.
The green "COMPANY CALL" memo indicates that a voice contact request has been received from the ground.
The green "VHF 3 VOICE" memo indicates that the VHF 3 tranceiver operates in voice mode; therefore, datalink communications are interrupted.
The voice frequency may either be tuned by the ATSU, or tuned by the crew via the RMP.
The DATALINK/VOICE transfer can either be done from any of the RMPs, or from the ATSU via the VHF3 VOICE DIRECTORY MCDU page.
DATALINK/VOICE transfer from a RMP :



Pressing the RMP's transfer key again returns to DATALINK mode.

. DATALINK/VOICE transfer from the ATSU through the VHF3 VOICE DIRECTORY page :



On the MCDU's VHF 3 VOICE DIRECTORY page :

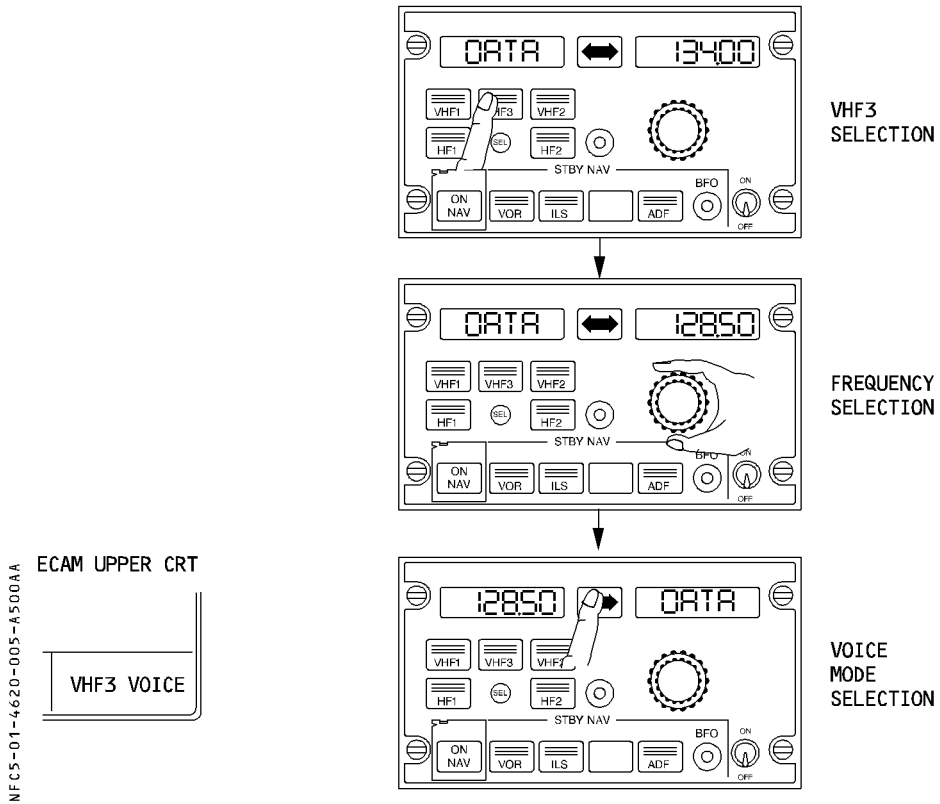
- Below the title, it is indicated whether VHF3 is in "VOICE", or "DATA" mode.
- Fields [1L] to [3L], and [1R] to [3R], display the voice frequencies defined in the operator's database.
  Pressing one of the adjacent keys activates the corresponding preselected voice frequency.
- Field [4L] displays the voice frequency provided in the last received COMPANY CALL message. Pressing the adjacent key deletes the adjacent COMPANY CALL memo, and activates the voice frequency on VHF3.

Note : After activation of the voice frequency, DATA remains displayed in the active window of the RMP.

Pressing the [5R] key returns VHF3 to DATALINK mode.

DATALINK/VOICE TRANSFER ON VHF3

VHF 3 can be used in voice mode, in case of a :
– VHF 1 or VHF 2 failure, or
– COMPANY CALL.
The green "COMPANY CALL" memo indicates that a request for voice contact was received from the ground.
The green "VHF 3 VOICE" memo indicates that the VHF 3 tranceiver operates in voice mode. Therefore, datalink communication is interrupted.
The VHF 3 frequency may be tuned by the crew, via the RMP. The DATALINK/VOICE transfer can be done from any of the RMPs.
DATALINK/VOICE Transfer from an RMP :

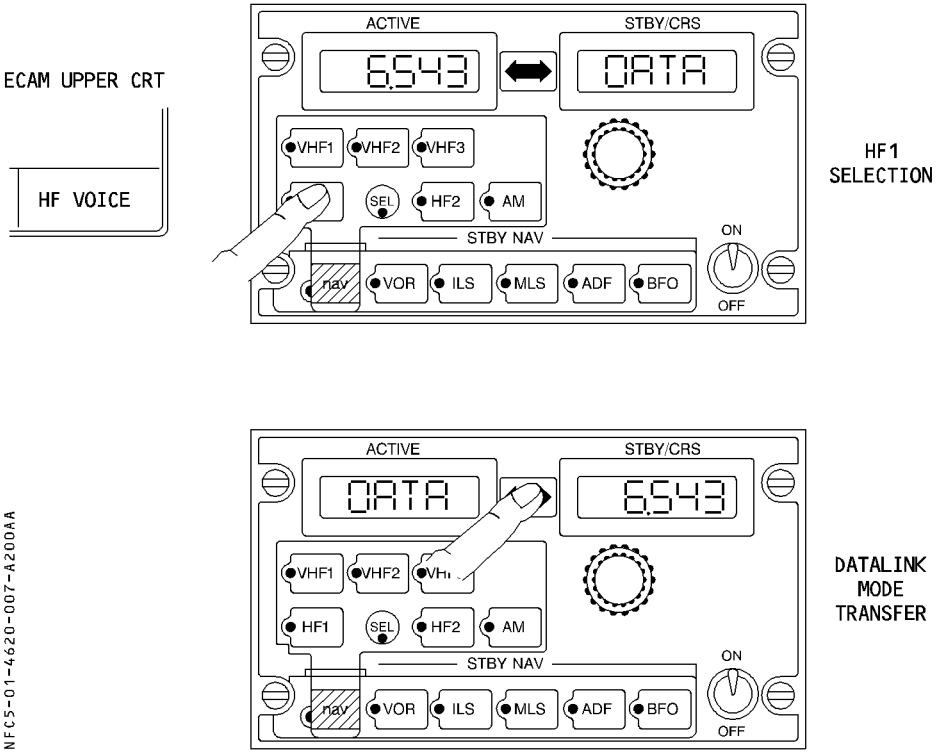


DATALINK mode resumes, when the transfer key on the RMP is pressed again.

INTENTIONALLY LEFT BLANK

DATALINK/VOICE TRANSFER ON HF1

HF1 can also be used in data mode. It constitutes an alternative to VHF3 and SATCOM. The datalink HF frequency tuning is automatically managed .
The green HF VOICE memo indicates that the HF transceiver operates in voice mode, therefore, datalink communications are interrupted.
The datalink/voice transfer can be done from any of the RMPs as follows :



Pressing the transfer key on the RMP again returns to voice mode.

SCRATCHPAD MESSAGES ON THE COMM MENU

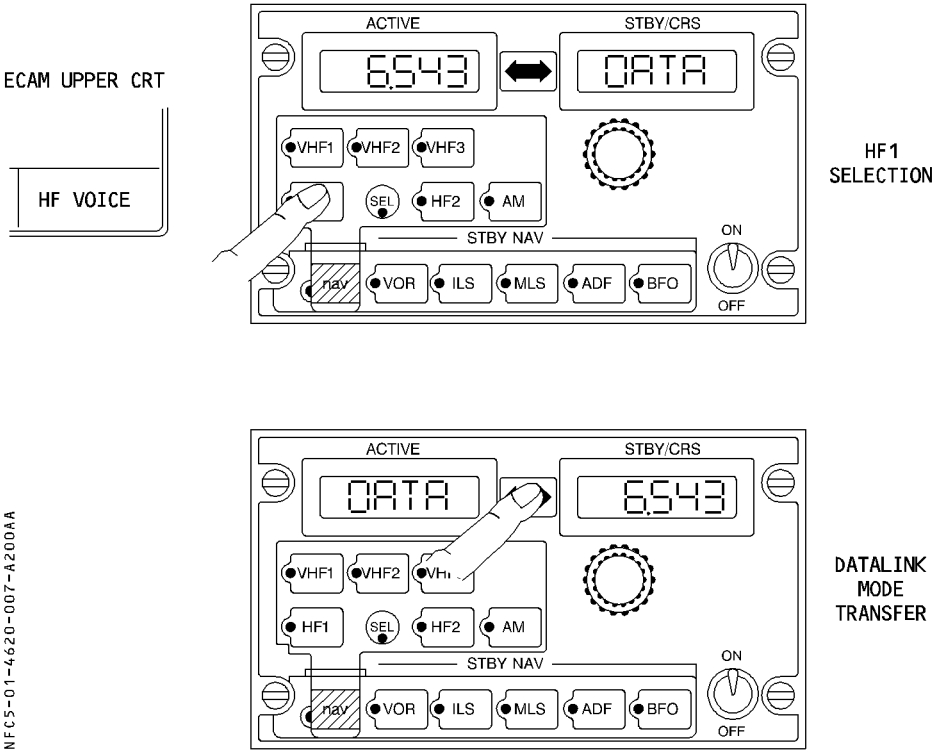
R

MESSAGE	COLOR	CONDITIONS
NOT ALLOWED	W	It is not permitted to press this key.
ENTER A/C REGISTR	A	The aircraft registration number is not valid. To enter this parameter, refer to 3.04.46.
PRINT FAILED	W	A print command is not successful.
FORMAT ERROR	W	The message was entered in an inappropriate format.
VHF3 SWITCH IMPOSSIBLE	A	It is not possible to switch from VHF 3 voice mode to VHF 3 data mode.
DEFAULT VHF SP LIST	A	The new SCAN MASK is not available. The system displays the default SCAN MASK instead.
SYSTEM BUSY - TRY LATER	W	The system is busy. The command, selected by the flight crew, cannot currently be performed.
COMMAND NOT AVAIL	W	The command is not available.
VHF3 CAN BE SET IN VOICE	A	VHF 3 datalink communications are lost. However, VHF 3 can be used in voice mode.
ENTER VHF3 SCAN SELECT	A	No service provider has been selected. To select a service provider, refer to 3.04.46.
ENTER ACARS A/L ID	A	The airline identification number is not valid. To enter this parameter, refer to 3.04.46.
PRT MSG PRINT FAIL	W	Automatic print of an AOC uplink message was not successful.
ENTER A/C ICAO CODE	W	The aircraft ICAO code is not valid. To enter the A/C ICAO code, refer to 3.04.46.

R * Depending on airline customization, access to the SCAN SELECT menu may not be
R possible. If it is not, the DEFAULT VHF SP LIST and ENTER VHF3 SCAN SELECT
R scratchpad messages are not applicable.

DATALINK/VOICE TRANSFER ON HF1

HF1 can also be used in data mode. It constitutes an alternative to VHF3 and SATCOM. The datalink HF frequency tuning is automatically managed .
The green HF VOICE memo indicates that the HF transceiver operates in voice mode, therefore, datalink communications are interrupted.
The datalink/voice transfer can be done from any of the RMPs as follows :



Pressing the transfer key on the RMP again returns to voice mode.

SCRATCHPAD MESSAGES ON THE COMM MENU

MESSAGE	COLOR	CONDITIONS
NOT ALLOWED	W	It is not allowed to press this key.
ENTER A/C REGISTR	A	The aircraft registration number is not valid. To enter this parameter, refer to 3.04.46.
PRINT FAILED	W	A print command was unsuccessful.
FORMAT ERROR	W	The message was entered in an inappropriate format.
VHF3 SWITCH IMPOSSIBLE	A	It is not possible to switch from VHF 3 voice mode to VHF 3 data mode.
DEFAULT VHF SP LIST*	A	The new SCAN MASK is unavailable. The system displays the default SCAN MASK instead.
SYSTEM BUSY - TRY LATER	W	The system is busy. The command, selected by the crew, cannot currently be performed.
COMMAND NOT AVAIL	W	The command is unavailable.
VHF3 CAN BE SET IN VOICE	A	VHF 3 datalink communications are lost. However, VHF 3 can be used in voice mode.
ENTER VHF3 SCAN SELECT*	A	No service provider has been selected.
ENTER ACARS A/L ID	A	The airline identification number is not valid. To enter this parameter, refer to 3.04.46.
ENTER A/C ICAO CODE	W	The aircraft ICAO code is not valid. To enter the A/C ICAO code, refer to 3.04.46.

* Depending on airline customization, access to the SCAN SELECT menu may not be possible. If it is not, the DEFAULT VHF SP LIST and ENTER VHF3 SCAN SELECT scratchpad messages are not applicable.

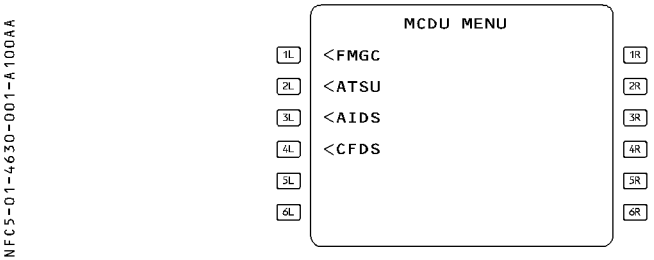
INTRODUCTION

Two kinds of Airline Operational Control (AOC) applications are provided :
- Remote AOC applications embedded in systems peripheral to ATSU (AIDS, CFDS, FMGC, CABIN TERMINAL)
- Hosted AOC applications uploaded into the ATSU.

Due to the highly customized aspect of the hosted AOC applications, only the remote AOC applications are described in this chapter.

REMOTE APPLICATIONS

The remote AOC applications are accessible by pressing the related system key on the MCDU MENU page.



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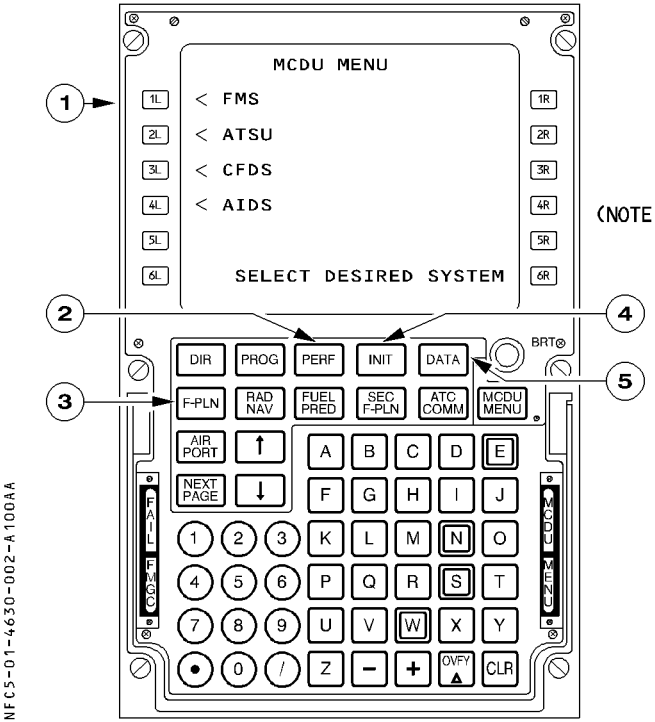
Message/reports are processed by the AOC peripherals (FMGC, AIDS, CFDS) ; the ATSU communication function only routes the request according to the company routing policy.

FLIGHT MANAGEMENT SYSTEM (FMGC) (Refer to 1.22.45)

Through the FMGC interface it is possible to access the following data :
- Wind data (F-PLN page)
- Takeoff data (uplink only)
- F-PLN initialization (uplink only)
- Pre-flight, post-flight report and ACARS print/program (downlink only)

See FMGS PILOT GUIDE (Refer to 4.04.40)

R



(NOTE : DEPENDING ON OPTIONS, MCDU FRONT FACE MAY SLIGHTLY DIFFER)

(1) Pressing key selects related system then

(2) Pressing key gives access to takeoff data (Uplink only)

(3) Pressing key gives access to wind data (F-PLN page)

(4) Pressing key gives access to F-PLN initialisation and wind data (Uplink only)

(5) Pressing key gives access to Pre-flight, Post-flight report and ACARS print/program (downlink only).
For operation see FMGS PILOT GUIDE (Refer to 4.04.40).

Centralized Fault Display System (CFDS) (refer to 1.45.20)

Through the CFDS interface it is possible to downlink the following data :
- Post flight report (on the ground) or current flight report (in flight) which includes :
  · All failure messages detected by the BITEs
  · The warnings displayed to the crew during the last or current flight leg.
  Report can be downlinked upon crew action or upon ground request or automatically.
- Previous Flight Report (on the ground)
- Real-time failure and warning messages (in flight).
- Class 3 report (on the ground) containing all class 3 failures detected during the last flight leg. The report can be downlinked upon crew action or automatically.

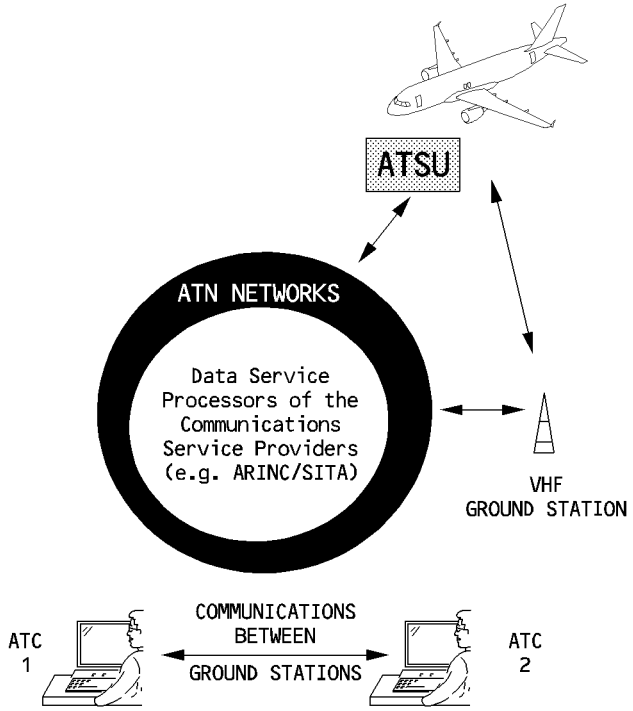
Aircraft Integrated Data System (AIDS)

The AIDS interface provides ATSU with the data for the following applications :
- Aircraft Performance Monitoring (APM),
- Engine Condition Monitoring (ECM),
- APU Health Monitoring (AHM).

Any of the AIDS DMU reports can be downlinked (through ATSU) :
- Manually on the ground or in flight
- Automatically in real-time,
- Upon ground request or upon automatic request from the ATSU.

INTRODUCTION

The global Communications Navigation Surveillance/Air Traffic Management (CNS/ATM) system is made up of the C (Communications), N (Navigation) and S (Surveillance) tools, developed to provide efficient Air Traffic Management methods.
Such methods include the introduction of datalink communication between pilots and controllers. The initial use of datalink in continental area (high density airspaces with radar surveillance) is introduced with FANS B. It will be used as a supplemental means in addition to voice communications.
The current FANS B system uses the ATN network and through VDL Mode 2 subnetwork : These networks are mainly ARINC and SITA. The related data communications are managed by the Air Traffic System Unit (ATSU).



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The FANS B system includes the following functions :
- The Context Management Application (CMA)
- The Controller Pilot Data Link Communications (CPDLC)

CONTEXT MANAGEMENT APPLICATION (CMA)

Context Management Application (CMA) is necessary in order to inform the ATC that the aircraft is capable of datalink communications, and to exchange address information. It is initiated by the pilot (See the NOTIFICATION Procedure in 3.04.46).

CONTROLLER PILOT DATA LINK COMMUNICATIONS (CPDLC)

All ATC messages, either coming from the ATC center (uplink) or to be sent to the ATC center (downlink), transit through the DCDU.

UPLINK MESSAGES (FROM THE ATC TO THE CREW)

The following message categories can be uplinked :
1. Clearances (immediate, speed, heading, altitude, offset or direct to etc...)
2. Report requests (confirm)
3. (Open) negotiation (ex : When can accept)
4. Information messages.
5. Without answer (ex : Unable, ...)

Upon message reception, the ATSU triggers the ATC chime and the flashing blue "ATC MSG" pushbutton light on the glare shield.
For normal messages, the aural signal is repeated every 15 seconds (with the first signal delayed by 15 seconds). For urgent messages, the aural signal is triggered without any delay and is repeated every 5 seconds.
If the screen is empty, the message appears on the DCDU. If not, a flashing "MSG 1/2" cue is displayed.
The pilot can display the message by using the MSG + pushbutton.

Note : Urgent messages are displayed, regardless of the state of the screen.

ATC APPLICATIONS

Not yet installed.

Push one of the two "ATC MSG" pushbuttons to stop the alert. The alert can also be stopped, when the pilot performs any action regarding the latter uplink message displayed on the DCDU.

To answer the message :

– Manually prepare the message by selecting the appropriate function key (WILCO, ROGER, AFFIRM, NEGATIVE...).
– Send the message to the ground by using the SEND key.

Once the message is sent, the screen should be cleared by pressing the CLOSE key.

The RECALL function key can be used to display the last closed message.

Other messages can be reviewed from the MCDU MSG RECORD page.

To allow some delay in answering, the pilot may answer STBY. In this case, the message cannot be removed until the final answer is sent, within an expected short period of time.

DOWNLINK MESSAGES (FROM THE CREW TO THE ATC)

All downlink messages must be displayed on the DCDU prior to being sent. This allows the crew to visualize the exact message (concatenated) that will be displayed on the controller screen.

The following message categories can be downlinked :

1. Answers to ATC messages by using the DCDU function keys (WILCO, UNABLE, AFFIRM...).
2. Standard requests (vertical, lateral, speed).
3. Confirm (immediate confirm or reports).

All messages, not in direct response to an ATC uplink message, are prepared on the MCDU prior to appearing on the DCDU for review before sending.

Standard requests are prepared on the MCDU ATC MENU page (through the prompt REQUEST). Then, they are displayed on the DCDU using the MCDU's XFR TO DCDU prompt.

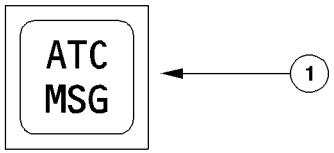
Reports or confirm answers have to be prepared by the crew using the DCDU EDIT key which calls for the MCDU EDIT page.

The crew must then send the DCDU-displayed messages by using the SEND key.

The message may be removed from the screen by using the CLOSE key.

GLARESHIELD

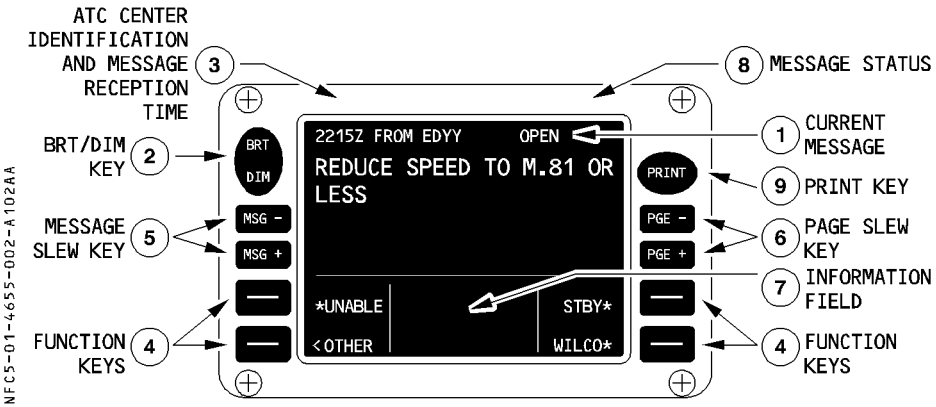
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(1) ATC MSG pushbutton

It flashes in blue, when a message, associated to an aural alert, is received.
Press : To stop the aural alert and the flashing light.

DATA COMMUNICATION DISPLAY UNITS (DCDU)



(1) Current Message Indication

Displays uplink and downlink messages.
Uplink messages :
- Are displayed on a black blackground.
- When received, the message appears in white and the main parameters in blue.
- When answered, the message becomes green.

Downlink messages :
- Are displayed in black, on a colored background.
- Before sending, the background is blue.
- When sent, the background becomes green.

(2) BRT/DIM key

Adjusts the brightness of the DCDU.

(3) ATC Center Identification and Message Reception Time

- Identifies the ATC Center
- Indicates the time at which the ATC Center sends the message or the time at which the pilot transfers the message from the MCDU.

④ Function Keys

The function keys are only operative, if a star or a prompt is visible.
Depending on the nature of the message, the system automatically proposes an appropriate function (Example : WILCO, or AFFIRM, or ROGER).

1. WILCO : To accept an ATC clearance.
2. ROGER : To confirm reception, and understanding of an ATC information or report request.
3. UNABLE : To reject an ATC clearance.
4. AFFIRM : To answer “yes” to an ATC question.
5. NEGATV : To answer “no” to an ATC question.
6. STBY : To inform the ATC that you need to delay the answer.
7. CANCEL : To remove a prepared downlink message from the DCDU, or to cancel a selected reply to an uplink message.
8. SEND : To send a message or an answer, that was prepared by using the other function keys (Example : WILCO, ROGER, AFFIRMATIVE, STBY...).
9. CLOSE : To erase a message (from the screen) which has been sent to the ATC, or to erase a message from the ATC which has been answered, and send it to the MSG RECORD. This is not applicable when the answer is on STBY.
10. RECALL : To recall the last message that was removed from the screen, using the CLOSE function.
11. CANNOT : Negative answer to an OPEN negotiation message from the ATC.
12. OTHER : To display the other functions that could be applicable to the current message, but are not currently displayed.
13. ANSWER: Default reply for an uplink message with two or more confirm/open negociation message elements.
14. EDIT : To access to the EDIT page on the MCDU.

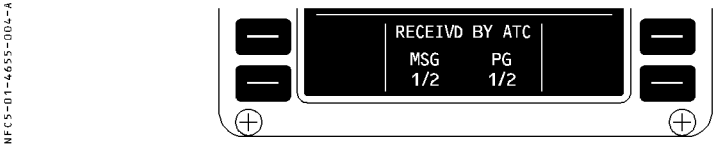
(5) Message Slew Key

To scroll from one message to another.

(6) Page Slew Key

To scroll through the different pages of a message.

(7) Information Field



NFCS-01-4655-004-A102AA

MSG 1/2
– Displayed, when several messages are available on the MCDU.
– Flashes, when a new message is received.

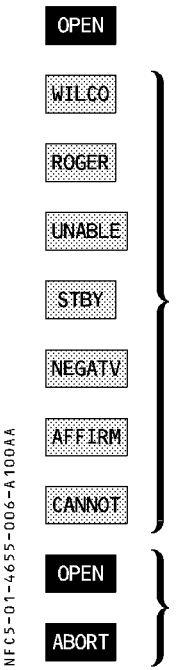
PG 1/2
– Displayed, when the current message contains several pages.

(7) Information Field (Cont'd)

Miscellaneous Information

SENDING (white) : The current message is being sent.
SENT (white) : The current message was sent, but not necessarily received.
RECEIVD BY ATC (white) : the current message has been received by the controller.
REJ BY ATC (amber) : Message rejected by the ATC system, controller not aware of this message.
COM FAULT (amber) : ATC communication means faulty.
LINK LOST (amber) : Communication with the ATC is unavailable (displayed on any message pending when the loss occured).
COM NOT AVAIL (amber) : Communication means temporarily unavailable.
SEND FAILED (amber) : Transmission of a request or a reply to an uplink message are unsuccessful.
NO ATC REPLY (amber) : No answer received within 270 seconds.
PRINTING (white) : Printing was requested from the DCDUs and printing is in progress.
PRINT FAILED (amber) : Printing was requested from the DCDUs and printing failed.
PRINTING UNAVAIL (white) : Printing was requested from the DCDUs, but the printer is unavailable.
NO MORE MSG (white) : Follows pressing of the "MSG + " or "MSG -" key, when no more messages are accessible.
NO MORE PGE (white) : Follows pressing of the "PGE+" or "PGE-" key, when no more pages are accessible.
RECALL MODE (white) : Recalls the last stored message.
ANSWER MSG (amber) : Maximum number of pending uplink messages is reached.
FILE FULL (amber) : Maximum number of downlink messages, accessible on the DCDUs, is reached.
OVERFLW CLOSED (amber) : Maximum number of non-pending messages is reached, and a new non-pending message is registered in the file.
MCDU FOR EDIT (white) : Follows pressing of the "EDIT" key.
COM NOT INIT (amber) : Router not initialized.
REPLY : TIME OUT (amber) : Crew answers have to be delivered within 100 seconds.
NO ATC DLK (white) : ATC communication means temporarily unavailable.

(8) Message status



BLUE FONTS ON A BLACK BACKGROUND: THE CURRENT UPLINKED MESSAGE HAS NOT BEEN ANSWERED, OR THE CURRENT DOWNLINK MESSAGE HAS NOT BEEN SENT.

BLACK FONTS ON A BLUE BACKGROUND: THE CREW HAS ANSWERED THE UPLINKED MESSAGE, BUT THE ANSWER HAS NOT BEEN SENT.
BLACK FONTS ON A GREEN BACKGROUND: THE ANSWER HAS BEEN SENT.

AMBER FONTS ON A BLACK BACKGROUND: TRANSMISSION FAILURE.

(9) Print key

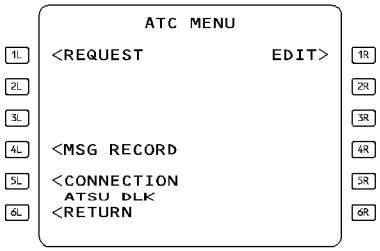
To print the current message.

MULTIPURPOSE CONTROL AND DISPLAY UNIT (MCDU)

ATC MENU PAGE

To call up the ATC MENU page, press the ATC prompt on the ATSU DATALINK page, or the ATC COMM key on the MCDU keyboard. The ATC MENU page is used to access the different functions for the ATC applications.

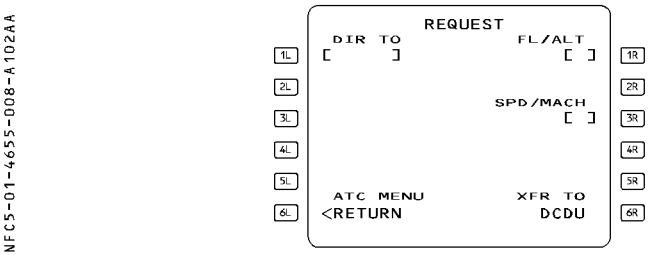
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[1L] REQUEST	To call up the REQUEST page
[4L] MSG RECORD	To call up the MSG RECORD page
[5L] CONNECTION	To call up the CONNECTION page
[6L] ATSU DLK RETURN	To call up the ATSU DATALINK page
[1R] EDIT	To call up the EDIT page (Displayed when the EDIT key on the DCDU is pressed)

REQUEST PAGE

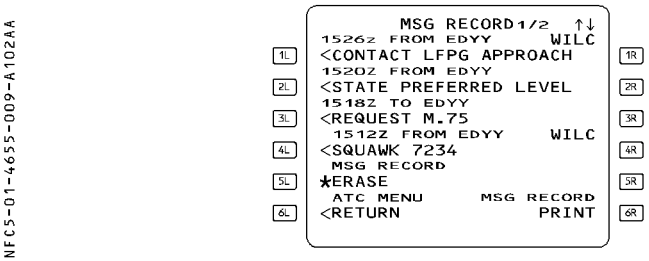
To prepare dowlink CPDLC requests to ATC.



[1L] DIR TO	To prepare a request to go from the present position to a selected waypoint.
[6L] ATC MENU RETURN	To call up the ATC MENU page.
[1R] FL/ALT	To prepare a request for a new altitude.
[3R] SPD/MACH	To prepare a request for a new speed.
[6R] XFR TO DCDU	To transfer the message from the MCDU to the DCDU.

MSG RECORD PAGES (1 to 2)

Display messages that were recorded from the DCDU.



Lines 1 to 4 — Display a summary of each recorded message : The time, the ATC, and the message status. The most recently recorded message is displayed on the first line.
The left or right key adjacent to the message title, displays the contents of the recorded message.

Note : Due to line length limitation, the messages status are abbreviated as following :

- *"WILC" for WILCO*
- *"UNBL" for UNABLE*
- *"ABRT" for ABORT*
- *"ROGR" for ROGER*
- *"AFRM" for AFFIRM*
- *"NEG" for NEGATIVE*
- *"STBY" for STANDBY*

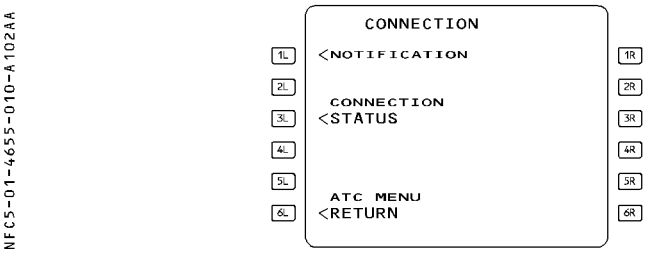
[5L] MSG RECORD ERASE — To clear the contents of the message record. When pressing this key, MSG RECORD ERASE is replaced by ERASE MSG RECORD CONFIRM, to prevent from inadvertently erasing the message record.

[6L] ATC MENU RETURN — To call up the ATC MENU page.

[6R] MSG RECORD PRINT — To print the MSG RECORD page contents.

CONNECTION PAGE

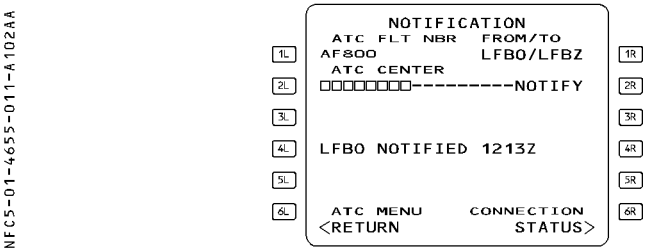
To provide access to the NOTIFICATION and CONNECTION STATUS page.



[1L] NOTIFICATION — To display the NOTIFICATION page.
[3L] CONNECTION STATUS — To display the CONNECTION STATUS page.
[6L] ATC MENU RETURN — To call up the ATC MENU page.

NOTIFICATION PAGE

To initiate notification and provide information on the logon process and the last successfully notified ATC.



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[1L] ATC FLT NBR — To display the flight number that comes from the FMGS. It cannot be modified via this page.

Line 2 ATC CENTER — Displays the logon status in front of the "ATC CENTER". The status is either "NOTIFYING" in small white font, or "NOTIF FAILED" in small amber font :

– NOTIFYING indicates that the logon is in progress.
– NOTIF FAILED indicates that the logon was failed.

The logon status disappears, when the logon notification is completed.

[2L] ATC CENTER — To enter the ATC's ICAO code for notification. A correctly entered ATC code is displayed in large cyan font. When the logon procedure is successfully completed, 8 amber boxes will be shown.

Note : At initialization, a default code is displayed in small cyan font, and corresponds to :
– Last manually–entered ATC code,
– Otherwise : 8 amber boxes appear.

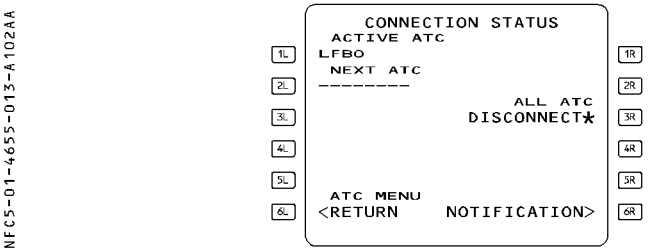
Lines 3 to 5 — Display the last ATC center for which a manual and successful logon notification has been performed. Once a CPDLC connection is established, the indication disappears.

Note : "NOTIFICATION UNAVAILABLE" is displayed in Line 5, if the communication means, or the flight number are unavailable.

[1R] FROM/TO	To display the departure and destination airports.
[2R] NOTIFY	To send a notification to the ATC. It is not active during a notification process, or if the communication means, ATC center, flight number, or departure/destination airport are unavailable.
[6L] ATC MENU RETURN	To call up the ATC MENU page.
[6R] CONNECTION STATUS	To call up the CONNECTION STATUS page.

CONNECTION STATUS PAGE

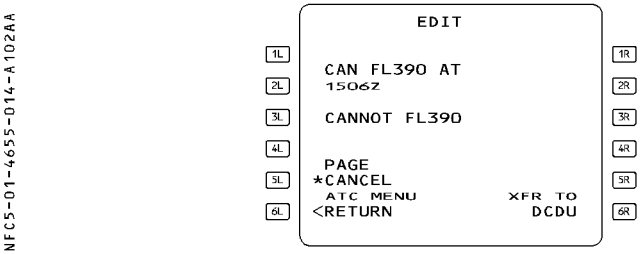
To display the status of CPDLC connections, and enable the crew to disconnect them if needed.



[1L] ACTIVE ATC	To display the currently active ATC for CPDLC connection.
[2L] NEXT ATC	To display the next ATC for CPDLC connection.
[6L] ATC MENU RETURN	To call up the ATC MENU page.
[3R] ALL ATC DISCONNECT	To disconnect all established CPDLC connections. When selected, DISCONNECT CONFIRM will be displayed to confirm disconnection.
[6R] NOTIFICATION	To call up the NOTIFICATION page.

EDIT PAGE

To edit and complete the donwlink messages displayed on the DCDU before sending to ATC.



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Depending on the type of message and response on the DCDU, the message to edit can be associated to several line keys.

[2L] PRESENT LEVEL	To notify the present level.
ASSIGNED LEVEL	To read–back the assigned level.
CAN (AT)	To accept the specified level (at the specified time).
CAN BLOCK LEVEL (AT)	To accept the specified block level (at the specified time).
PREFERRED LEVEL	To notify the preferred level.
TOP OF DESCENT	To notify the preferred time to commence descent for approach.
[3L] CANNOT	To refuse the specified level.
CANNOT BLOCK LEVEL	To refuse the specified block level.
[5L] PAGE CANCEL	To reset the EDIT page.
[6L] ATC MENU RETURN	To call up the ATC MENU page.
[6R] XFR TO DCDU	To transfer the message from the MCDU to the DCDU.

SCRATCHPAD MESSAGES ON THE ATC MENU FOR CMA and CPDLC

MESSAGE	CONDITIONS
FORMAT : _ _ _	The acquisition format is not valid. An example of the required format is displayed (FORMAT : NNN, FORMAT : XXXX, etc), where : – N : Numerical data (0 to 9) – X : Alphanumerical data (0 to 9, or A to Z). To display the required format of specific data on the scratchpad message field, press on the corresponding empty field. This serves as a reference to the crew.
ENTRY OUT OF RANGE	The single value that was entered is out of range.
OUT OF RANGE	A single value of double data is out of range.
TWO ENTRIES OUT OF RANGE	The double value that was entered is out of range.
NOT ALLOWED	It is not allowed to enter data.
NON MODIFIABLE FIELD	A non-modifiable field was selected.
KEY NOT ACTIVE	It is not allowed to press this key.
ALREADY SELECTED	The selectable key has already been selected.
NOT ALLOWED	Data entry not allowed, or deselection of a selectable key not yet selected, or selection of a selectable key with any entry on the scratchpad other than CLR.
CLR NOT ALLOWED	An available key has been selected, but the function is not available due to CLR still displayed on the scratchpad field.
FLIGHT NBR UNAVAILABLE	Notification is not available, because the flight number is unavailable.
ENTER MANDATORY FIELDS	Selection of a command is not available, because mandatory fields are not filled in.
NO WHOLE MSG PREPARED	Selection of the ATC DISPL or ADD TEXT command is not available, because the message is not completely prepared.

MESSAGE	CONDITIONS
COM UNAVAILABLE	The selected command is not available, because datalink comunications means are currently unavailable.
DCDU FILE FULL	The selected command is not available, because the DCDU file is full.
MSG ALREADY DISPLAYED	The XFR to DCDU command is not available, because the message is already displayed on the DCDU.
NO MSG TO PRINT	The PRINT key was selected, but the function is currently unavailable because there is no message to be printed.
PRINTER UNAVAILABLE	The PRINT key was selected, but the printer is currently unavailable.
LAST MSG ELEMENT	Maximum number of message elements for a given downlink message is reached.
TOO MANY MSG ELEMENTS	Entry of a new parameter is not allowed, because the maximum number of message elements has been reached.
NO ACTIVE ATC	The XFR to DCDU key was selected, but the function is currently unavailable because there is no active CPDLC connection.
LAT/LON DISPL ABREVIATED	The LAT/LONG display is abbreviated only on the MCDU display field, because there is lack of space.
MSG RECORD NOT RELIABLE	Due to a technical problem, the list of messages recorded is not reliable. All CPDLC messages are deleted and new messages should not be recorded.
MSG RECORD IS EMPTY	The MSG RECORD ERASE command is not available, because there are no messages recorded.
NOT IN DATABASE	Entry not in database.

MCDU DATA FORMAT LIST FOR CMA and CPDLC

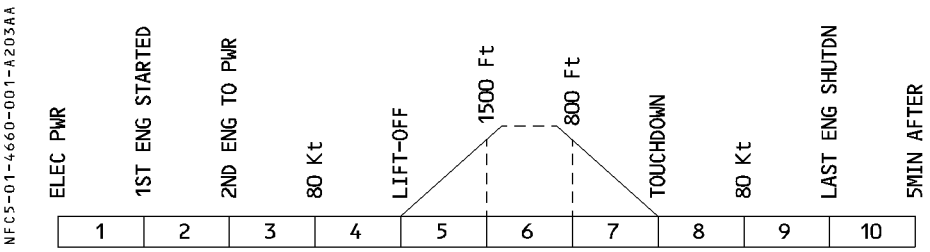
The following chart lists all the data the pilot may enter on the MCDU.
It also shows the acceptable format for the various data items, the acceptable range, the units of entry, and the MCDU pages on which the data can be entered.
The following codes are used to indicate various data formats :

A : Letters
N : Numbers
X : Letters and Numbers

DATA NAME	FORMAT	RANGE	UNIT	DISPLAY PAGE
A/C ICAO CODE	XXXXXXXX	8 characters		COMM CONFIG
A/C REGISTR	XXXXXXX	7 characters		COMM CONFIG
ACARS A/L ID	AA	2 letters		COMM CONFIG
ASSIGNED ALT	Same as ALT			EDIT
ATC CENTER	AAAA	4 letters		NOTIFICATION
DIR TO	XXXXX (Fixname)	Min 1 alphanumeric Max 5 alphanumeric		REQUEST
	DDMM.MB/ EEEMM.MC (lat/long)	DD : 0-89 B : N or S	Degrees	
	"DD" = lat degrees "EEE" = long degrees	MM.M : 0-59.9	Minutes	
	"MM.M" = lat and long minutes Leading zeros may be omitted	EEE : 0-179 C : E or W	Degrees	
DISTANCE	NNN.NNM or NNN.N Leading zeros may be omitted	0-999.9	NM	MESSAGE MODIFY
	NNNNKM "KM" must be written. Leading zeros may be omitted	0-2000	KM	

DATA NAME	FORMAT	RANGE	UNIT	DISPLAY PAGE
FL/ALT	FLNNN or NNN Leading zeros on NNN may be omitted	30-410	Hundreds of feet (MSL)	REQUEST
	NNNNNFT or NNNNN Between 0 and 410 feet, "FT" must be written. Leading zeros may be omitted.	-600-41000	Feet	
	NNNNNM or -NNNNNM or +NNNNNM Leading zeros may be omitted	-30-12500	Meters	
FROM	Same as DIR TO			MESSAGE MODIFY
FROM/TO	AAAA			NOTIFICATION
PRESENT ALT	Same as ALT			EDIT
PREFERRED	Same as ALT			EDIT
SPD/MACH	NNN or NNNKT Leading zeros may be omitted	0-350	Kt	REQUEST
	M.NN or .NN The decimal point must be written, trailing zeros may be omitted	0.5-0.92	Mach	
STANDARD A/L ID	AAA			COMM CONFIG
TOD	HHMM "HH" = NN or NNH "MM" = NN or NNMIN "MIN" = "MIN" or "MN" or "M" or "Z"	HH : 0-23 MM : 0-59	Hours Minutes	EDIT

WARNINGS AND CAUTIONS

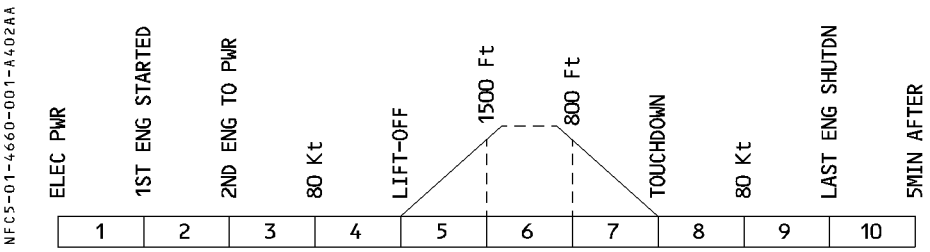


E / WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNIG	FLT PHASE INHIB
ATSU FAULT (Failure at ATSU initialization, if associated with ATSU INIT FAULT ECAM message).	SINGLE CHIME	MASTER CAUTION	NIL	NIL	3, 4, 5, 7, 8
COMPANY FAULT AOC datalink communications failure.	NIL	NIL			

MEMO DISPLAY

- The COMPANY DATALINK STBY message is displayed in green, when AOC datalink air-ground communication is temporarily unavailable, but not lost.
- The COMPANY CALL message is displayed in green, when the aircraft receives a message from the ground requesting voice communication on VHF.
- The COMPANY MSG message is displayed in green, when the aircraft receives a message from the ground.
- The COMPANY ALERT message is displayed in green, when the aircraft receives an uplink alert message, or when an AOC special condition requires a pilot action on the MCDU (depends on AOC programming). This message pulses green for 180 seconds, then remains steady. It is associated with a buzzer for 1 second.

WARNINGS AND CAUTIONS



E / WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNIG	FLT PHASE INHIB
ATSU FAULT Failure at ATSU initialization, if associated with ATSU INIT FAULT ECAM message.	SINGLE CHIME	MASTER CAUTION	NIL	NIL	3, 4, 5, 7, 8
ATC FAULT ATC datalink Communications failure, or ATC datalink application loss.					
COMPANY FAULT AOC datalink communications failure.	NIL	NIL	NIL	NIL	3, 4, 5, 7, 8

MEMO DISPLAY

- The COMPANY DATALINK STBY message is displayed in green, when AOC datalink air-ground communication is temporarily unavailable, but not lost.
- The COMPANY CALL message is displayed in green, when the aircraft receives a message from the ground requesting voice communication on VHF.
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ATC MSG ALERT

	AURAL ALERT	VISUAL ALERT	FLT PHASE INHIB
ATC MSG alert When a new ATC message arrives from the ground, or a reminder message is automatically presented within the DCDU message file.	RING	"ATC MSG" pushbuttons flashing	3,4,5, 7,8

BUS EQUIPMENT LIST

		NORM			EMER ELEC		
		AC	DC	DC BAT	AC ESS	DC ESS	HOT
ATSU	ATSU 1	AC1	DC1				

BUS EQUIPMENT LIST

		NORM			EMER ELEC		
		AC	DC	DC BAT	AC ESS	DC ESS	HOT
ATSU	ATSU 1	AC1	DC1				
	DCDU-1		DC1				
	DCDU-2		DC2				

BUS EQUIPMENT LIST

		NORM			EMER ELEC		
		AC	DC	DC BAT	AC ESS	DC ESS	HOT
ATSU	ATSU 1	AC1	DC1				
	DCDU-1*		DC1				
	DCDU-2*		DC2				

* Not yet installed

49.00 CONTENTS

49.10 DESCRIPTION

– GENERAL 1
– MAIN COMPONENTS 2

49.20 CONTROLS AND INDICATORS

– OVERHEAD PANEL 1
– EXTERNAL CONTROLS 3
– ECAM APU PAGE 4
– WARNINGS AND CAUTIONS 6
– MEMO DISPLAY 6

49.30 ELECTRICAL SUPPLY

GENERAL

The Auxiliary Power Unit (APU) is a self-contained unit that makes the aircraft independent of external pneumatic and electrical power supplies.

On the ground

– It supplies bleed air for starting the engines and for the air conditioning system.
– It supplies electrical power to the electrical system.

During takeoff

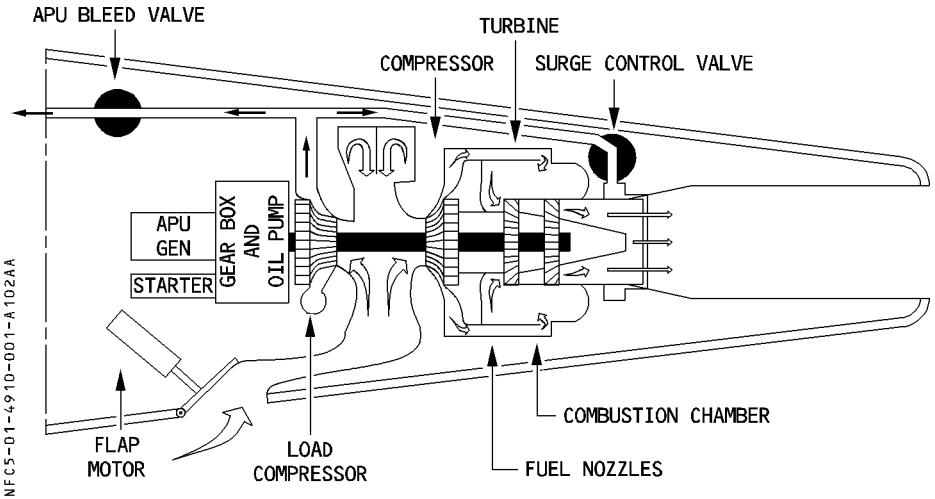
– It supplies bleed air for air conditioning, thus avoiding a reduction in engine thrust caused by the use of engine bleed air for this purpose when optimum aircraft performance is required.

In flight

– It backs up the electrical system.
– It backs up the air conditioning.
– It can be used to start the engines.

The APU may obtain power for starting from the aircraft's batteries or normal electrical system, or from ground service.
APU starting is permitted throughout the normal flight envelope (refer to FCOM 3.01.49).
The ECAM displays APU parameters.

FOR INFO



MAIN COMPONENTS

APU ENGINE

The basic element of the APU is a single-shaft gas turbine that delivers mechanical shaft power for driving the accessory gearbox (electrical generator, starter, etc.) and produces bleed air (engine starting and pneumatic supply).

ELECTRONIC CONTROL BOX

The Electronic Control Box (ECB) is a full-authority digital electronic controller that performs the bulk of the APU system logic for all modes of engine operation, such as :
- Sequences the start and monitors it.
- Monitors speed and temperature.
- Monitors bleed air.
- Sequences the shutdown.
- Controls the automatic shutdown.

AIR INTAKE SYSTEM

The air intake and an electrically operated flap allow external air to reach the compressor inlet.

STARTER

The ECB controls the electric starter. The starter engages if the air intake is fully open and the MASTER SW and the START pushbutton are ON.

FUEL SYSTEM

The left fuel feed line supplies the APU.
The required pressure is normally available from tank pumps.
If pressure is not available (batteries only or pumps off) the APU FUEL PUMP starts automatically.
The ECB controls the fuel flow.

OIL SYSTEM

The APU has an integral independent lubrication system (for lubrication and cooling).

INLET GUIDE VANES (IGV)

The IGVs control bleed air flow, and a fuel-pressure-powered actuator positions the IGVs. The ECB controls the actuator in response to aircraft demand.

AIR BLEED SYSTEM

The air bleed system is fully automatic.

R The ECB always sets the APU speed to 100 %, except for air conditioning demand, if the
R ambient temperature is between – 18 deg. C and 35 deg. C. In this case, the ECB sets the
R APU speed to 99 %. For all other ambient temperatures (less than – 18 deg. C or more than
R 35 deg. C), the ECB sets the APU speed to 100 %.

CONTROLS

The flight crew uses the controls on the APU panel for routine shutdown. For emergency shutdown :

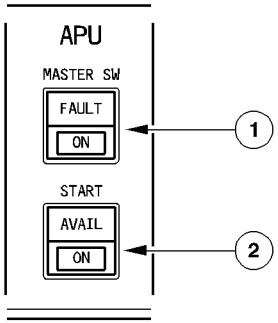
- the flight crew can push the APU FIRE handle, or
- the ground crew can push the APU SHUT OFF pushbutton on the interphone panel under the nose fuselage.

GROUND OPERATION SAFETY DEVICES

The APU may run without cockpit crew supervision when the aircraft is on the ground. In case of fire in the APU compartment :

- APU fire warnings operate in the cockpit.
- A horn in the nose gear bay sounds.
- The AVAIL light goes out.
- The FAULT light in the MASTER SW lights up.
- The APU shuts down.
- The APU fire extinguisher discharges.

OVERHEAD PANEL



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(1) MASTER SW pushbutton

This switch controls the electric power supply for APU operation, and its protective features. It also controls the starting and shutdown sequences.

ON : The blue ON light comes on.
Electric power goes to the APU system ; the ECB performs a power-up test.
The APU air intake flap opens.
The APU fuel isolation valve opens.
If no fuel tank pump is running, the APU fuel pump operates.
If the aircraft has ground power or main generator power, the APU page appears on the ECAM display.

OFF : Manual shutdown sequence.
- The ON light on the MASTER SW pushbutton, and the AVAIL light on the START pushbutton, go off.
- If the aircraft was using APU bleed air, the APU keeps running for a cooling period of 60 seconds.
- At 7 %, the air inlet flap closes.

R

FAULT lt : This amber light comes on, and a caution appears on the ECAM, when an automatic APU shutdown occurs, which happens in case of :

Fire (on ground only)	Reverse flow
Air inlet flap not open	Low oil pressure
Overspeed	High oil temperature
No acceleration	DC power loss. (BAT OFF when aircraft on batteries only)
No speed	
EGT overtemperature	ECB failure
No flame	Loss of overspeed protection
Underspeed	Oil system shutdown
	Inlet overheat
	Clogged oil filter
	Loss of EGT thermocouples

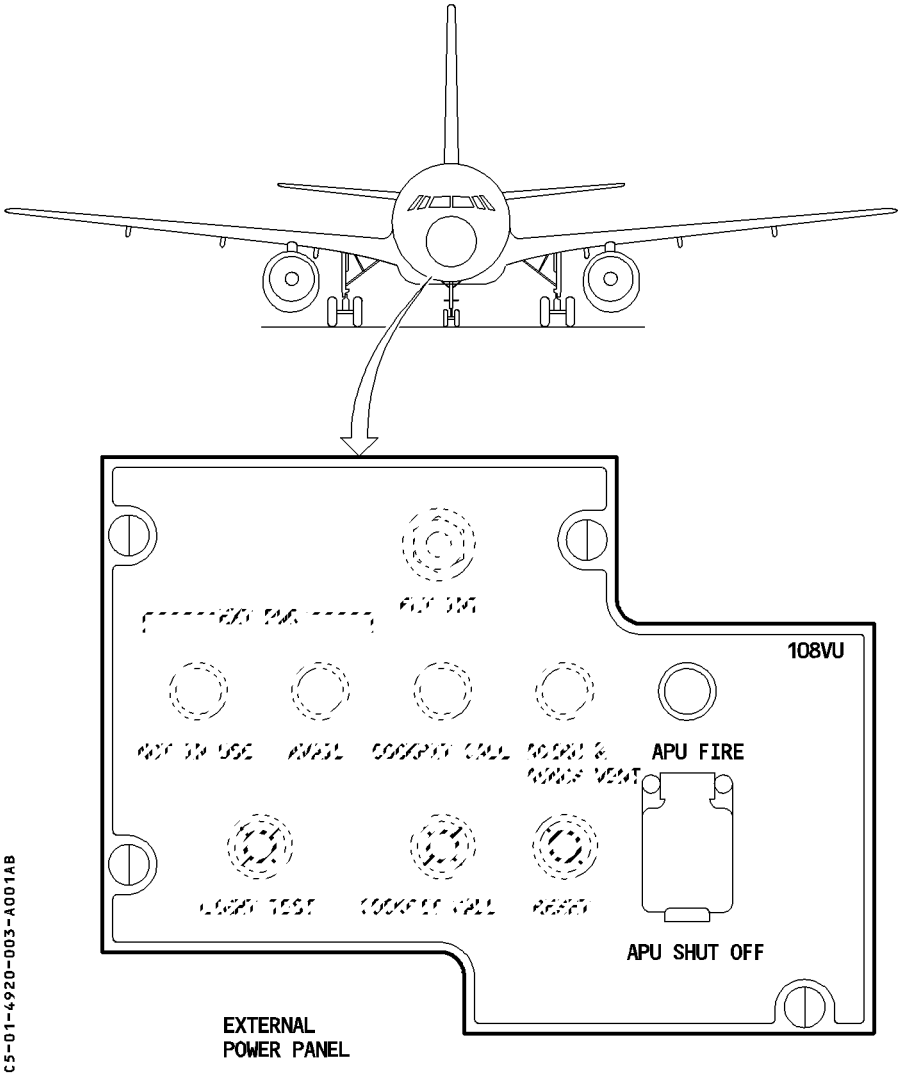
(2) START pb sw

ON : Blue ON light comes on.

R
- When the flap is completely open, the starter is energized.
- 1.5 second after the starter is energized, the ignition turns on.
- When N = 60 %. The APU starter is de-energized. The ignition is turned off.
- 2 seconds after N reached 95 %, or when N is above 99.5 % :
  The ON light on the START pushbutton goes out.
  The APU may now supply bleed air and electrical power to the aircraft systems.
- 10 seconds later, the APU page disappears from the ECAM display.

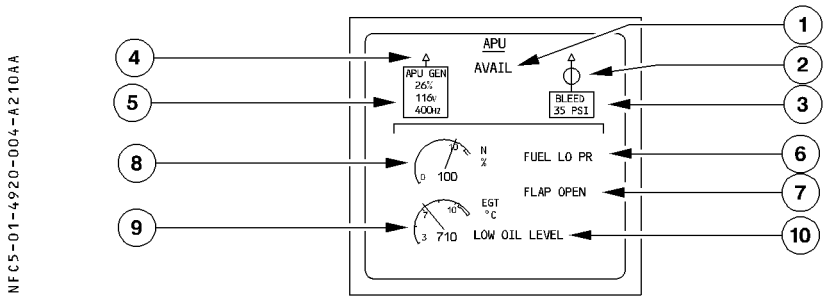
AVAIL lt : This green light comes on when N is above 99.5 % or 2 seconds after N reaches 95 %.

EXTERNAL CONTROLS



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ECAM APU PAGE



(1) AVAIL

Displayed in green, when APU N is above 95 %.

(2) APU bleed air valve position

Inline - Green : The APU bleed air valve is not closed.
Crossline - Green : The APU bleed air valve is closed.
Crossline - Amber : The APU bleed air valve is closed and the APU bleed is ON.
XX - Amber : The APU bleed air valve status information is not available, or the APU BLEED pushbutton status is not available.

(3) APU bleed air pressure

This box displays the relative bleed air pressure in green.
R It shows an amber XX, when ADIRS1 is not available, or selected OFF.

(4) APU GEN contactor indication

Displayed in green, when the APU GEN contactor is closed.

(5) APU GEN parameters

Identical to the APU GEN parameters on the ELEC page.

(6) FUEL LO PR

Displayed in amber, if the APU fuel pressure gets low.

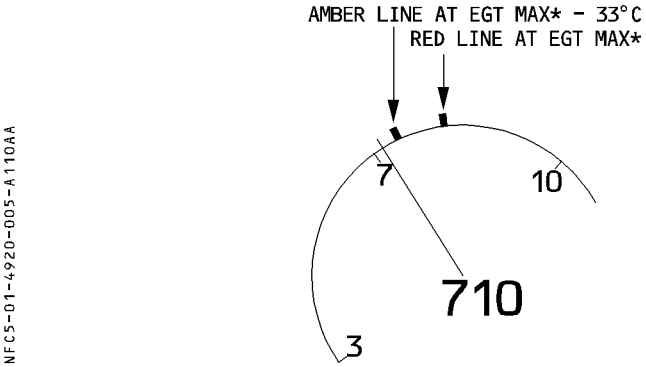
(7) FLAP OPEN

– Displayed in green, when the APU air intake flap is fully open (MASTER SW ON).

(8) APU N

- Displays APU speed in green.
- Becomes amber when N ≥ 102 %.
- Becomes red when N ≥ 107 %.

(9) APU EGT



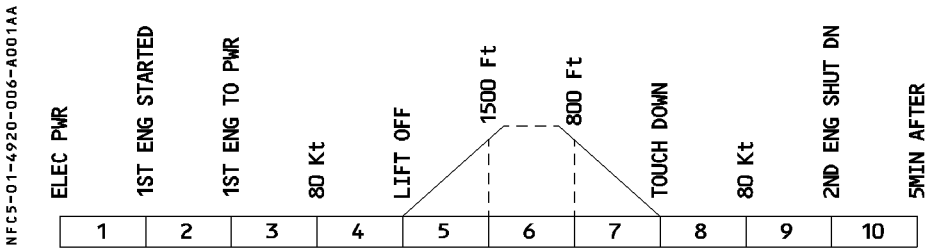
- Displays APU EGT in green.
- Becomes amber when EGT ≥ EGT max* – 33°C.
- Becomes red when EGT ≥ EGT max* (automatic shutdown begins).

* ECB calculates EGT max and transmits it to ECAM. It is a function of N during start and a function of ambient temperature when the APU is running.
  Maximum EGT during start : 1090°C.
  Maximum EGT with APU running : 675°C.

(10) LOW OIL LEVEL

Advisory : displayed if the ECB detects a low APU oil level when the aircraft is on the ground and the APU is not running.

WARNINGS AND CAUTIONS



E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
AUTO SHUT DOWN automatic shut down of APU for a reason other than a fire.	SINGLE CHIME	MASTER CAUT	APU	APU MASTER SW FAULT lt	3, 4, 5 7, 8
EMER SHUT DOWN use of APU shut off pushbutton on external power panel or APU FIRE pushbutton pushed. In case of APU fire on ground, the APU FIRE warning is triggered.					

MEMO DISPLAY

– APU AVAIL appears in green when APU N is above 95 %.

BUS EQUIPMENT LIST

	NORM			EMER ELEC		
	AC	DC	DC BAT	AC ESS	DC ESS	HOT
ECB SUPPLY			X			
STARTER MOTOR			X			

Note : When the system is in electrical emergency configuration, battery contactors automatically close for a maximum of 3 minutes, when the APU MASTER SW is ON.
When the aircraft is in flight, and when the system is in electrical emergency configuration, the APU start is inhibited for 45 seconds.

52.00 CONTENTS

52.10 DESCRIPTION

– GENERAL 1
– PASSENGER DOORS 2
– EMERGENCY EXITS 5
– CARGO DOORS 8
– AVIONICS COMPARTMENT ACCESS DOORS 8
R – COCKPIT DOOR 8
– ESCAPE SLIDES/RAFT 9

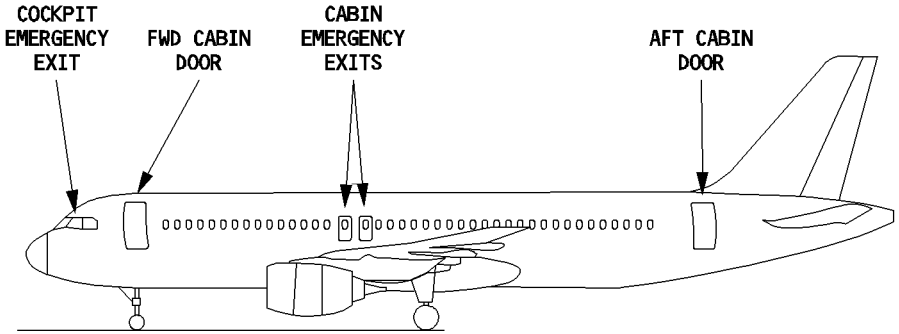
52.20 CONTROLS AND INDICATORS

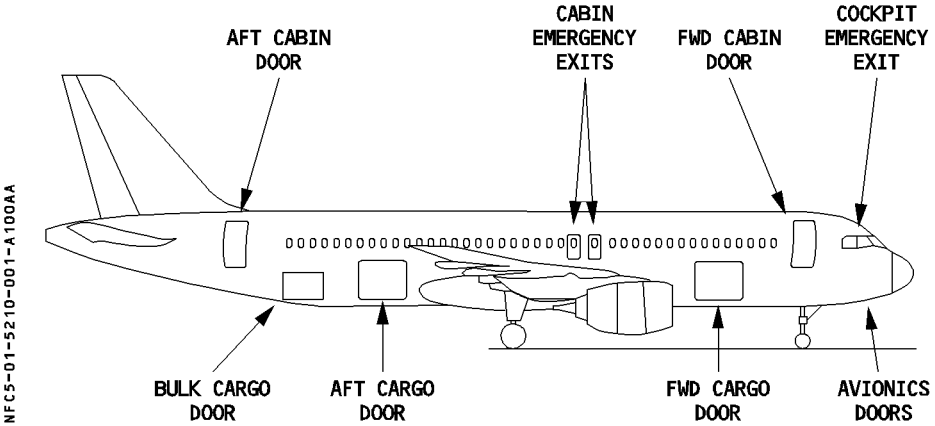
– ECAM DOOR PAGE 1
R – WARNINGS AND CAUTIONS 2

52.40 ELECTRICAL SUPPLY

GENERAL

The fuselage of A320 has :
- four passenger doors
- four emergency exits in the cabin
- cockpit emergency exits (two sliding windows)
- three cargo compartment doors
- four avionic compartment access doors.





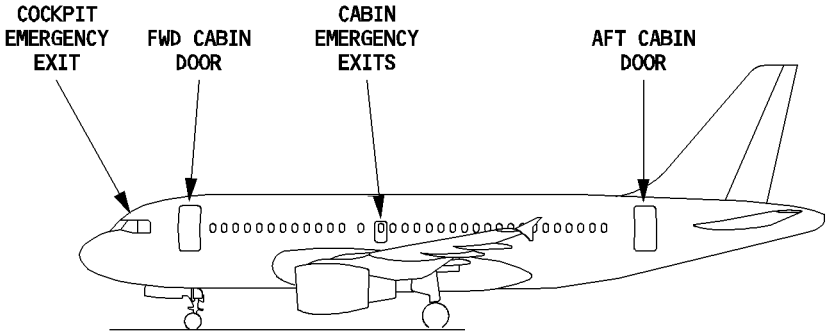
PASSENGER DOORS

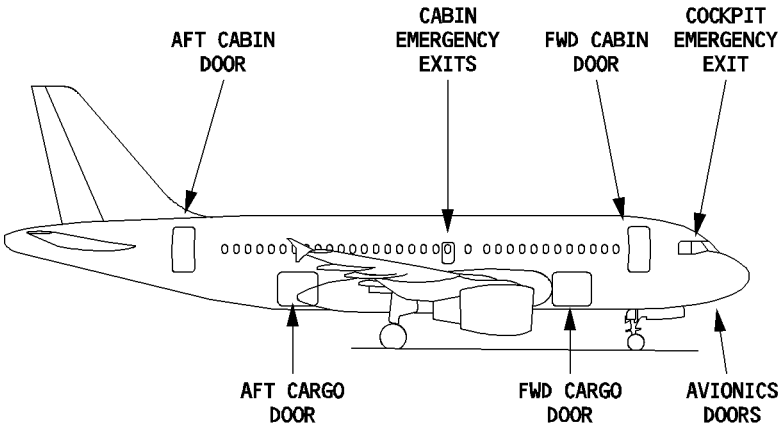
The aircraft has four plug-type doors that open outward and forward. There are two of these on each side of the fuselage (two forward, two aft).
They can be operated from inside or outside the aircraft. Normal operation is manual, with hydraulic damping.
Each door has features that tailor it to emergency situations :
– an escape slide stowed in a container attached to the inboard lower side of the door.
– a damper actuator that limits door travel in normal mode, but in an emergency acts as an actuator for automatic door opening.
– a slide arming lever.

When the slide arming lever is in the ARMED position, the slide is connected to the floor brackets on both sides of the door. When the door is opened, the slide inflates and deploys automatically. If the inflation bottle fails to discharge automatically, a crew member can open its valve to make it perform its function.
Opening the door from the outside disarms the door and the escape slide.
Each passenger door has :
– a mechanical locking indicator that shows whether the door is locked or unlocked.
– one warning light to show whether the escape slide is ARMED or DISARMED.
– one CABIN PRESSURE warning light that warns of residual pressure in the cabin.

GENERAL

The fuselage of A319 has :
- four passenger doors
- two emergency exits in the cabin
- cockpit emergency exits (two sliding windows)
- two cargo compartment doors
- four avionic compartment access doors.





NFC5-01-5210-001-A106AA

PASSENGER DOORS

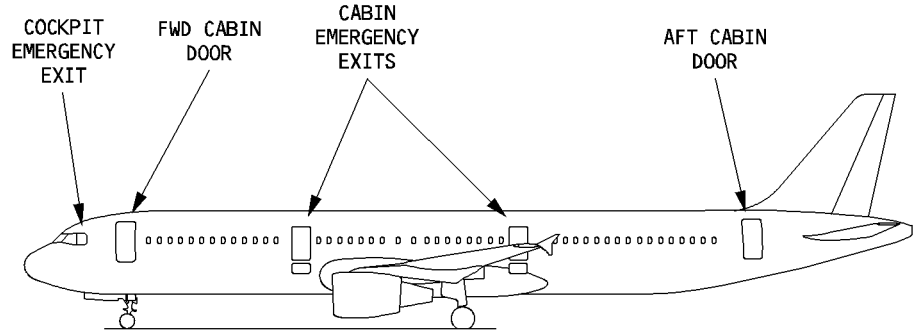
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Each door has features that tailor it to emergency situations :
– an escape slide stowed in a container attached to the inboard lower side of the door.
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– a slide arming lever.

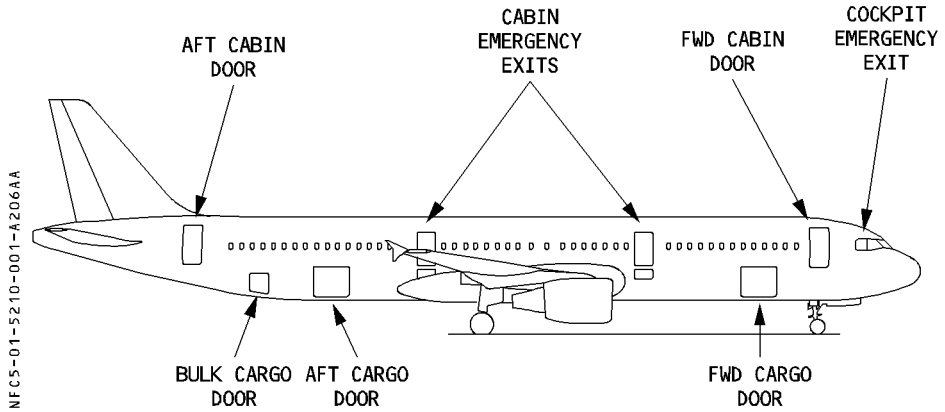
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Each passenger door has :
– a mechanical locking indicator that shows whether the door is locked or unlocked.
– one warning light to show whether the escape slide is ARMED or DISARMED.
– one CABIN PRESSURE warning light that warns of residual pressure in the cabin.

GENERAL

The A321 fuselage has :

- Four passenger doors,
- Four emergency exits in the cabin,
- Cockpit emergency exits (two sliding windows),
- Three cargo compartment doors, and
- Four avionic compartment access doors.





PASSENGER DOORS

The aircraft has four plug-type doors that open outward and forward. There are two of these on each side of the fuselage (two forward, two aft).
They can be operated from inside or outside the aircraft. Normal operation is manual, with hydraulic damping.
Each door has features that tailor it to emergency situations :

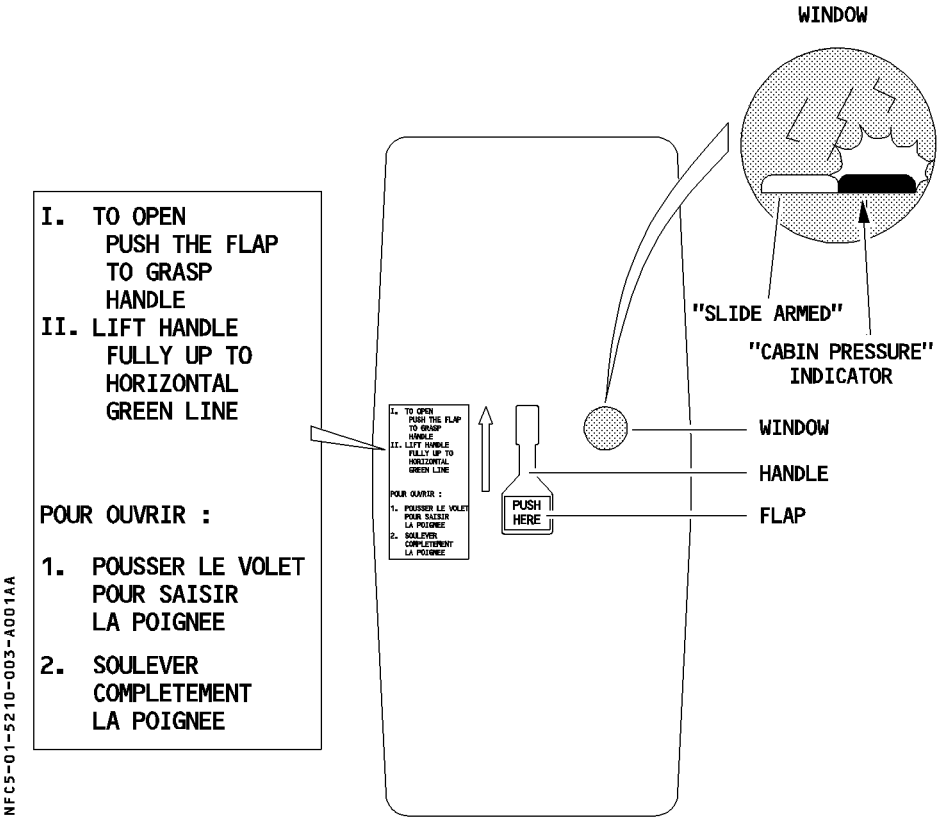
- an escape slide stowed in a container attached to the inboard lower side of the door.
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Each passenger door has :

- a mechanical locking indicator that shows whether the door is locked or unlocked.
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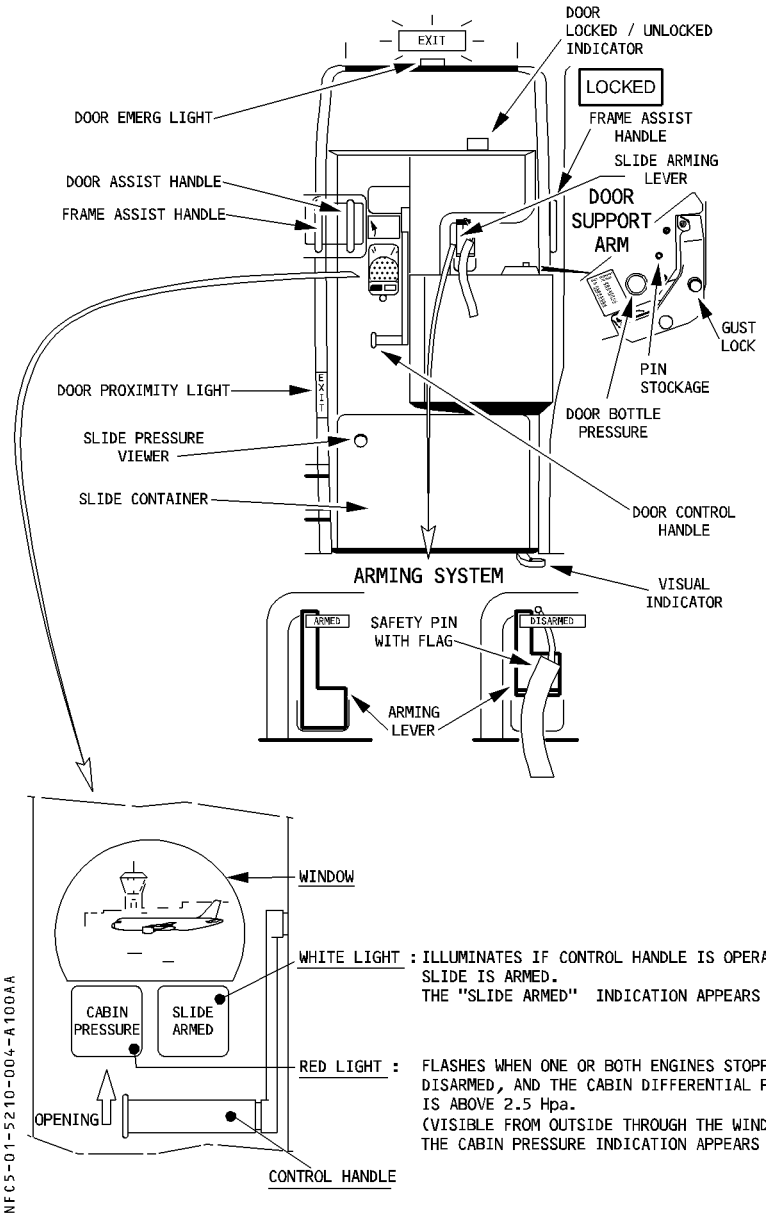
PASSENGERS DOORS

OUTSIDE



PASSENGERS DOORS

INSIDE



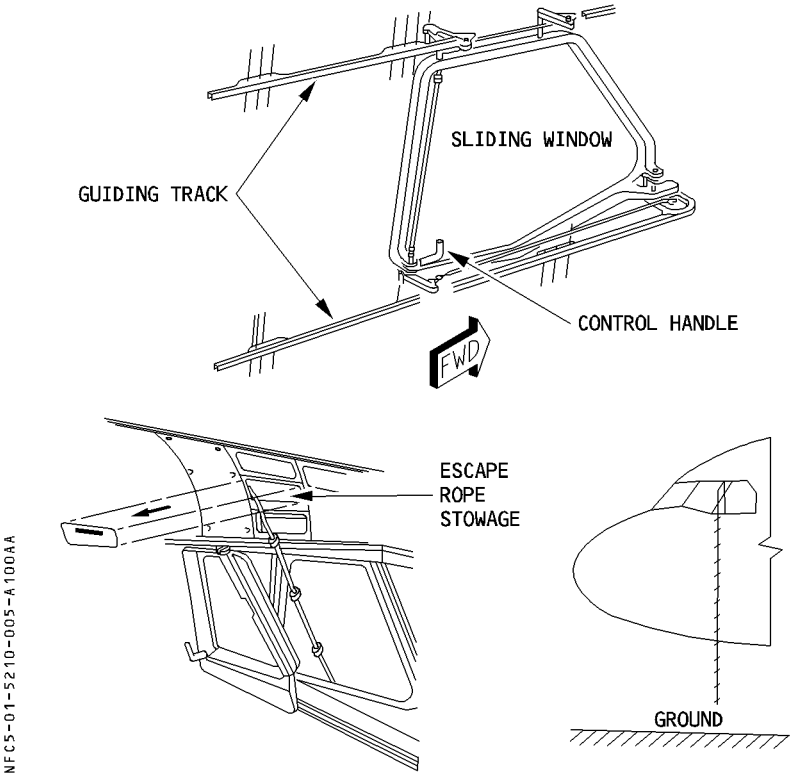
WHITE LIGHT : ILLUMINATES IF CONTROL HANDLE IS OPERATED WHEN SLIDE IS ARMED.
THE "SLIDE ARMED" INDICATION APPEARS IN BLACK.

RED LIGHT : FLASHES WHEN ONE OR BOTH ENGINES STOPPED, THE SLIDES ARE DISARMED, AND THE CABIN DIFFERENTIAL PRESSURE IS ABOVE 2.5 Hpa.
(VISIBLE FROM OUTSIDE THROUGH THE WINDOW).
THE CABIN PRESSURE INDICATION APPEARS IN BLACK.

EMERGENCY EXITS

COCKPIT

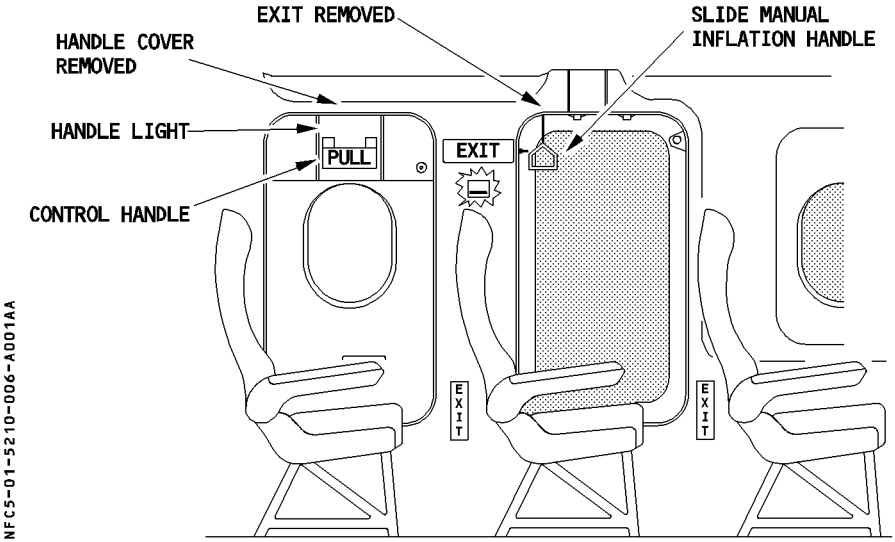
The two sliding windows in the cockpit are flight crew emergency exits.
A small compartment, located above each window, contains an escape rope that is long enough to reach the ground when lowered through either sliding window.
The cockpit windows can only be opened from the inside.



Emergency cockpit evacuation is also possible through the cockpit door escape panel. It is designed to be pushed open in the direction of the cabin after removal of the quick-release pins.

CABIN

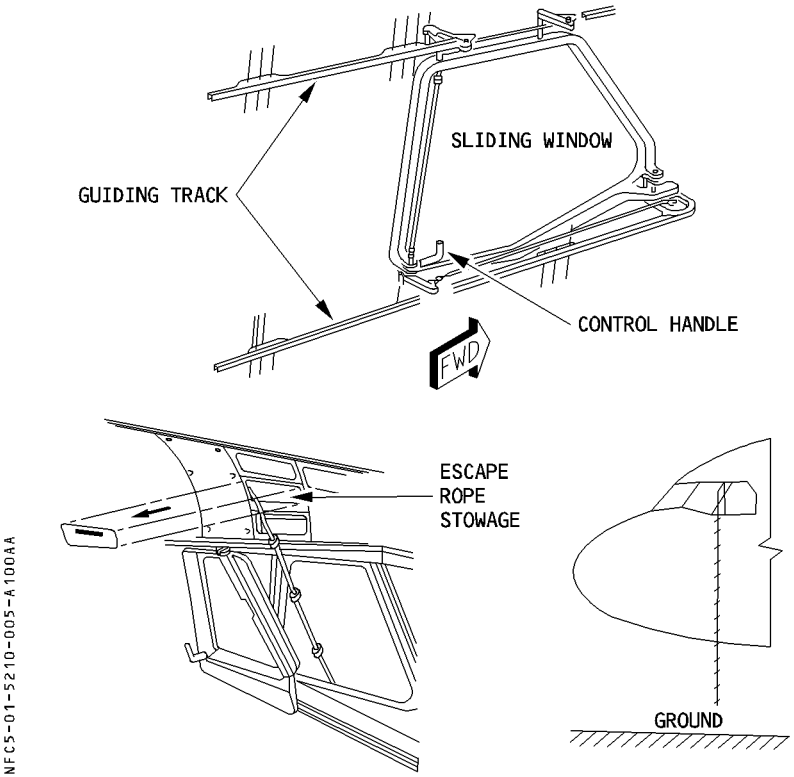
R In case of an emergency, two inward opening emergency exits are provided on each side of the cabin, in addition to the regular cabin doors. They are also equipped with escape
R slides.



EMERGENCY EXITS

COCKPIT

The two sliding windows in the cockpit are flight crew emergency exits.
A small compartment, located above each window, contains an escape rope that is long enough to reach the ground when lowered through either sliding window.
The cockpit windows can only be opened from the inside.

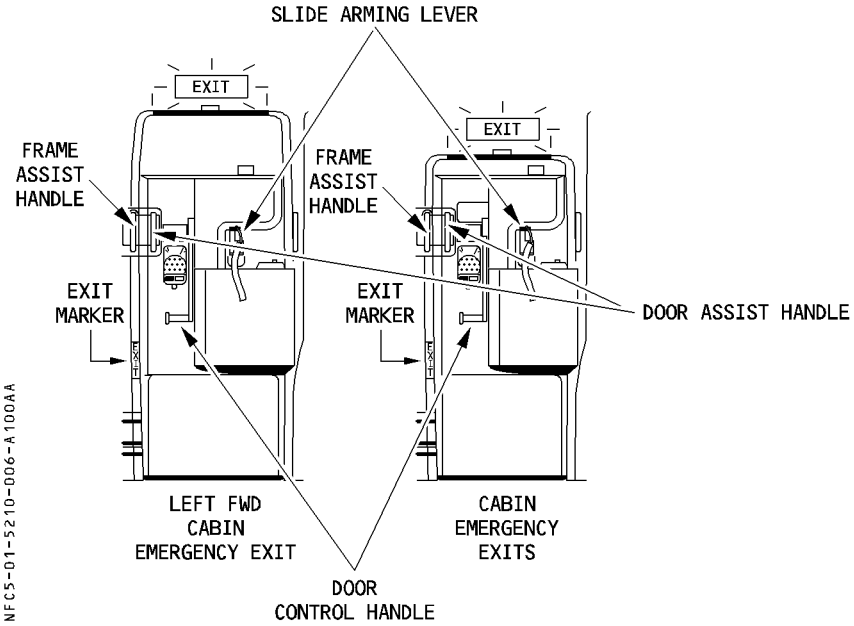


Emergency cockpit evacuation is also possible through the cockpit door escape panel. It is designed to be pushed open in the direction of the cabin after removal of the quick-release pins.

CABIN

Two plug type doors on each side of the cabin are emergency exits. They open outward and forward and each has an escape slide stowed in a compartment below the cabin floor. Operation of these exits is similar to that of passenger doors.

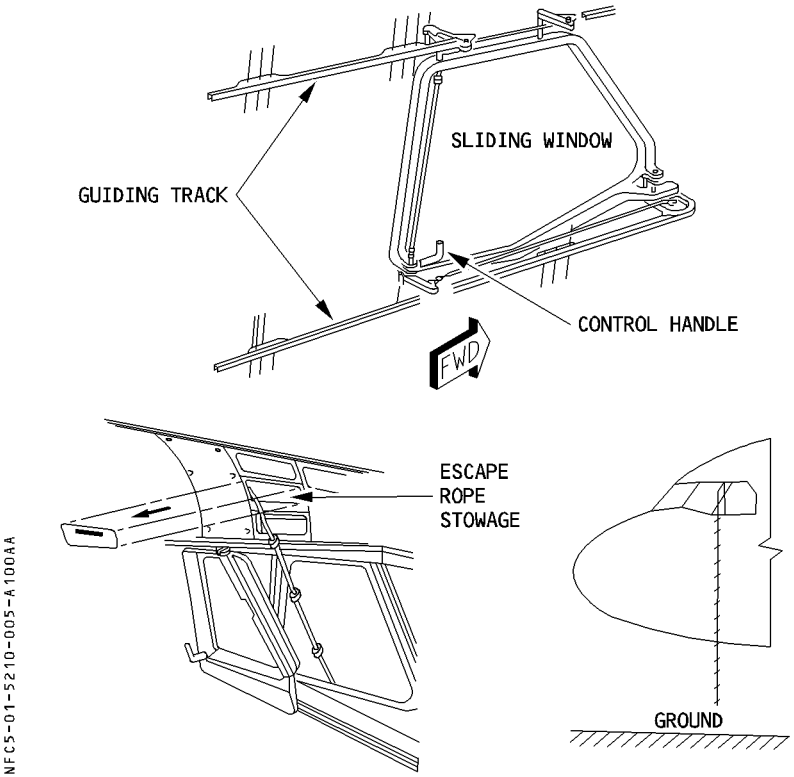
R



EMERGENCY EXITS

COCKPIT

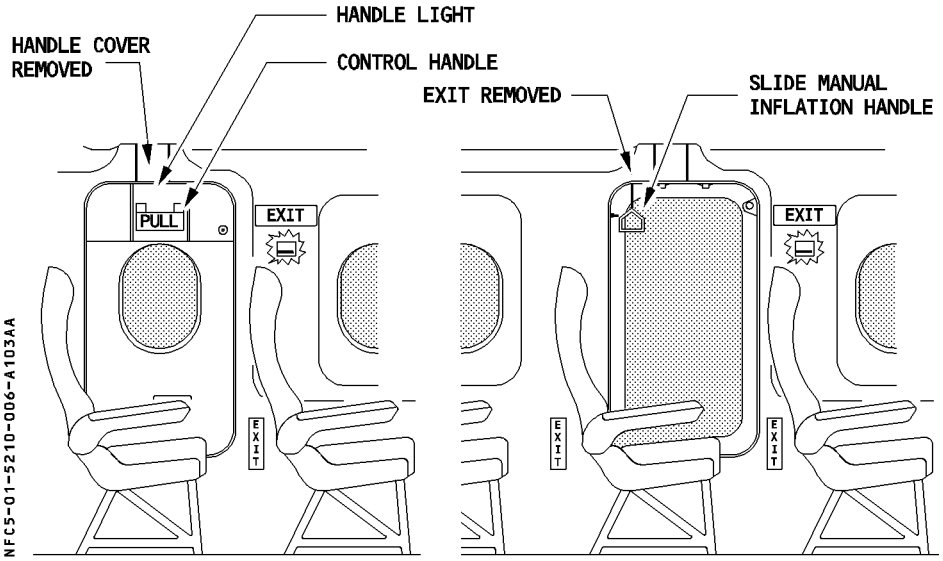
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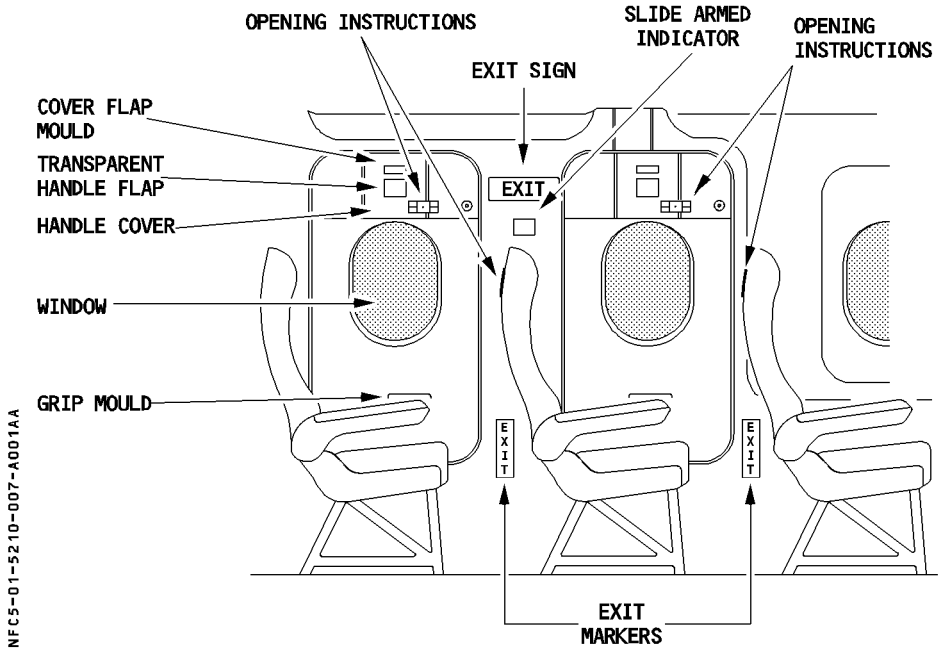
CABIN

R In case of an emergency, one inward opening emergency exit is provided on each side of the cabin, in addition to the regular cabin doors. It is also equipped with an escape slide.



The slides of the overwing emergency exits are always in armed configuration.
To open :

- Remove HANDLE COVER : The HANDLE LIGHT and SLIDE ARMED indicator illuminate.
- Pull CONTROL HANDLE : The EXIT moves inwards.
- Lift EXIT from frame by holding the GRIPMOULD.
- Throw EXIT out.



CARGO DOORS

The aircraft has two (three ◁) cargo doors on the right side of the fuselage below the cabin floor.

FWD AND AFT CARGO DOORS

The yellow hydraulic system opens these doors outwards and upwards. They lock open, or close mechanically.
If the yellow system's electric pump fails, crewmembers can use a hand pump to pressurize the system. This hand pump is on the hydraulic maintenance panel.
The FWD and AFT cargo doors can only be opened from the outside.

Note : When the electric pump is operating the FWD or AFT cargo doors, the only other yellow system devices that can operate are braking and engine 2 reverse.

BULK CARGO DOOR ◁

The bulk cargo door opens inwards and upwards. It is a plug-type door that is mechanically-locked and manually-operated.
This door can either be opened from the outside or the inside.

AVIONICS COMPARTMENT ACCESS DOOR

Four inward-opening, manually-operated, hinged doors give external access to the avionics compartments. These doors are in the lower fuselage, around the nose landing gear bay.

COCKPIT DOOR

Refer to 1.25.11 for information about the secured cockpit door.

INTENTIONALLY LEFT BLANK

CARGO DOORS

The aircraft has two (three ◁) cargo doors on the right side of the fuselage below the cabin floor.

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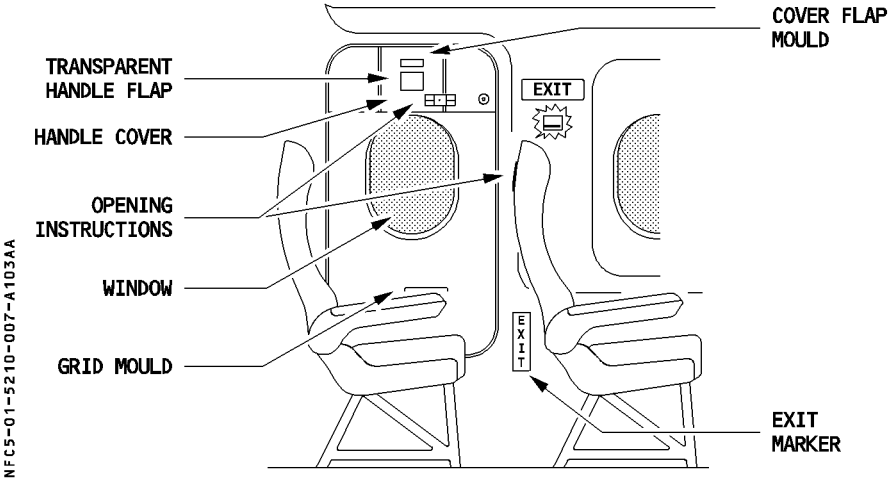
AVIONICS COMPARTMENT ACCESS DOOR

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COCKPIT DOOR

Refer to 1.25.11 for information about the secured cockpit door.

The overwing emergency exit are always in armed configuration.
To open :
– Remove HANDLE COVER : The HANDLE LIGHT and SLIDE ARMED indicator illuminate.
– Pull CONTROL HANDLE : The EXIT moves inwards.
– Lift EXIT from frame by holding the GRIPMOULD.
– Throw EXIT out.



CARGO DOORS

The aircraft has two (three ◁) cargo doors on the right side of the fuselage below the cabin floor.

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The yellow hydraulic system opens these doors outwards and upwards. They lock open, or close mechanically.
If the yellow system's electric pump fails, crewmembers can use a hand pump to pressurize the system. This hand pump is on the hydraulic maintenance panel.
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This door can either be opened from the outside or the inside.

AVIONICS COMPARTMENT ACCESS DOOR

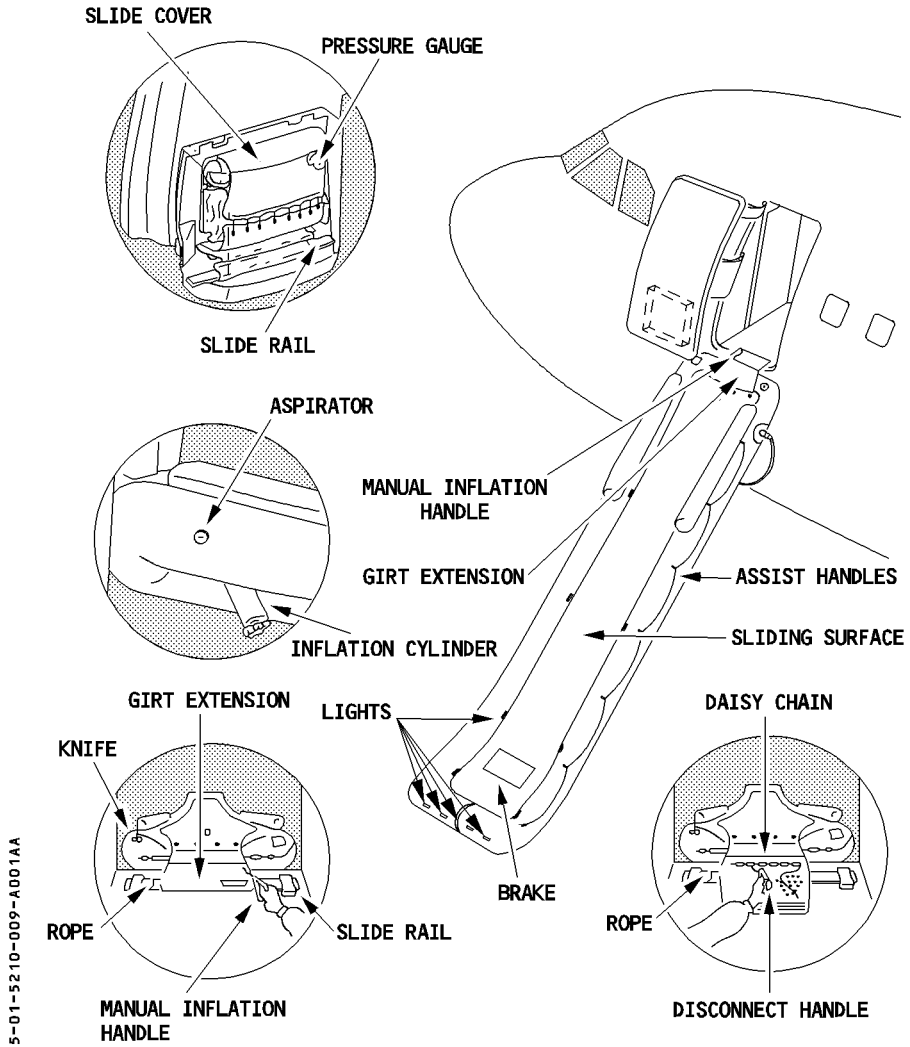
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COCKPIT DOOR

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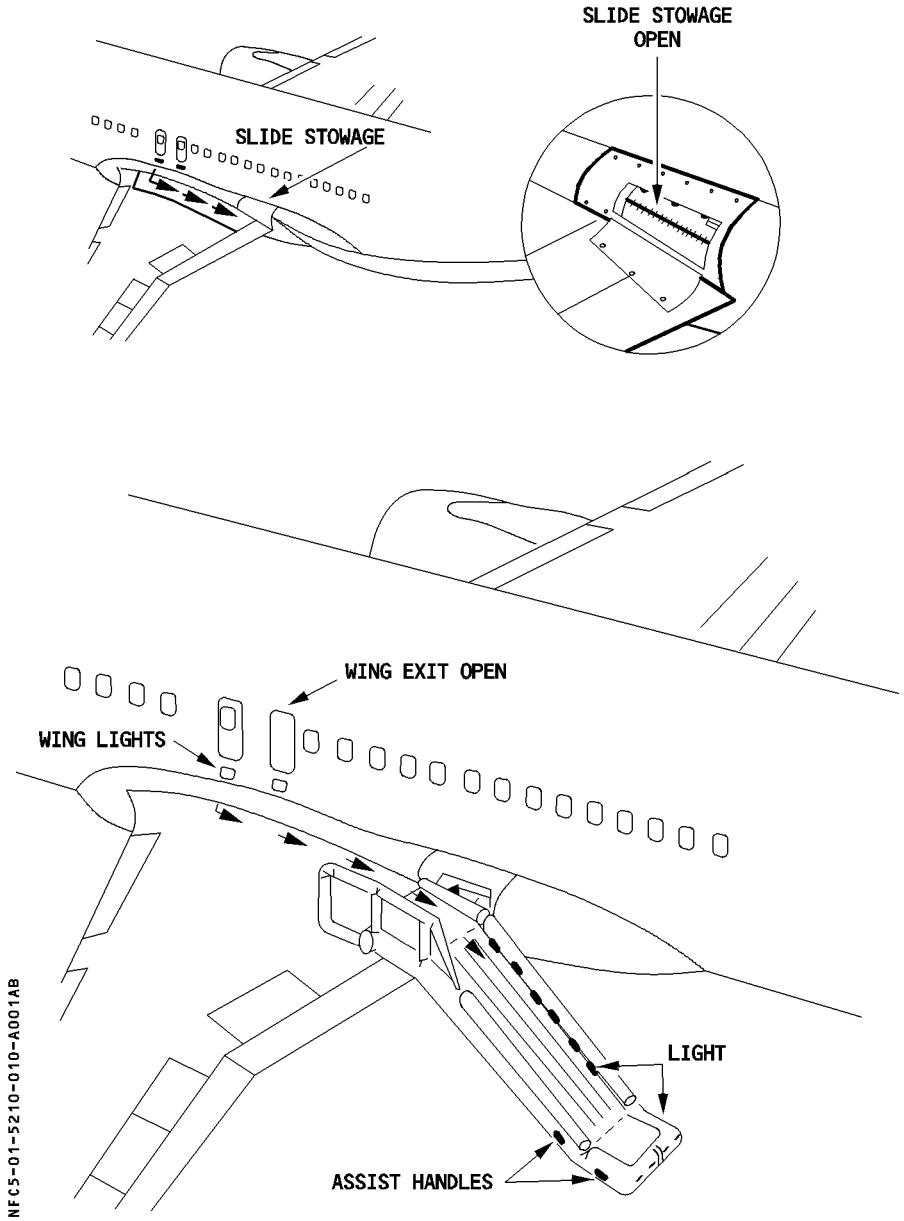
ESCAPE SLIDES/RAFT

DOOR SLIDES



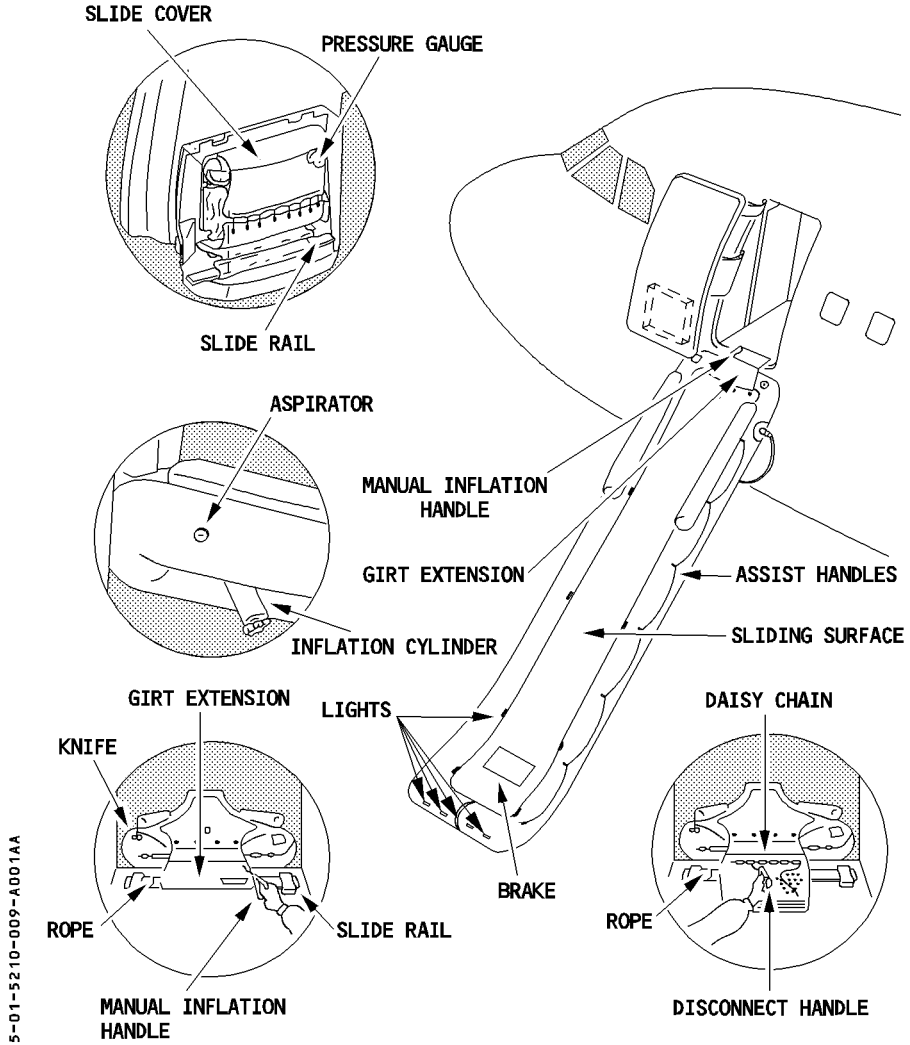
NOTE : THE ROPE MUST BE CUT AFTER DISCONNECTION

WING SLIDES


SLIDE STOWAGE
OPEN
SLIDE STOWAGE
WING EXIT OPEN
WING LIGHTS
LIGHT
ASSIST HANDLES
NFC5-01-5210-010-A001AB

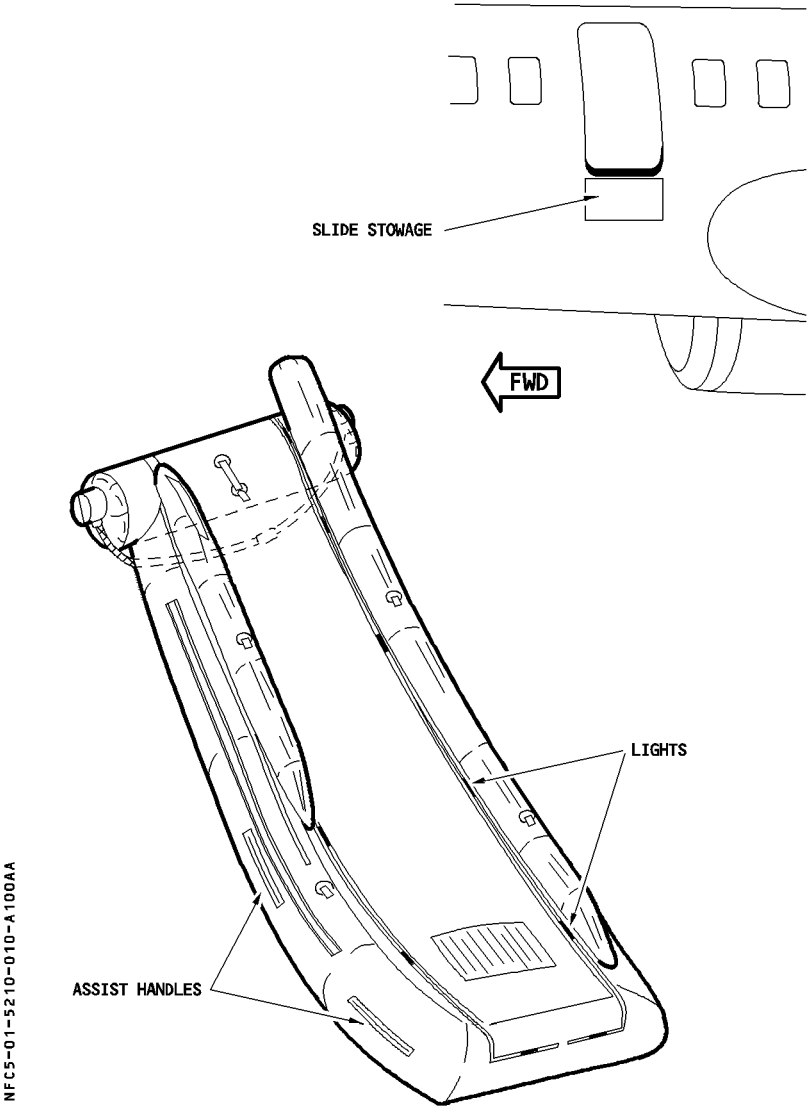
ESCAPE SLIDES/RAFT

DOOR SLIDES



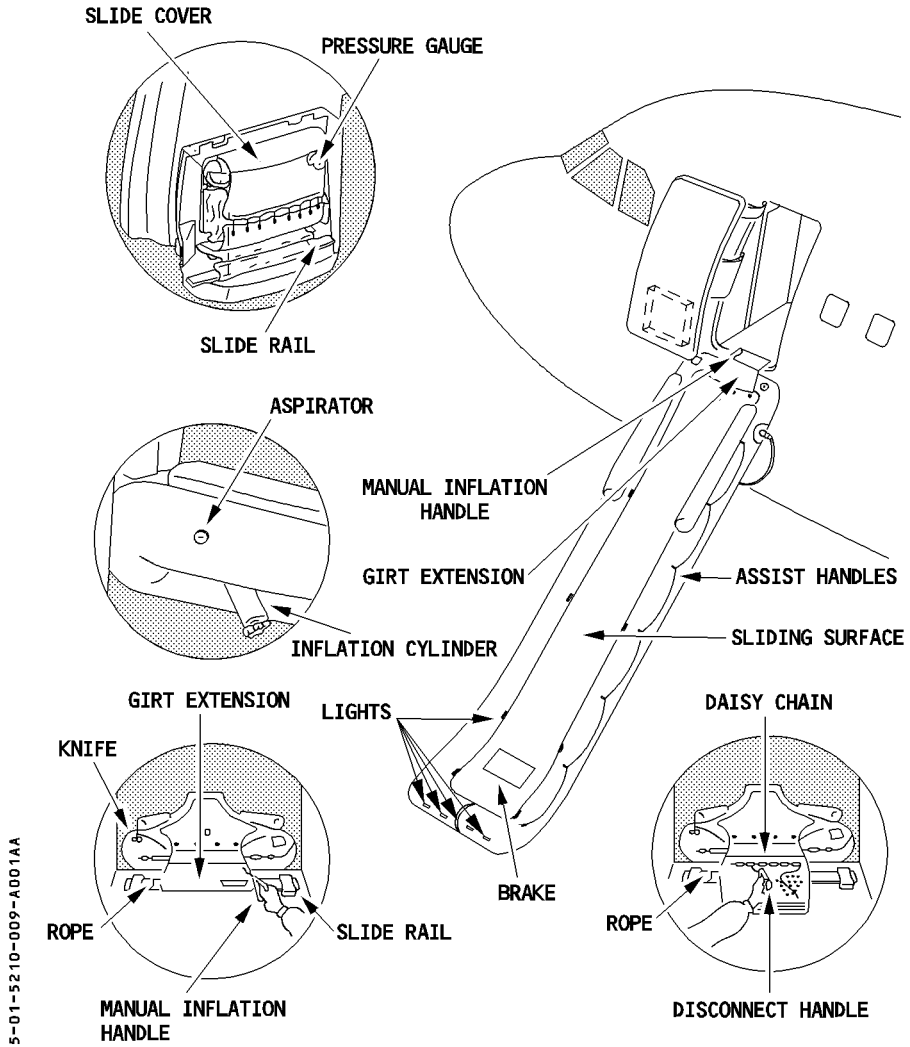
NOTE : THE ROPE MUST BE CUT AFTER DISCONNECTION

CABIN EMERGENCY EXIT SLIDES



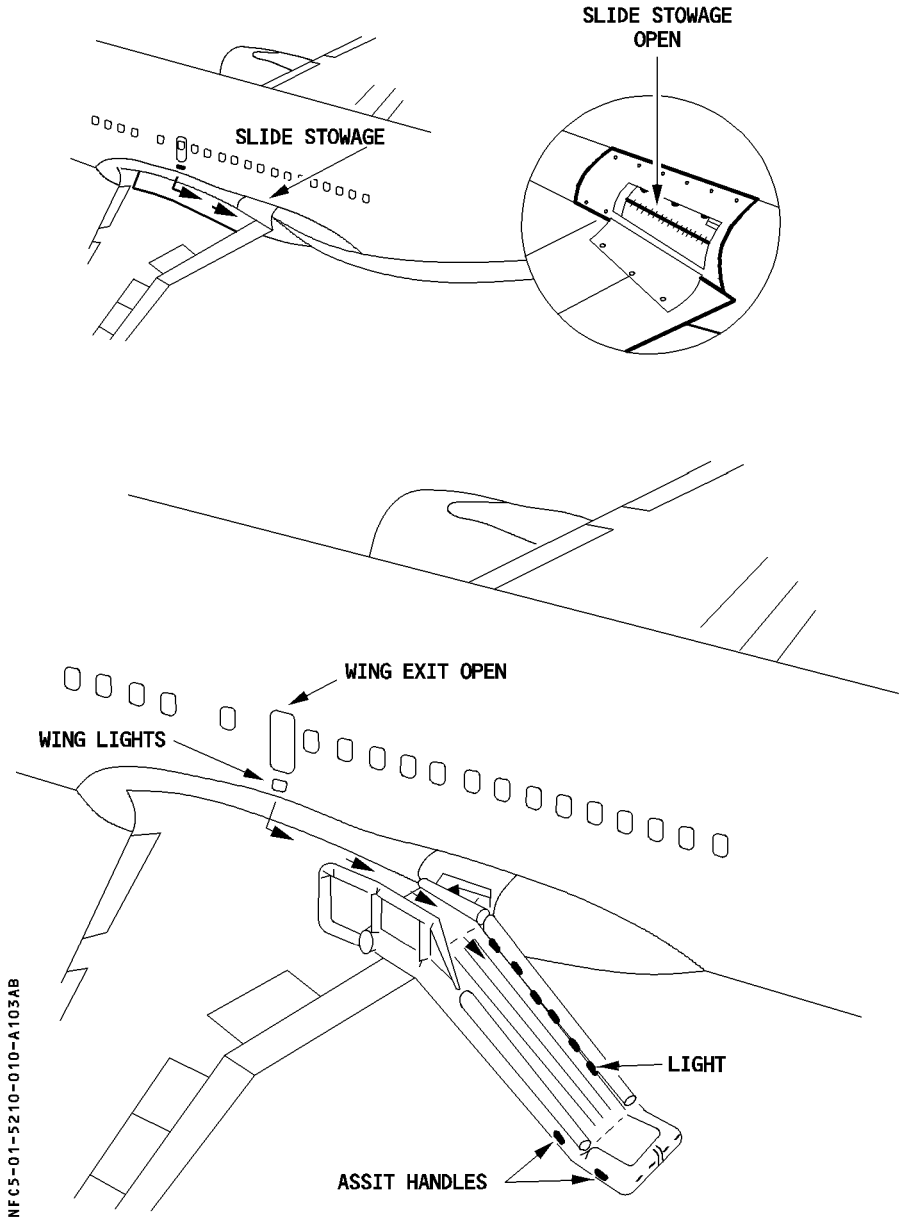
ESCAPE SLIDES/RAFT

DOOR SLIDES



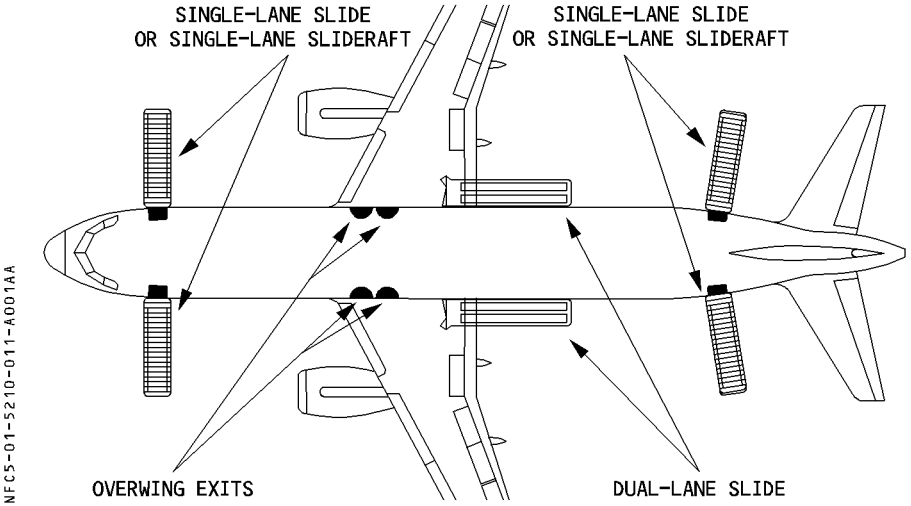
NOTE : THE ROPE MUST BE CUT AFTER DISCONNECTION

WING SLIDES


SLIDE STOWAGE
OPEN
SLIDE STOWAGE
WING EXIT OPEN
WING LIGHTS
LIGHT
ASSIT HANDLES
NFC5-01-5210-010-A103AB

ESCAPE SLIDE ARRANGEMENT

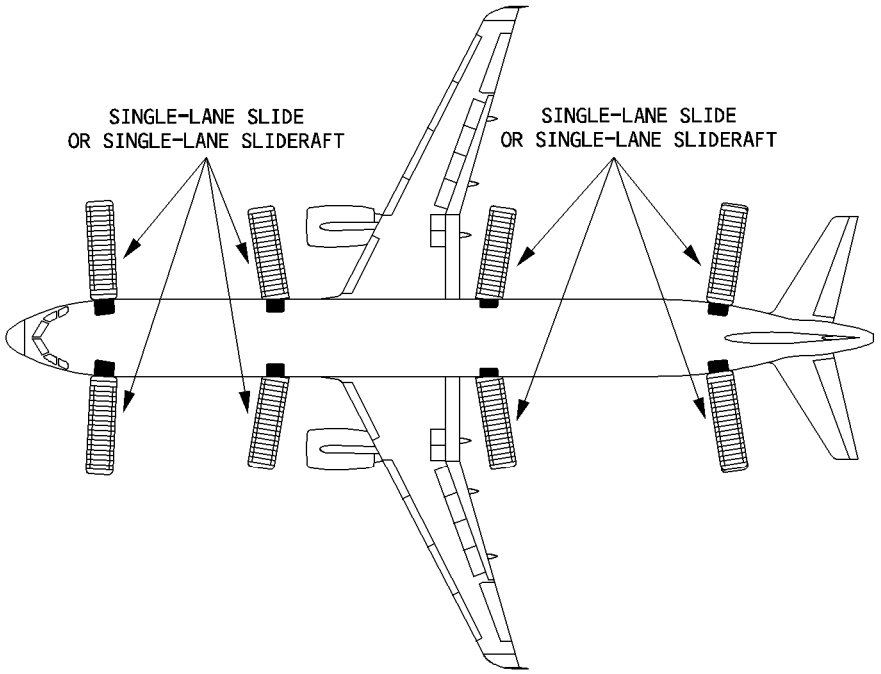
R Each passenger door either has a single-lane escape slide, or a single-lane slideraft, and each emergency exit has a dual-lane escape slide.



ESCAPE SLIDE ARRANGEMENT

R Each passenger door and emergency exit either has a single-lane escape slide, or a single-lane slideraft. In addition, to accommodate high density configurations, additional rafts may be installed in the overhead stowage compartments that are located near the doors.

R

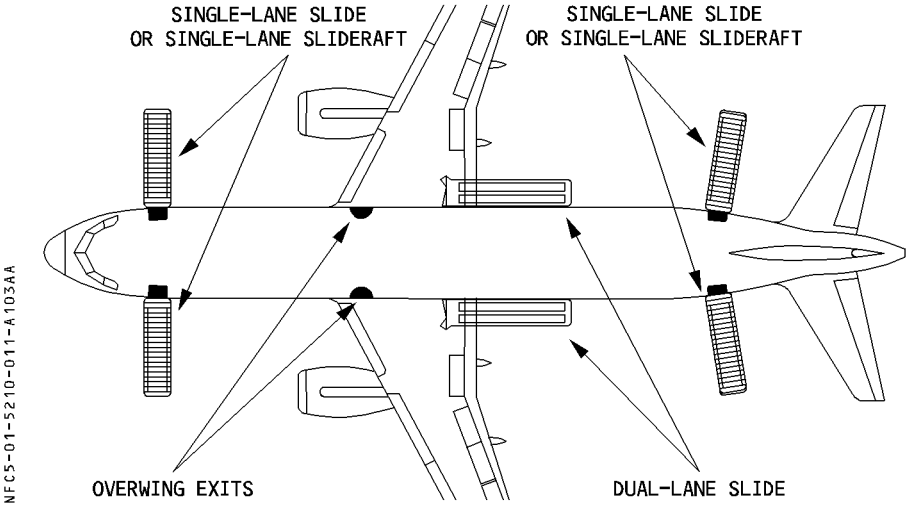


NFCS-01-5210-011-A100AA

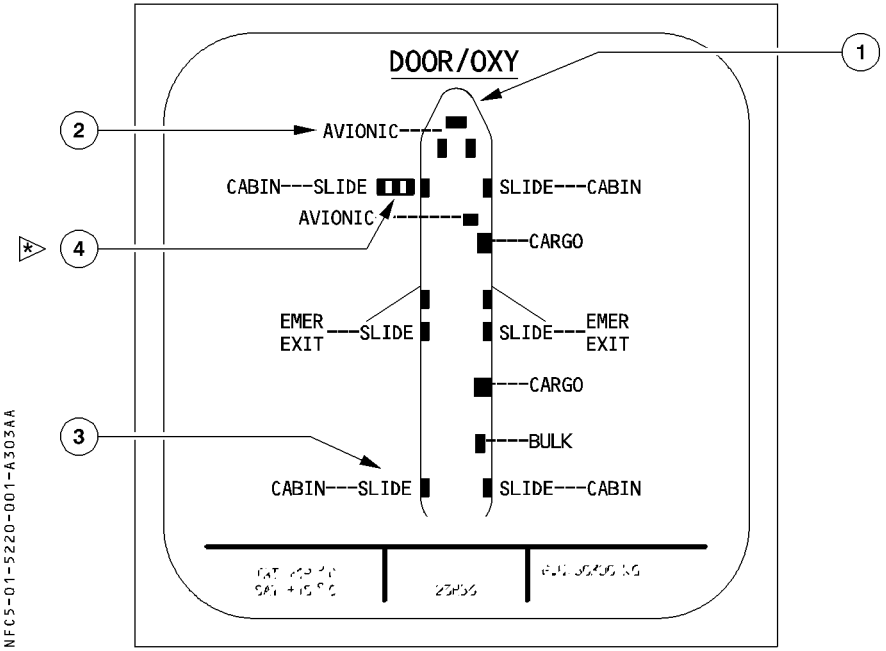
ESCAPE SLIDE ARRANGEMENT

Each passenger door either has a single-lane escape slide, or a single-lane slideraft, and each emergency exit has a dual-lane escape slide.

R



ECAM DOOR PAGE



(1) Door symbol

Green □ : The door is closed and locked.
Amber ■: The door is not locked.

(2) Door indication

This appears in amber, when the door is not locked.

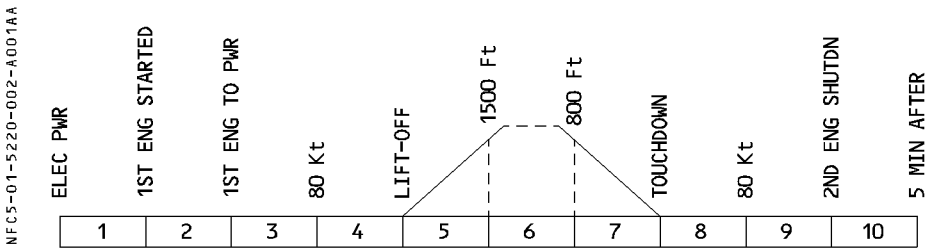
(3) SLIDE indication

This appears in white, when the slide is armed.

(4) Stair symbol (◁)

This appears in amber, when the stair door is not closed.

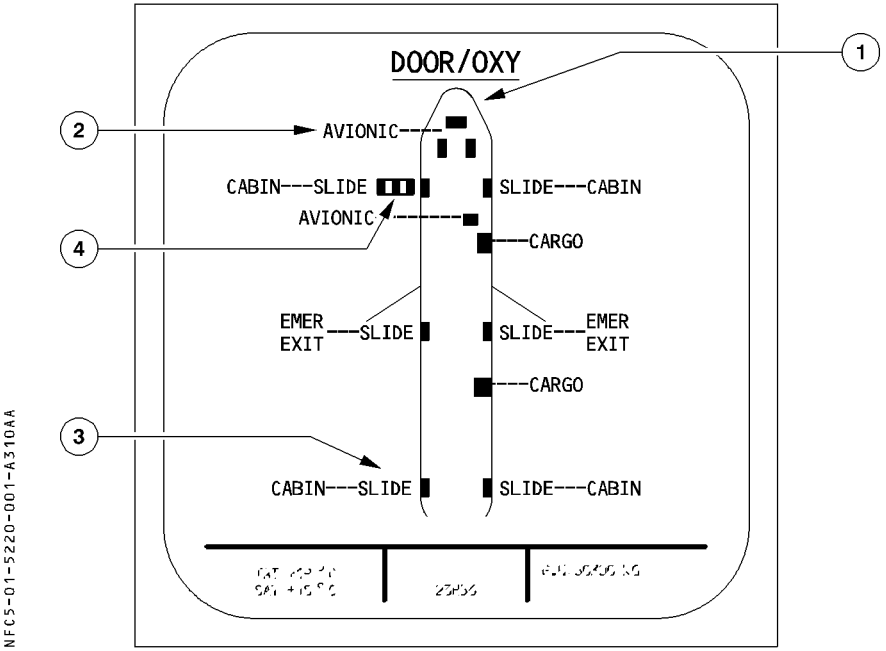
WARNINGS AND CAUTIONS



R

E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
L(R) FWD (AFT) AVIONICS L(R) FWD CABIN L(R) AFT CABIN L(R) FWD EMER EXIT L(R) AFT EMER EXIT FWD CARGO AFT CARGO BULK CARGO ◁ STAIRS ◁ Affected door not closed (proximity detectors)	SINGLE CHIME	MASTER CAUT	DOOR	NIL	1, 4, 5 7, 8, 10

ECAM DOOR PAGE



(1) Door symbol

Green □ : The door is closed and locked.
Amber ■: The door is not locked.

(2) Door indication

This appears in amber, when the door is not locked.

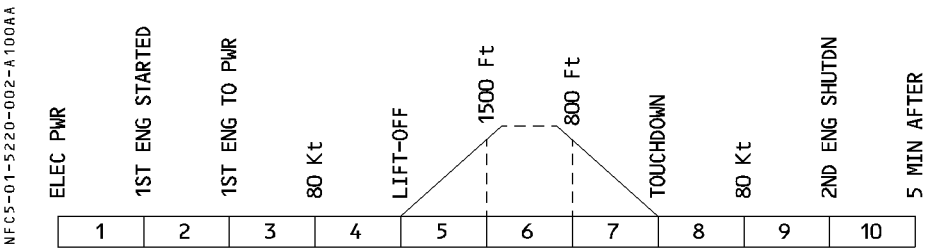
(3) SLIDE indication

This appears in white, when the slide is armed.

(4) Stair symbol (◁)

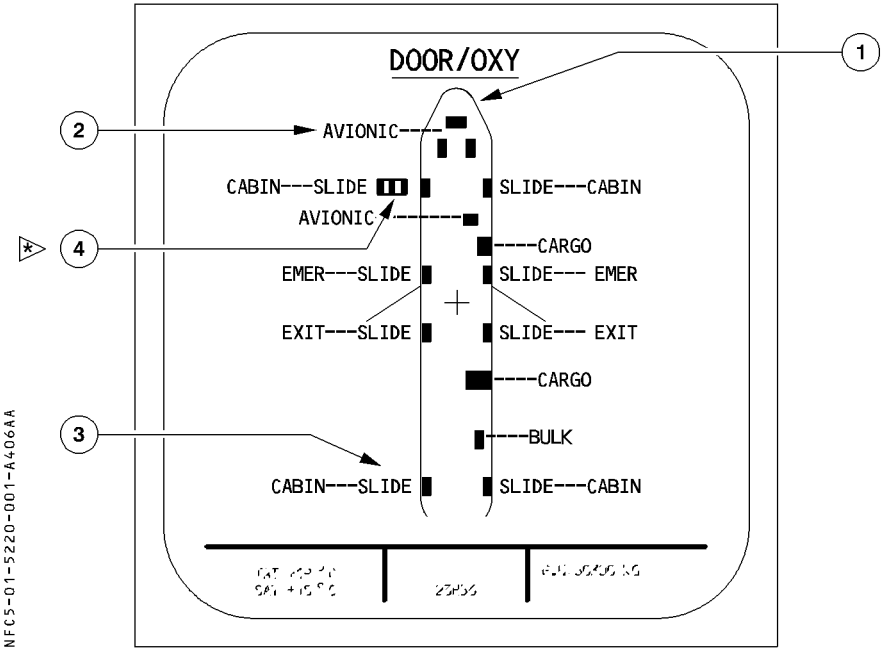
This appears in amber, when the stair door is not closed.

WARNINGS AND CAUTIONS



E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
L(R) FWD (AFT) AVIONICS L(R) FWD CABIN L(R) AFT CABIN L(R) EMER EXIT FWD CARGO AFT CARGO BULK CARGO ◁ STAIRS ◁ Affected door not closed (proximity detectors)	SINGLE CHIME	MASTER CAUT	DOOR	NIL	1, 4, 5 7, 8, 10

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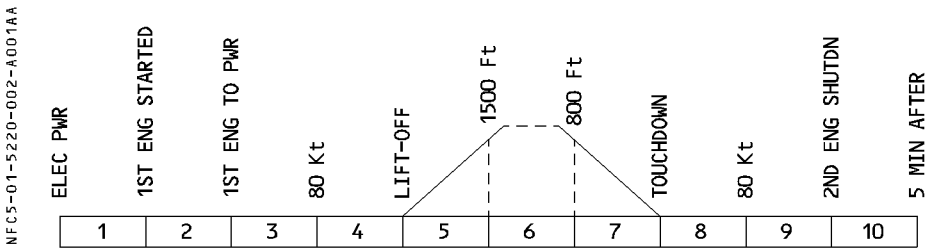
(3) SLIDE indication

This appears in white, when the slide is armed.

(4) Stair symbol (◁)

This appears in amber, when the stair door is not closed.

WARNINGS AND CAUTIONS



R

E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
L(R) FWD (AFT) AVIONICS L(R) FWD CABIN L(R) AFT CABIN L(R) FWD EMER EXIT L(R) AFT EMER EXIT FWD CARGO AFT CARGO BULK CARGO ◁ STAIRS ◁ Affected door not closed (proximity detectors)	SINGLE CHIME	MASTER CAUT	DOOR	NIL	1, 4, 5 7, 8, 10

BUS EQUIPMENT LIST

	NORM		EMER ELEC		
	AC	DC	AC ESS	DC ESS	HOT
DOORS and SLIDES CTL		DC BAT (1)			HOT2 (1)
CARGO DOORS		DC GRND FLT			
AIR STAIRS ◁		DC2			HOT2 (2)

(1) STBY supply (normally supplied by the EMER PWR SUPPLY UNIT)
(2) STBY supply

70.00 CONTENTS

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– GENERAL 1
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– ACTUATION LOGIC 2
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– ARCHITECTURE 1
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– OVERHEAD PANEL 4
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– ECAM 5
– WARNINGS AND CAUTIONS 13
– MEMO DISPLAY 15

70.98 ELECTRICAL SUPPLY

GENERAL

R The CFM 56-5B engine is a high bypass ratio turbofan.

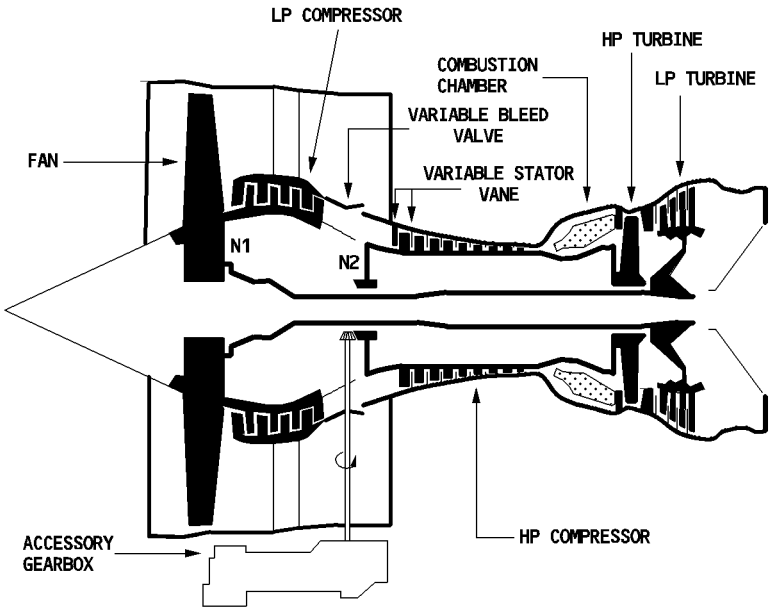
DESCRIPTION

– **Low-pressure (LP) compressor/turbine**
The low-speed rotor (N1) consists of a front fan (single-stage) and a four-stage LP compressor connected to a four-stage LP turbine.

– **High-pressure (HP) compressor/turbine**
The high-speed rotor (N2) consists of a nine-stage HP compressor connected to a single-stage HP turbine.

– **Combustion chamber**
The annular combustion chamber is fitted with 20 fuel nozzles and 2 igniters.

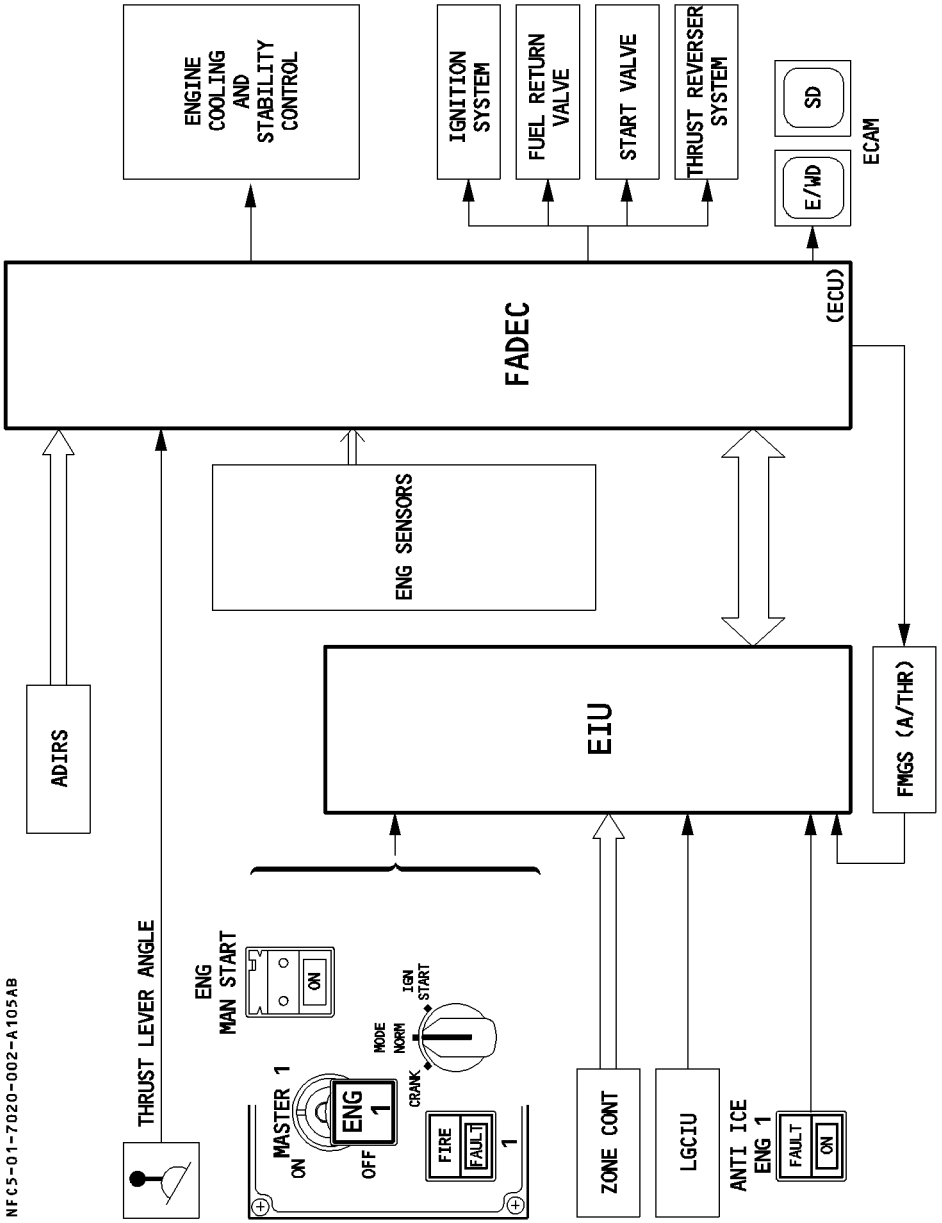
– **Accessory gearbox**
The accessory gearbox, located at the bottom of the fan case, receives torque from horizontal HP rotor drive shaft and drives gearbox mounted accessories.



GENERAL

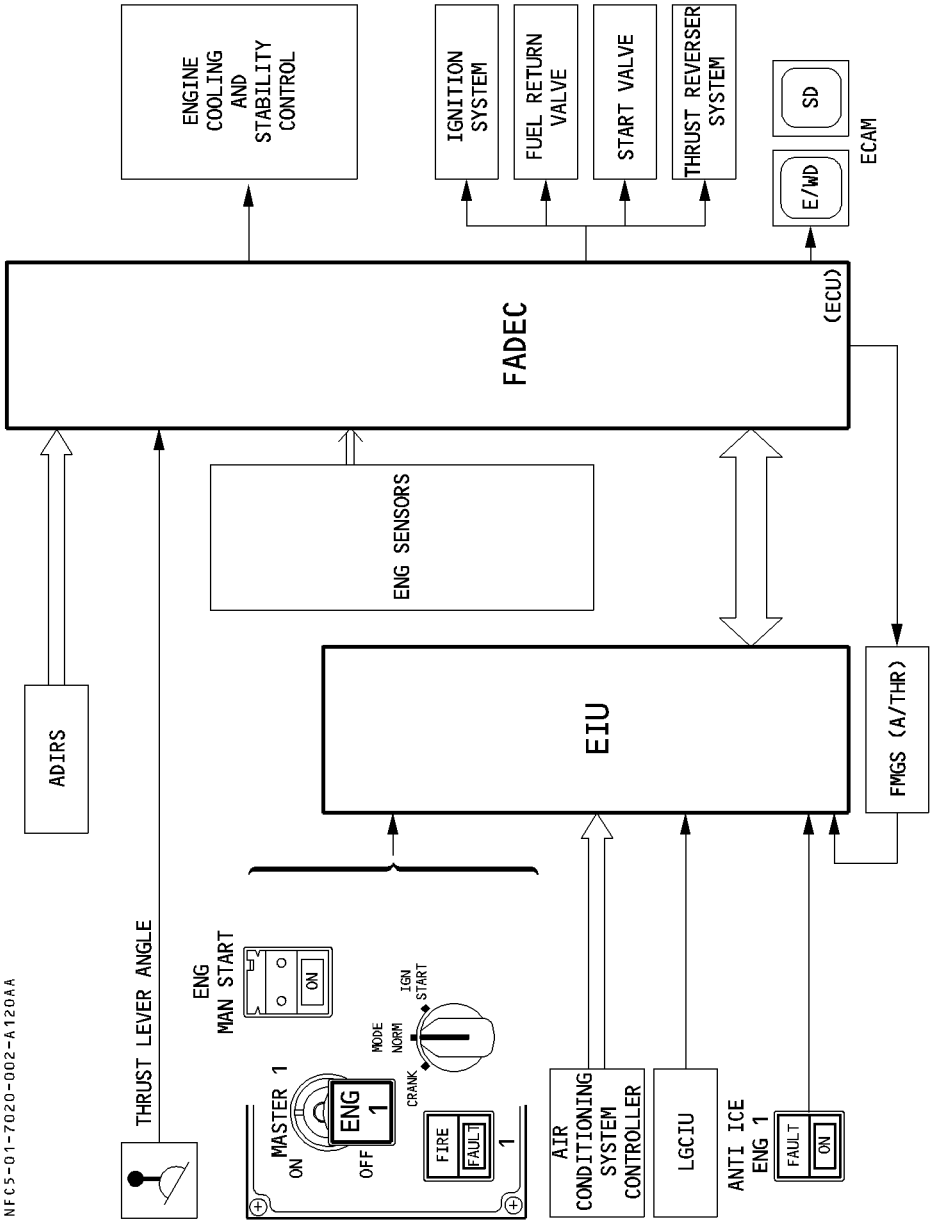
Each powerplant has a FADEC (Full Authority Digital Engine Control) system.
FADEC, also called the Electronic Control Unit (ECU), is a digital control system that performs complete engine management.
FADEC has two-channel redundancy, with one channel active and one in standby.
If one channel fails, the other automatically takes control.
The system has a magnetic alternator for an internal power source.
FADEC is mounted on the fan case.
The Engine Interface Unit (EIU) transmits to FADEC the data it uses for engine management.

R


ENGINE COOLING AND STABILITY CONTROL
IGNITION SYSTEM
FUEL RETURN VALVE
START VALVE
THRUST REVERSER SYSTEM
SD
E/WD
ECAM
FADEC
(ECU)
ENG SENSORS
ADIRS
EIU
FMGS (A/THR)
THRUST LEVER ANGLE
ENG MAN START
ON
MODE
NORM
IGN START
CRANK
MASTER 1
ON
OFF
ENG 1
FIRE
FAULT
1
ZONE CONT
LGCIU
ANTI ICE ENG 1
FAULT
ON
NFC5-01-7020-002-A105AB

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ENGINE COOLING AND STABILITY CONTROL
IGNITION SYSTEM
FUEL RETURN VALVE
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MASTER 1
ON
OFF
ENG 1
FIRE
FAULT
1
AIR CONDITIONING SYSTEM CONTROLLER
LGCIU
ANTI ICE ENG 1
FAULT
ON
NF65-01-7020-002-A120AA

FUNCTIONS

The FADEC system performs the following functions :

Control of gas generator
- control of fuel flow
- acceleration and deceleration schedules
- variable bleed valve and variable stator vane schedules
- control of turbine clearance
- idle setting

Protection against engine exceeding limits
- protection against N1 and N2 overspeed
- monitoring of EGT during engine start

Power management
- automatic control of engine thrust rating
- computation of thrust parameter limits
- manual management of power as a function of thrust lever position
- automatic management of power (A/THR demand).

Automatic engine starting sequence
- control of :
  - the start valve (ON/OFF)
  - the HP fuel valve
  - the fuel flow
  - the ignition (ON/OFF)
- monitoring of N1, N2, FF and EGT
- initiation of abort and recycle (on the ground only)

Manual engine starting sequence
- passive monitoring of engine
- control of :
  - the start valve
  - the HP fuel valve
  - the ignition

Thrust reverser control

· actuation of the blocker doors
· engine setting during reverser operation

Fuel recirculation control

· recirculation of fuel to the fuel tanks according to the engine oil temperature, the fuel system configuration and the flight phase.

Transmission of engine parameters and engine monitoring information to cockpit indicators

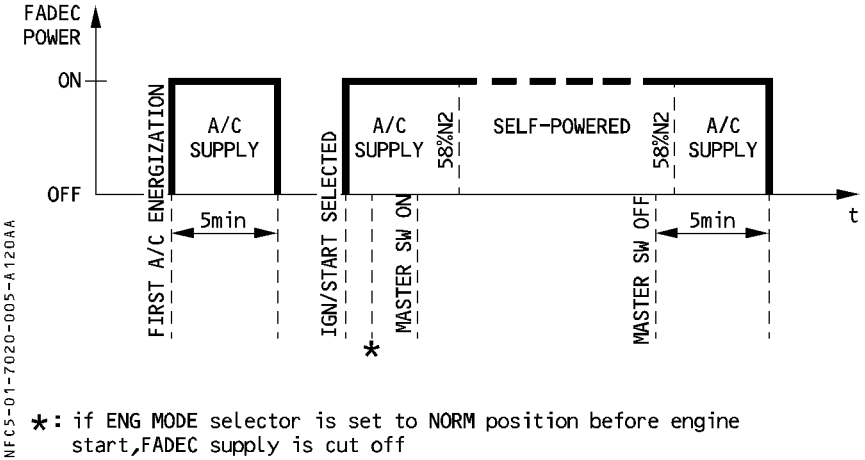
· the primary engine parameters
· the starting system status
· the thrust reverser system status
· the FADEC system status

Detection, isolation, and recording of failures

FADEC cooling

POWER SUPPLY

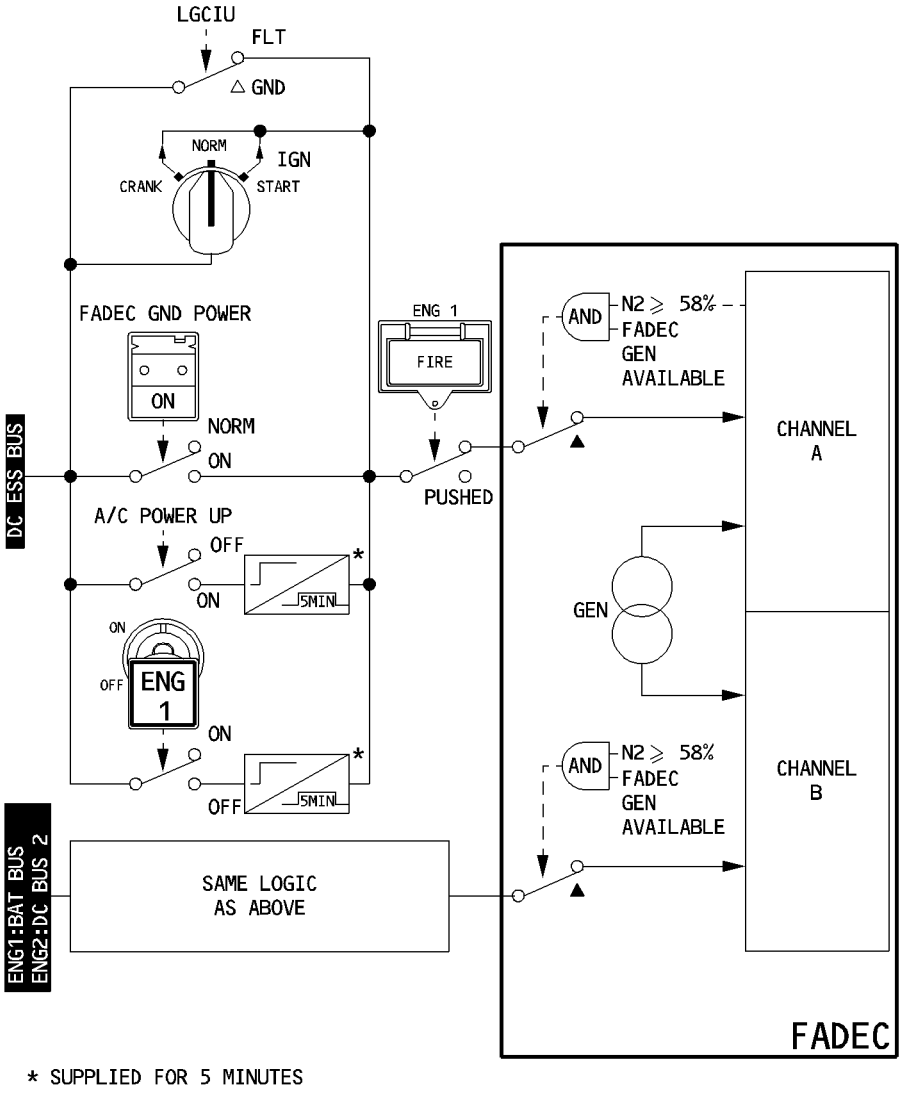
The FADEC system is self-powered above 58 % N2.



*: if ENG MODE selector is set to NORM position before engine start,FADEC supply is cut off

FADEC POWER SUPPLY

FOR INFO

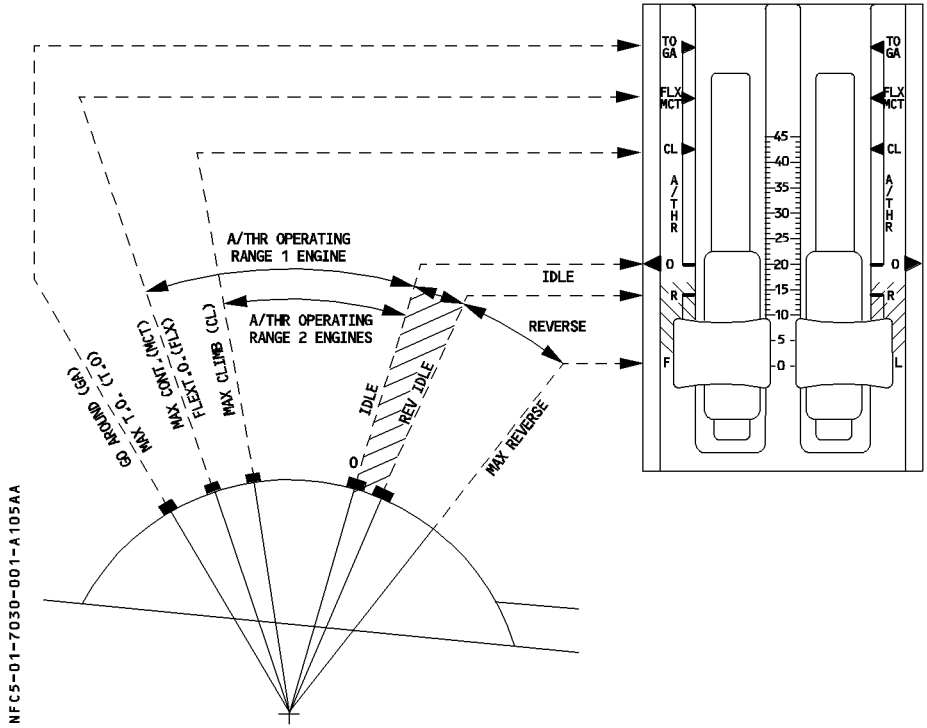


* SUPPLIED FOR 5 MINUTES

GENERAL

A FADEC dedicated to each engine controls thrust.
The pilot uses the thrust levers to set the thrust in manual mode, and the FMGS sets the thrust in automatic mode.
The FADEC prevents the thrust from exceeding the limit for the thrust lever position in both manual and automatic modes.

THRUST LEVERS



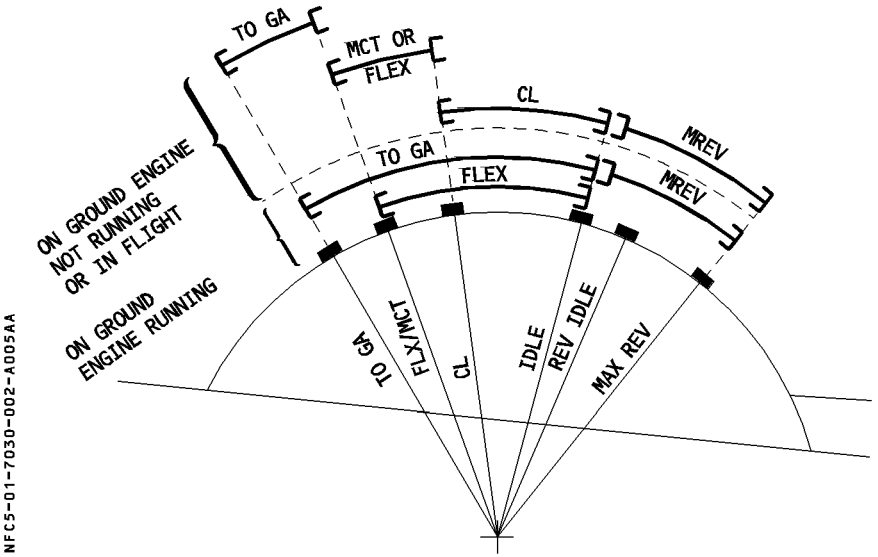
The thrust levers can only be moved manually.
They move over a sector that is divided into four operating segments.
The sector has five positions defined by detents or stops.
Thrust lever position is transmitted to the FADEC, which computes and displays the thrust rating limit and the N1 for that Thrust Lever Angle (TLA).

Note : There is no reverse idle detent. When the pilot moves the lever out of the idle stop by pulling up the reverse lever on the front of the thrust lever, he selects reverse idle.

THRUST RATING LIMIT

The FADEC computes the thrust rating limit for each thrust lever position, as shown below.
If the thrust lever is set in a detent, the FADEC selects the rating limit corresponding to this detent.
If the thrust lever is set between two detents, the FADEC selects the rating limit corresponding to the higher detent.

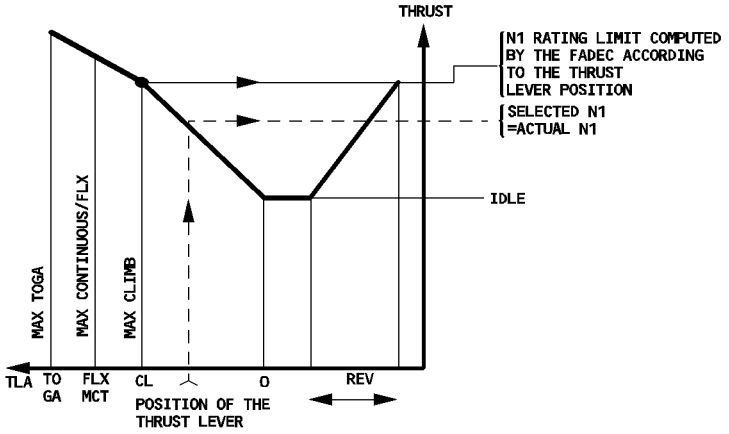
RATING LIMITS :



THRUST CONTROL

MANUAL MODE

The engines are in the manual mode provided the A/THR function is :
– not armed or
– armed and not active (thrust lever not in the A/THR operating range and no alpha floor).
In these conditions, each engine is controlled by the position of its thrust lever.
The pilot controls thrust by moving the thrust lever between the IDLE and TOGA positions.
Each position of the thrust lever within these limits corresponds to an N1.
When the thrust lever is in a detent, the corresponding N1 is equal to the N1 rating limit computed by the FADEC for that engine.



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When the thrust lever is in the FLX/MCT detent :

– **On the ground**
The engine runs at the flex takeoff thrust rating if the crew has selected a flex takeoff temperature on the MCDU that is higher than the current Total Air Temperature (TAT). Otherwise the engine produces Maximum Continuous Thrust (MCT).

Note : A change in FLEX TEMP during the takeoff has no effect on the thrust.

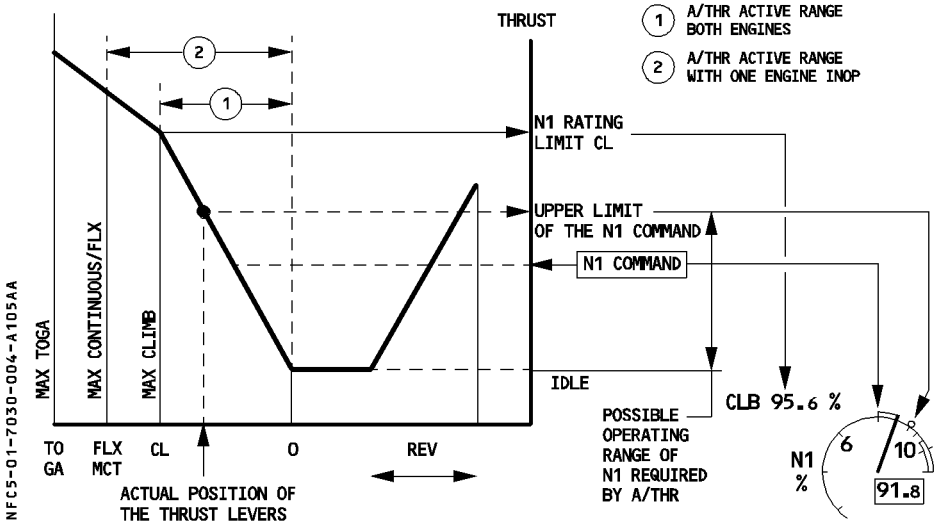
– **After takeoff**
The pilot can change from FLX to MCT by moving the thrust lever to TOGA or CL, then back to MCT. After that, he cannot use the FLX rating.

R *Note : Setting the thrust lever out of FLX/MCT detent without reaching TOGA or CL*
R *detent has no effect.*

The pilot can always get MAX TO thrust by pushing the thrust lever all the way forward.

AUTOMATIC MODE

In the autothrust mode (A/THR function active), the FMGC computes the thrust which is limited to the value corresponding to the thrust lever position (unless the alpha-floor mode is activated).



INDICATIONS ON FMA

The FADECs monitor the positions of the thrust levers, and trigger appropriate indications on the FMA.

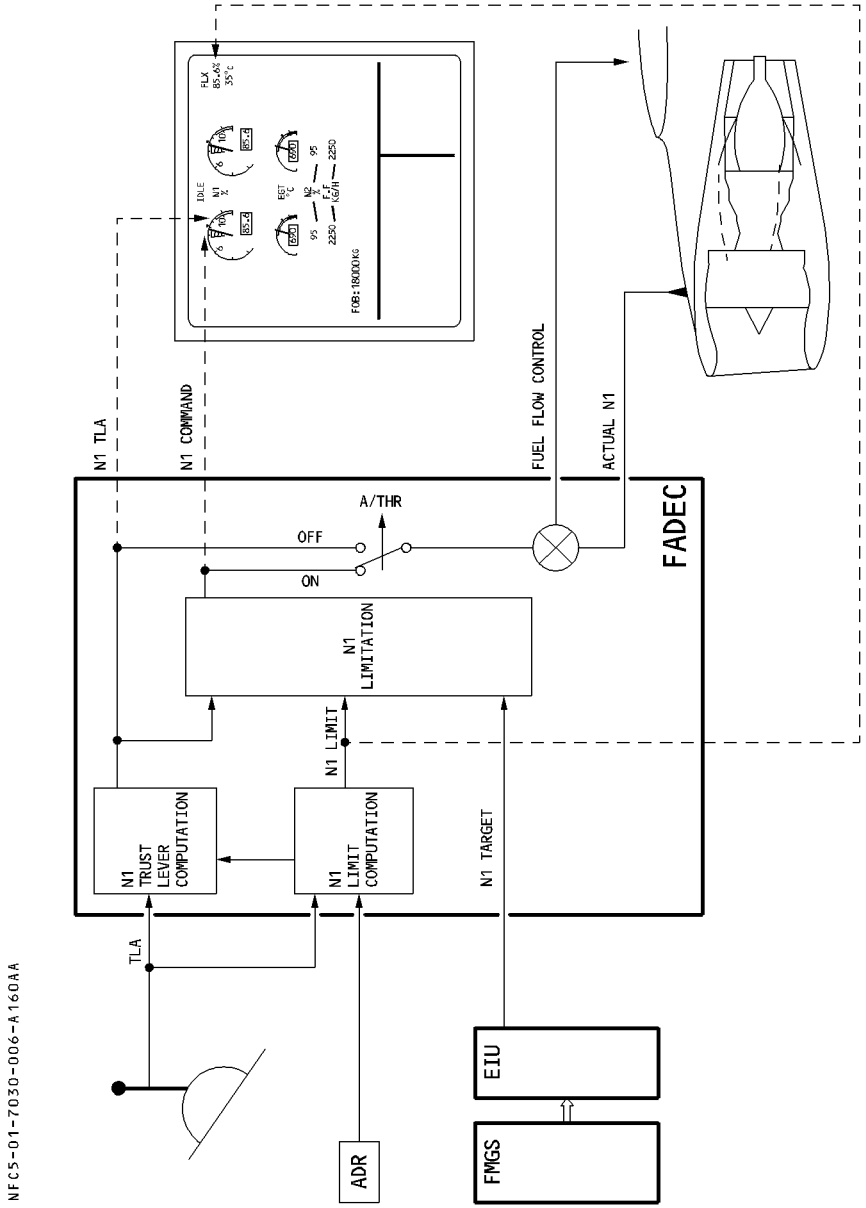
LVR ASYM : appears in amber (3rd line on the FMA) if, with A/THR active and both engines running, one thrust lever is set out of the CLB detent.

LVR CLB : flashes white (3rd line on the FMA) if the thrust levers are not in CL position while the aircraft is above the altitude of thrust reduction with both engines running.

LVR MCT : flashes white (3rd line on the FMA) if the thrust levers are not in MCT position after an engine failure (with speed above green dot).

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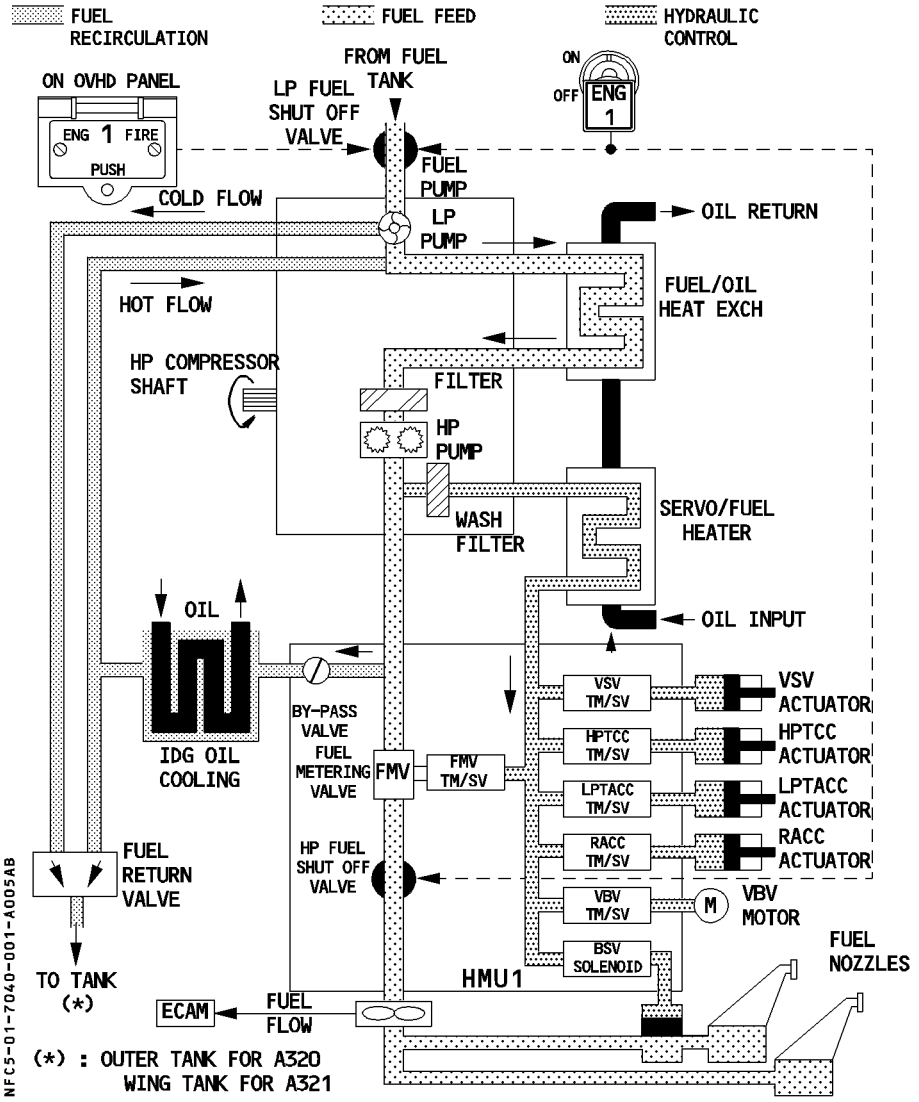
THRUST CONTROL



GENERAL

The fuel system supplies fuel to the combustion chamber at the required flow rate, pressure, and temperature.
The fuel flows from the tank, via the fuel pump unit and the fuel/oil heat exhanger, to the Hydromechanical Unit (HMU) and to the fuel nozzles.

FOR INFO



FUEL PUMP UNIT

The HP compressor shaft drives the HP fuel pump assembly. Fuel flows through the LP pump, then through the fuel/oil heat exchanger and the HP pump (gear pump).
The fuel then divides into a filtered flow for the servo fuel heater and the servo valves of the HMU, and an unfiltered flow for the metering valve of the HMU.

SHUT-OFF VALVES

Moving the ENG1 (ENG2) MASTER switch to OFF directly commands the closing of the LP and HP fuel shut off valves for that engine's fuel system.
It also closes the fuel return valve and opens the bypass valve.

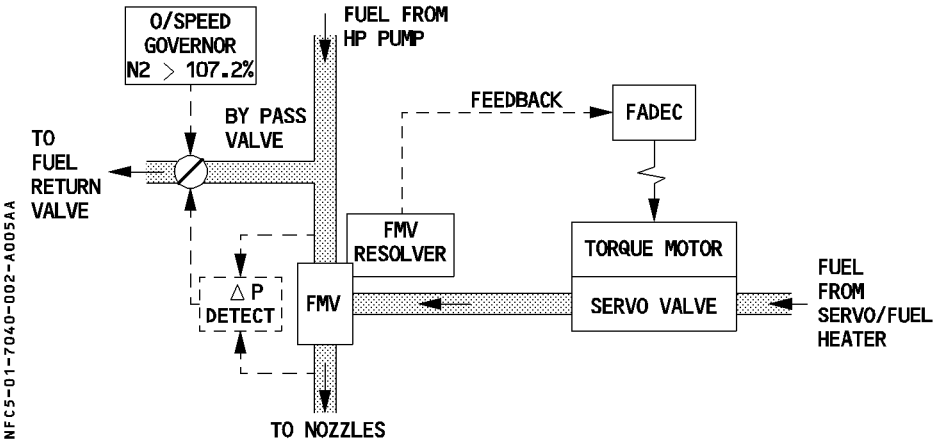
HYDROMECHANICAL UNIT

The FADEC controls the HMU, which :
– controls fuel flow to the engine combustion chamber
– controls fuel hydraulic signals to actuators
– protects against overspeeding.

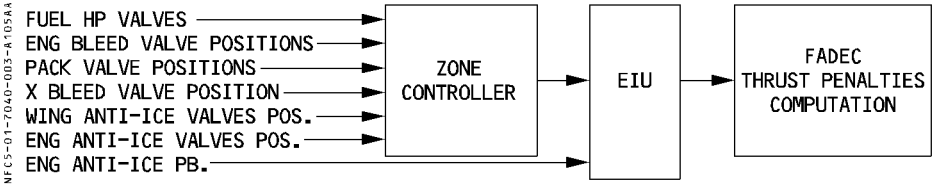
FUEL FLOW

FOR INFO

The Fuel Metering Valve (FMV) transforms FADEC orders through a torque motor and servo valve into fuel flow to the engine fuel nozzles.
The FMV resolver generates a feedback signal proportional to the FMV position.
The bypass valve maintains a constant pressure drop across the FMV to ensure that the metered fuel flow is proportional to the FMV position.



The FADEC computes the fuel flow that will maintain the target N1.
As the FADEC maintains this N1, it allows N2 to vary while remaining between N2 minimum and N2 maximum. The FADEC also controls the engine parameters to :
– Limit acceleration and deceleration ;
– Avoid engine stall or flameout ;
– Limit maximum N1 and N2 ;
– Maintain air bleed pressure requirement.
The FADEC computes an N2 correction according to the bleed configuration.



OVERSPEED GOVERNOR SYSTEM

Independent of the FADEC, the overspeed governor limits the N2 by opening the fuel bypass valve, in the event of a malfunction that could lead to an overspeed condition.

IDLE CONTROL

The FADEC has the following three idle modes :

Modulated idle

R – Is regulated according to :
  · bleed system demand
– Is selected :
  · In flight, when the flaps are retracted (FLAPS lever at zero position),
  · On ground, provided reverse is not selected.

Approach idle :

R – Is regulated according to aircraft altitude, regardless of bleed system demand.
– Is selected in flight, when the flaps are extended (FLAPS lever not at zero position)
– Allows the engine to accelerate rapidly from idle to go-around thrust

Reverse idle :

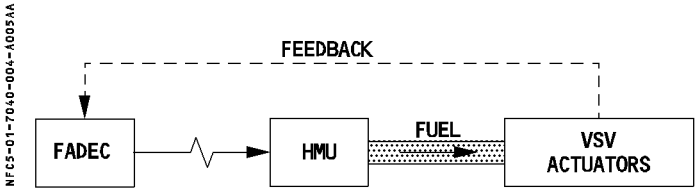
Is selected on ground, when the thrust lever is in REV IDLE position.
Is slightly higher than forward idle thrust.

FUEL HYDRAULIC SIGNALS

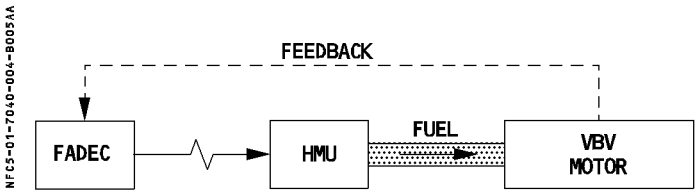
FOR INFO

Fuel hydraulic signals go to :

- *Low Pressure Turbine Clearance Control (LPTCC) valves*
  (Refer to 1.70.60)
- *High Pressure Turbine Clearance Control (HPTCC) valves*
  (Refer to 1.70.60)
- *Rotor Active Clearance Control (RACC) system*
  (Refer to 1.70.60)
- *Variable Stator Vanes (VSV)*
  The VSV system positions the compressor variable vanes.
  The FADEC maintains optimum compressor efficiency at a steady state and an adequate stall margin for transient engine operation.
  VSVs are fully closed during engine start and are fully open at high thrust.



- *Variable Bleed Valves (VBV)*
  The FADEC controls the VBVs, upstream of the HP compressor. Their setting depends on compressor inlet temperature and on N2. It varies between full open (start, low thrust, and during fast deceleration) and full closed (high thrust) positions.



FOR INFO

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IDG COOLING SYSTEM

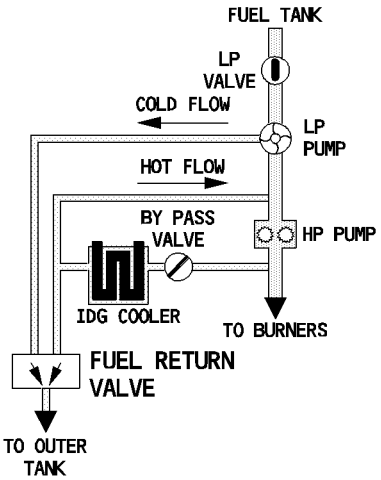
Some of the fuel flowing out of the HMU goes to cool the oil systems of the Integrated Drive Generators (IDGs). It then returns to the fuel pump unit or to the tank.
The Fuel Return Valve (FRV), controlled by the FADEC, ensures that this flow is adequate.

FOR INFO

At low engine thrust, if the oil going into the IDG is too hot, the cooling fuel is sent back to the tank (300 kg/h).
If oil temperature continues to rise, the ECU increases the minimum N2.
If oil temperature still keeps rising, the FADEC increases the fuel flow to the tank (from 300 to 600 kg/h, depending on fuel return temperature).
The fuel return valve is always mixing hot fuel with cold fuel so that the temperature of fuel returning to the tank stays below 100°C (from 200 to 400 kg/h, depending on fuel return temperature).
Fuel recirculation to the tank is inhibited (FVR closed) in the following cases :

- *at engine shutdown*
- *during takeoff and climb*
- *if :*
  - *wing tank level is below about 300 kg (660 lb).*
  - *there is fuel overflow in the surge tank*
  - *fuel feed is by gravity only.*
- *when fuel temperature in the wing tank in flight is above 52.5°C*

Note : On the ground high fuel temperature in the wing tanks does not cause the FRV to close.



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FOR INFO

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IDG COOLING SYSTEM

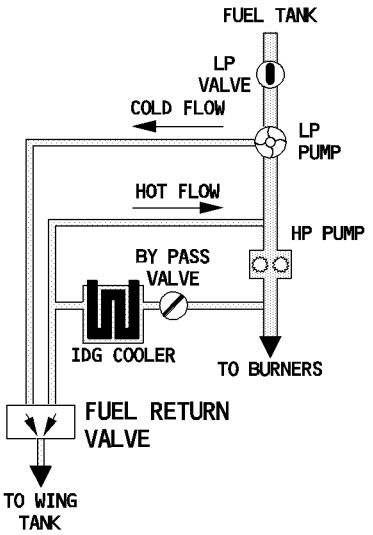
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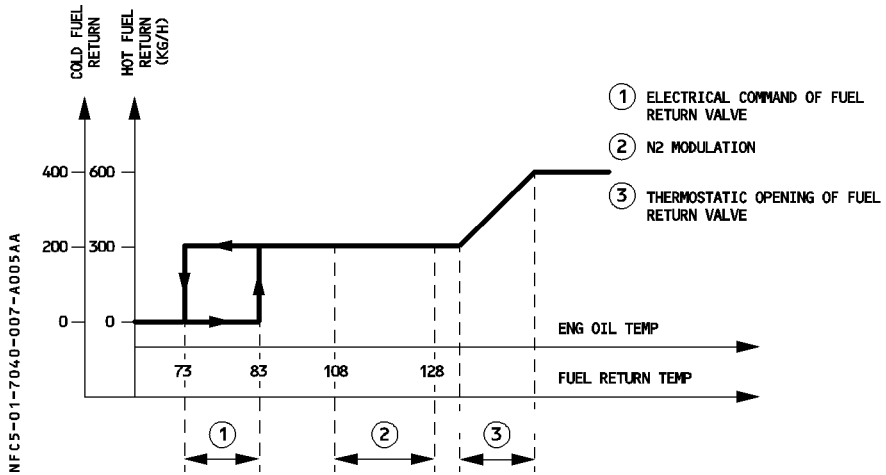
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Fuel recirculation to the tank is inhibited (FVR closed) in the following cases :

- *at engine shutdown*
- *during takeoff and climb*
- *if :*
  - *wing tank level is below about 280 kg (620 lb).*
  - *there is fuel overflow in the surge tank*
  - *fuel feed is by gravity only.*
- *when fuel temperature in the wing tank in flight is above 52.5°C*

Note : On the ground high fuel temperature in the wing tanks does not cause the FRV to close.



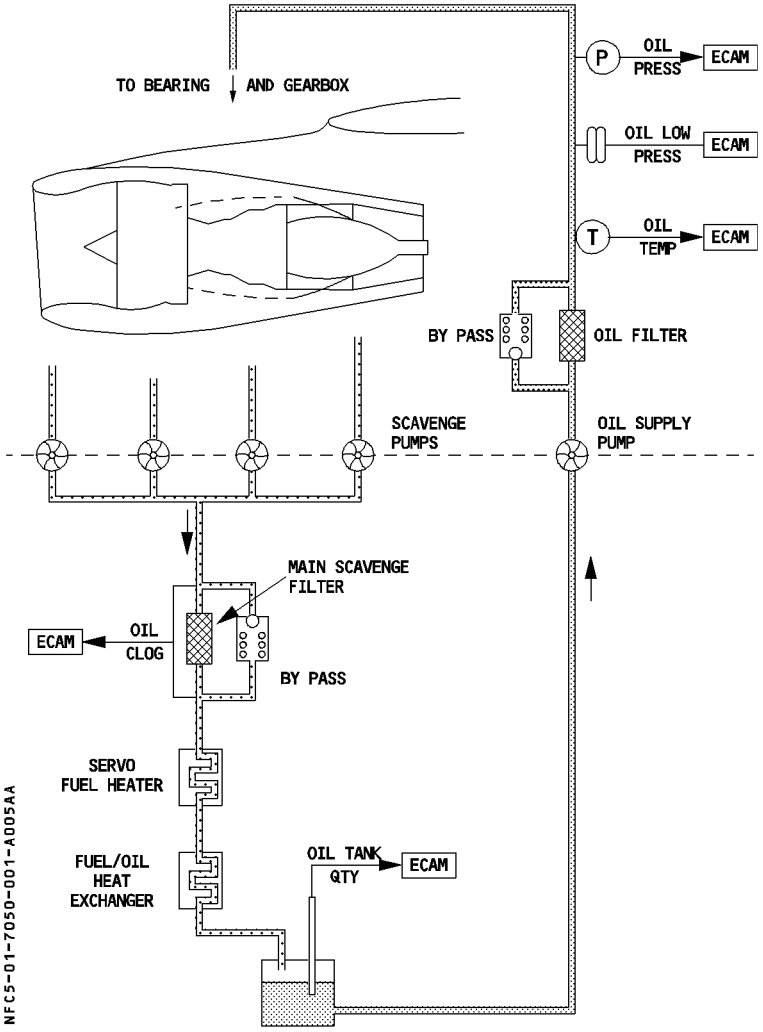
NFC5-01-7040-006-A105AA


COLD FUEL RETURN
HOT FUEL RETURN (KG/H)
400
600
200
300
0
0
73
83
108
128
ENG OIL TEMP
FUEL RETURN TEMP
1
2
3
1 ELECTRICAL COMMAND OF FUEL RETURN VALVE
2 N2 MODULATION
3 THERMOSTATIC OPENING OF FUEL RETURN VALVE
NFC5-01-7040-007-A005AA

GENERAL

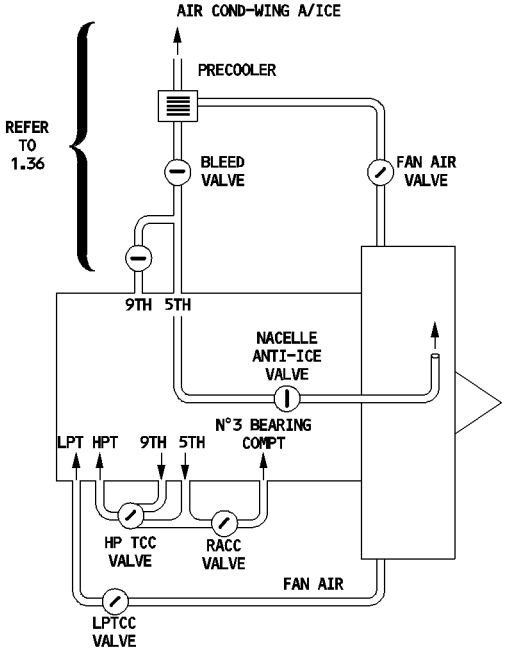
The oil system lubricates the engine components.
It contains :
– the oil tank
– the lube and scavenge pump modules
– the fuel/oil heat exchanger
– the filters, chip detectors, pressure relief and bypass valves.

FOR INFO



GENERAL

The air bleed system supplies the aircraft with compressed air.
It uses the air for :
– pneumatic system (refer to 1.36)
– cooling the engine compartment and the turbines.



NFC5-01-7060-001-A005AA

COOLING

ROTOR ACTIVE CLEARANCE CONTROL (RACC) SYSTEM

The FADEC controls the RACC system through the HMU. The RACC system controls the clearance between the rotor blades of the HP compressor and its stator case.
The RACC system uses fifth-stage compressor bleed air that has been modulated according to the N2 and the flight parameters. The bleed air goes to the N°3 bearing compartment, where it is mixed with fan boost discharge.
Clearances are at the maximum when the RACC valve is closed.

HP TURBINE CLEARANCE CONTROL (HPTCC) SYSTEM

The FADEC controls the HPTCC system through the HMU. The HPTCC system controls the HP turbine clearance by modulating the HP compressor bleed air flow for cooling the HP turbine case.
It optimizes HP turbine performance and reduces exhaust gas temperature.

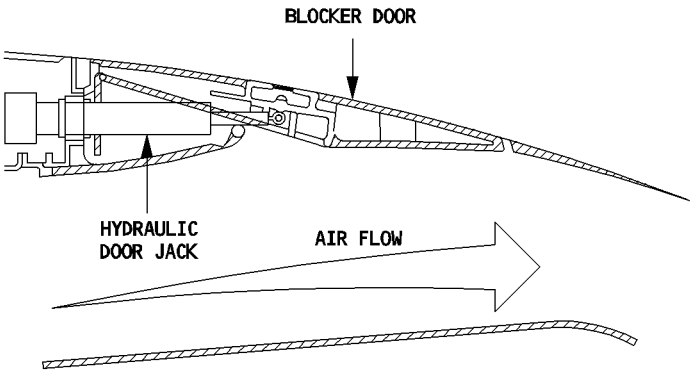
LP TURBINE CLEARANCE CONTROL (LPTCC) SYSTEM

The FADEC controls the LPTCC system through the HMU. The LPTCC system controls LP turbine clearance by modulating the fan bleed air flow for cooling the LP turbine case.

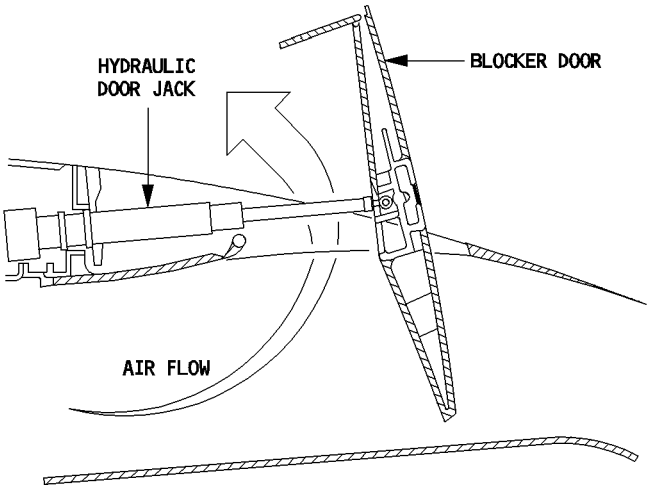
GENERAL

The aircraft reverses engine thrust by using four pivoting blocker doors on each engine to deflect the fan airstream.

FAN REVERSER (STOWED)



FAN REVERSER (DEPLOYED)



NFC5-01-7070-001-A005AA

A hydraulic door jack positions each door.
- The green circuit powers the doors on ENG 1.
- The yellow circuit powers the doors en ENG 2.

The associated FADEC controls the thrust reverser system. Each FADEC channel performs control and monitoring functions. The systems for the two engines are independent of each other.

The thrust reverser system on each engine has :

- 4 actuators,
- 4 latches,
- Door position switches,
- A Hydraulic Control Unit (HCU) that :
  - Pressurizes the thrust reverser hydraulic system,
  - Regulates the speed of the blocker doors, and
  - Supplies actuators with hydraulic power.
- A hydraulic shutoff valve which allows hydraulic pressure to the HCU.

Each pivoting door moves independently (the doors are not synchronized). The total actuation time is less than two seconds.

ACTUATION LOGIC

Deployment requires :

- One FADEC channel, operating with its associated throttle reverse signal ;
- Right and left main gear compressed signal from the corresponding LGCIUs ;
- A Thrust Lever Angle (TLA) reverse signals from at least one Spoiler Elevator Computer (SEC).

Before deployment is completed, the FADEC sets reverse idle thrust on the engine that is having its thrust reversed.

PROTECTION

- AUTO RESTOW FUNCTION

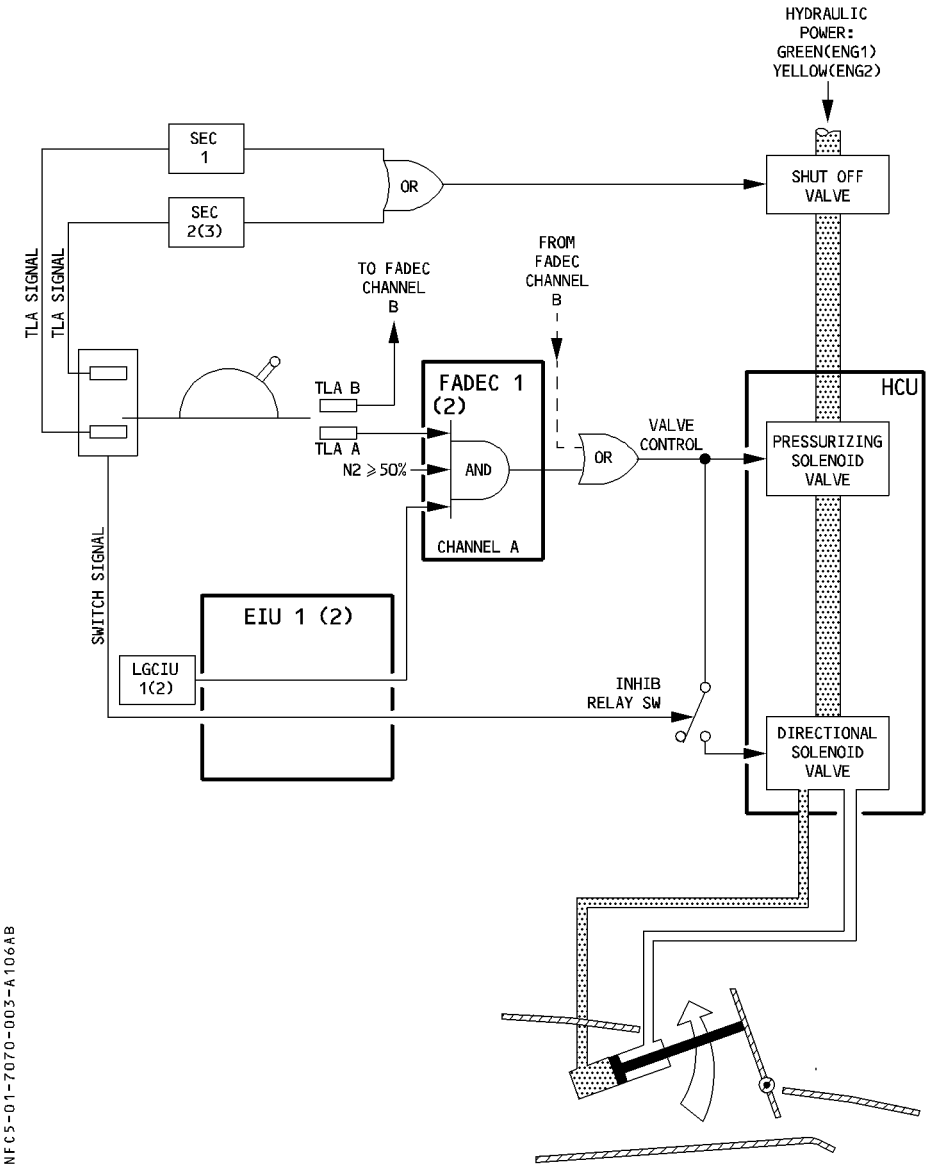
  The FADEC will automatically command the reverse to stow, if at least one door is unstowed and reverse thrust is not selected while the engine is running.

R Auto restow is totally inhibited in flight, and on ground, with N1 greater than 70 %.

- IDLE PROTECTION

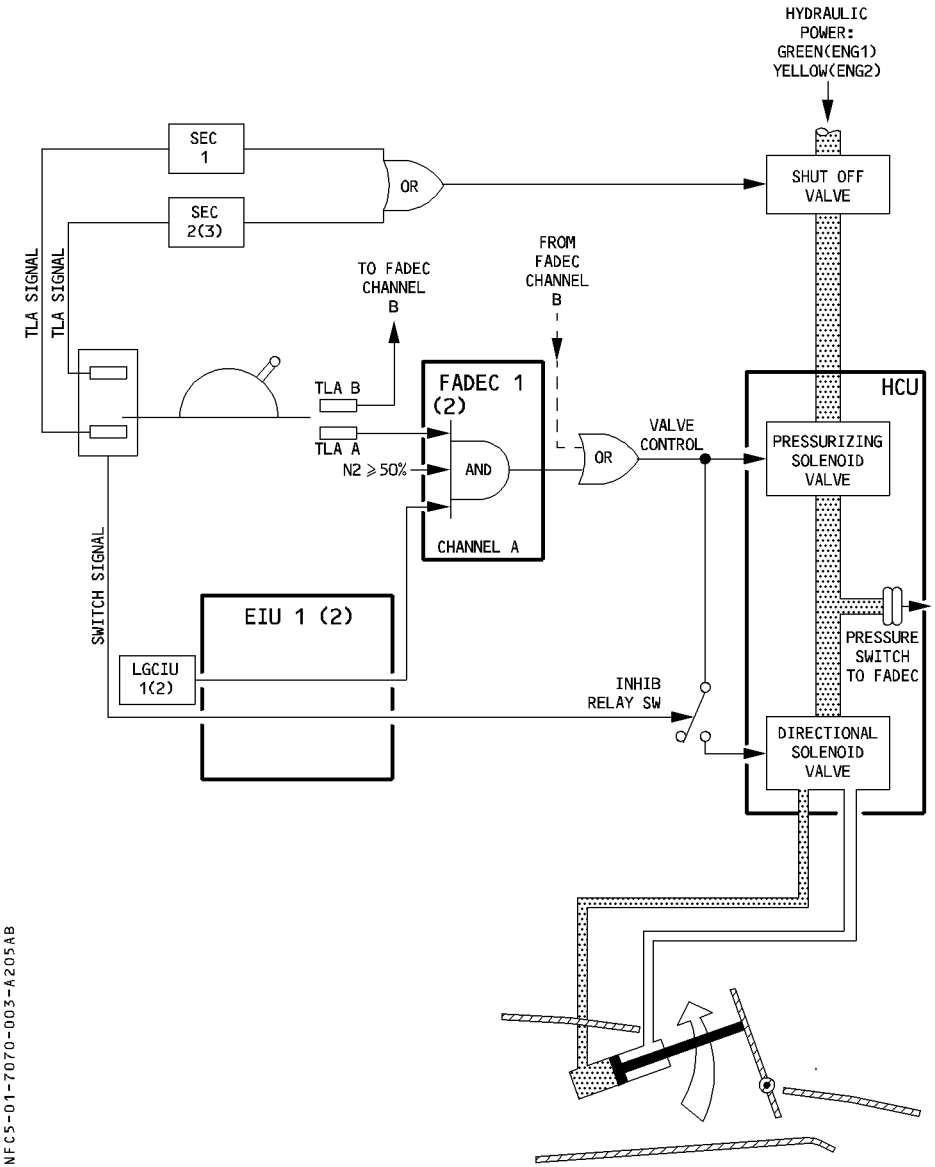
  The FADEC will automatically select idle thrust if the reverse thrust is not selected and:
  - The four doors are detected unstowed, or
  - At least one door is detected unstowed, and hydraulic pressure is detected in the HCU (downstream of the pressurizing valve), or
  - The door position is indefinite, and hydraulic pressure is detected in the HCU (downstream of the pressurizing valve).

SCHEMATIC



NFC5-01-7070-003-A106AB

SCHEMATIC



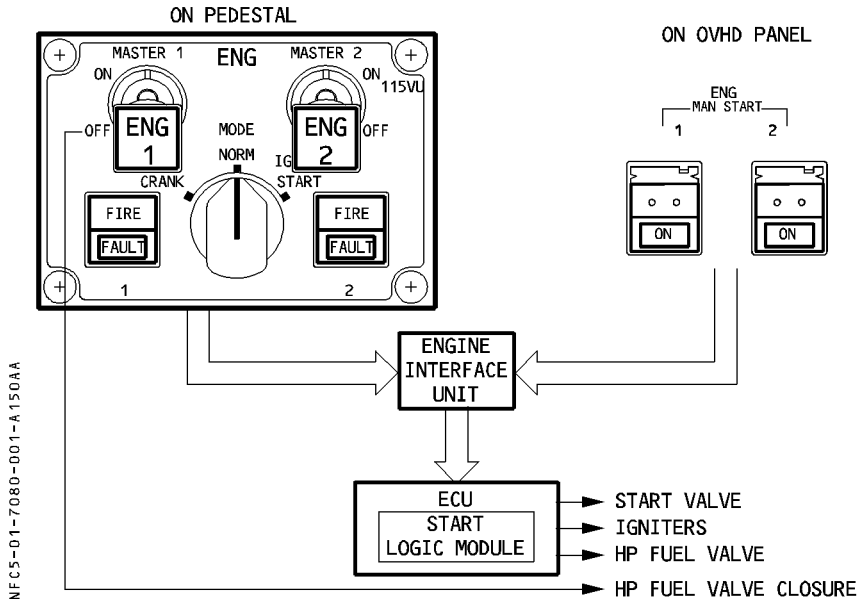
NFC5-01-7070-003-A205AB

GENERAL

The FADEC controls the ignition and starting system according to :
- the position of the engine start selector
- the position of the ENG MASTER switch
- the position of the ENG MAN START pushbutton switch
- the aircraft status (flight or ground).

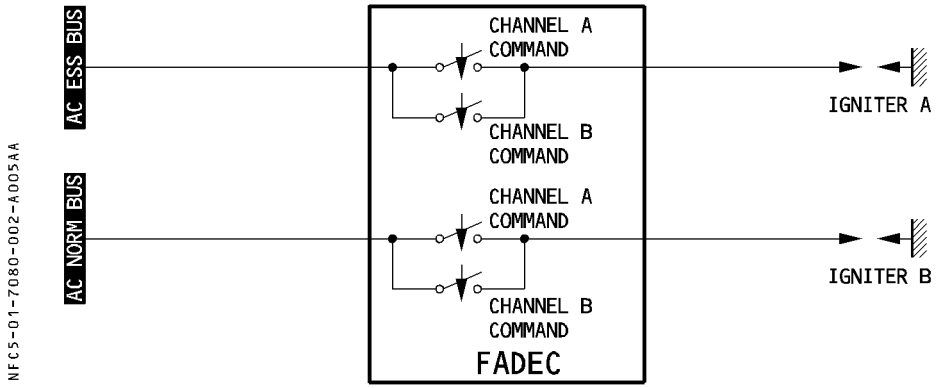
The FADEC receives its inputs from the Engine Interface Unit (EIU).

ARCHITECTURE



IGNITION SYSTEM

The ignition system is for engine starting on the ground and restarting in flight. It consists of two identical independent circuits for each engine, normally controlled by the FADEC channel A and channel B. Each FADEC channel can control both igniters.



Note : Supply for igniter A switches to the STAT INV BUS BAR as soon as the static inverter is operative.

IGNITION FOR STARTING

ON THE GROUND

- Automatic start
  - Only one igniter fires.
  - The FADEC automatically alternates the igniters used on successive starts following the sequence below :
    - channel A, igniter A
R   - channel B, igniter A
R   - channel A, igniter B
    - channel B, igniter B
  - The ignition comes on automatically when N2 reaches 16 % and cuts off automatically when N2 reaches 50 %.
- Manual start
  - Both igniters start firing when the MASTER switch is switched ON.
  - Both stop firing when N2 reaches 50 %.

IN FLIGHT

- Both igniters start firing when the MASTER switch is switched ON.

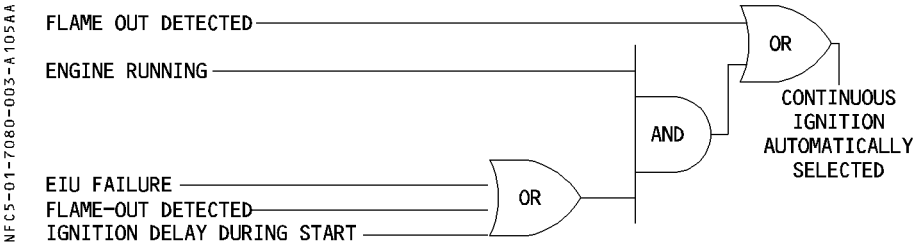
CONTINUOUS IGNITION

Continuous ignition is either selected manually or automatically to maintain engine combustion.

MANUAL SELECTION

In flight, continuous ignition is on when the ENG START selector is on IGN/START, if the corresponding engine is running.
Only one igniter is selected. If failed, both igniters are automatically selected.
On the ground after the engine is started, because ignition cuts off automatically, the flight crew must switch the ENG MODE selector to NORM, then back to IGN/START, to turn on continuous ignition.

AUTOMATIC SELECTION



ENGINE STARTING SYSTEM

GENERAL

The engine starting system consists of an air turbine starter and a start valve.
The start valve admits air supplied by the pneumatic system to operate the starter.
The FADEC controls the start valve electrically. If electrical control fails when the aircraft is on the ground, a handle allows the start valve to be operated manually.

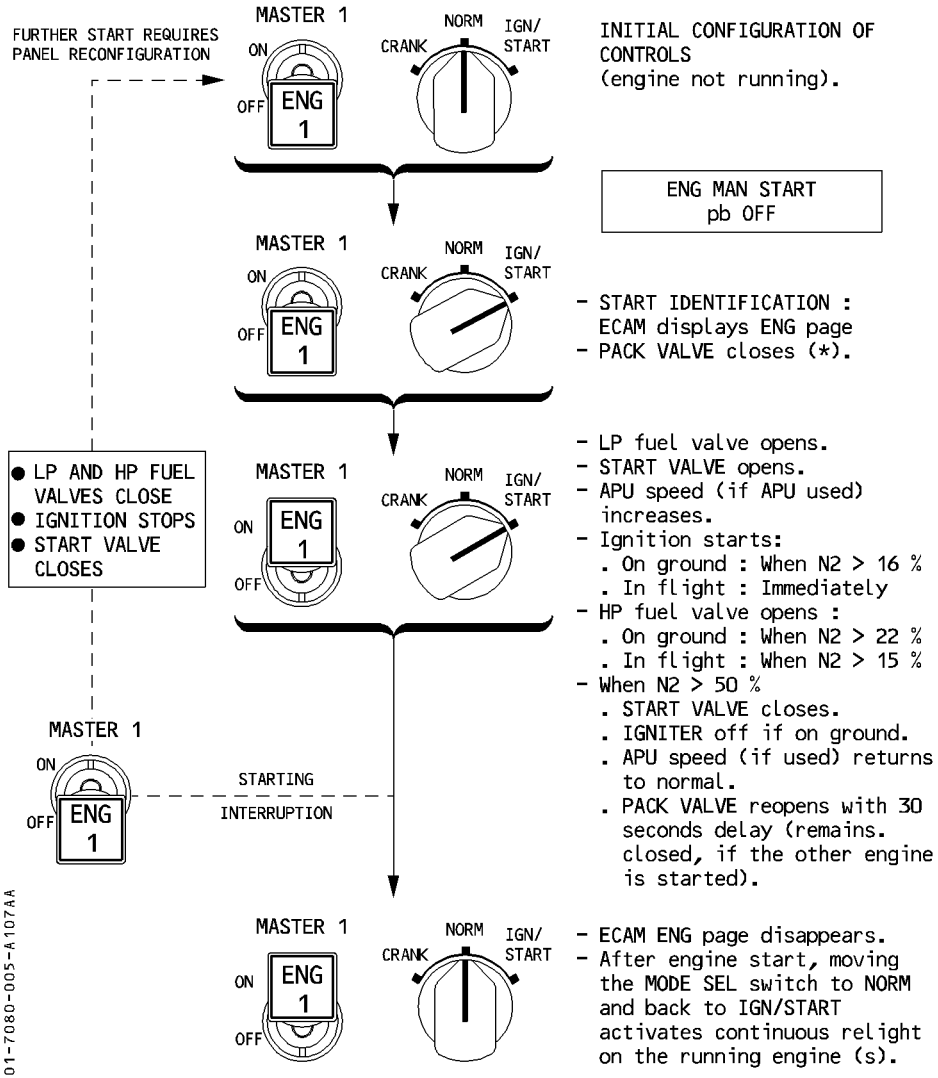
AUTOMATIC STARTING

This sequence is under the full authority of the FADEC, which controls :
– the start valve
– the igniters
– the fuel HP valves
The FADEC :
– detects a hot start, a hung start, a stall, or no light up
– announces FAULT and identifies the fault in an ECAM message
– runs an abort sequence if a start aborts on the ground
  · closes the HP valve
  · closes the start valve
  · turns off ignition
  · cranks the engine crank after the start abort in order to clear out fuel vapors
  · controls any additional start attemps.

For an inflight start, the FADEC decides whether the engine is windmilling fast enough or needs assistance from the starter in view of current engine parameters and flight environment parameters.
Flight crew may interrupt this start sequence by moving the MASTER switch to OFF.

R

AUTOMATIC STARTING SEQUENCE



NFC5-01-7080-005-A107AA

(*) Note : If the ENG MASTER is not switched ON after 30 seconds, then the pack valve will reopen.

MANUAL STARTING

The FADEC has limited authority over manual starting controlling :

- the opening of the start valve when the ENG MODE selector is set to IGN/START and the MAN START pushbutton switch is pressed.
- the position of the HP fuel valve and the operation of both igniters, when the master switch is turned ON
- the closing of the start valve at 50 % N2, and, on the ground, the cutting off of ignition.

R The FADEC makes a passive survey of the engine during the starting sequence : the flight
R crew is made aware of an abnormal start by a proper ECAM warning and has to interrupt
R the start sequence. The FADEC has not the authority to abort the manual start :
R - in flight
R - on ground, except if the start EGT limit is exceeded before reaching 50 % N2. In this case
R only, the FADEC aborts the start.

Flight crew may interrupt the starting sequence :

- before the MASTER switch is set to ON, by switching the MAN START pushbutton switch to OFF
- after the MASTER switch set to ON, by switching the MAN START pushbutton and the MASTER switch to OFF (flight crew must perform a dry cranking cycle).

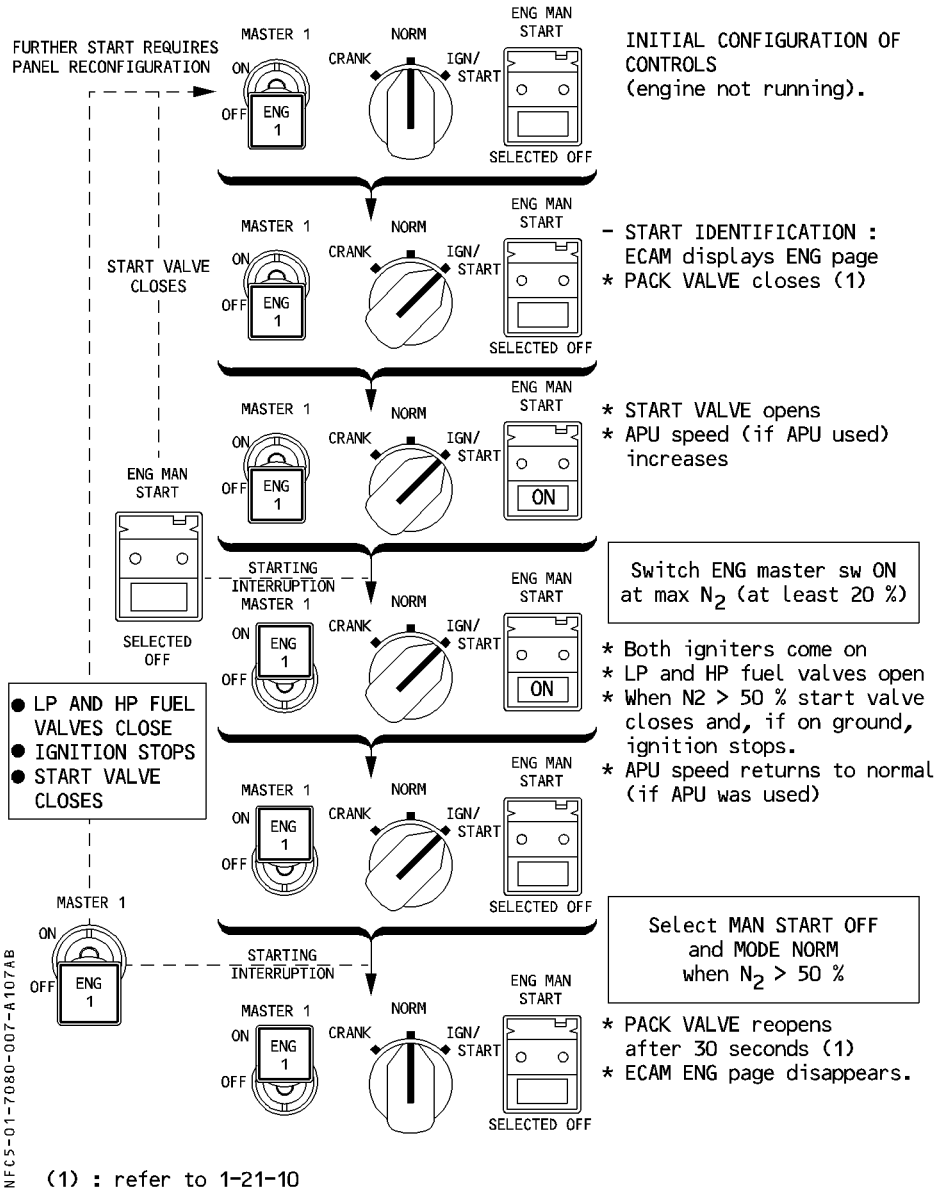
In flight, the FADEC always commands a starter-assisted air start.

ENGINE VENTILATION (dry cranking)

A dry cranking cycle ventilates the engine to remove fuel vapors after an unsuccessful start attempt on the ground.

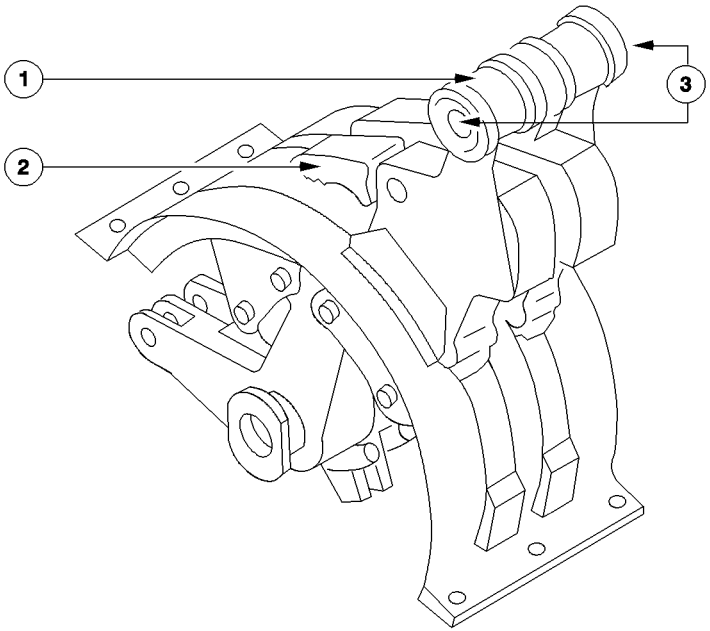
The flight crew can manually select cranking by setting the ENG MODE selector to CRANK and the MAN START pushbutton switch to ON (MASTER switch OFF). Flight crew can stop the cranking by setting the MAN START pushbutton switch to OFF.

MANUAL STARTING SEQUENCE



(1) : refer to 1-21-10

PEDESTAL



NFCS-01-7090-001-A005AA

(1) Thrust levers

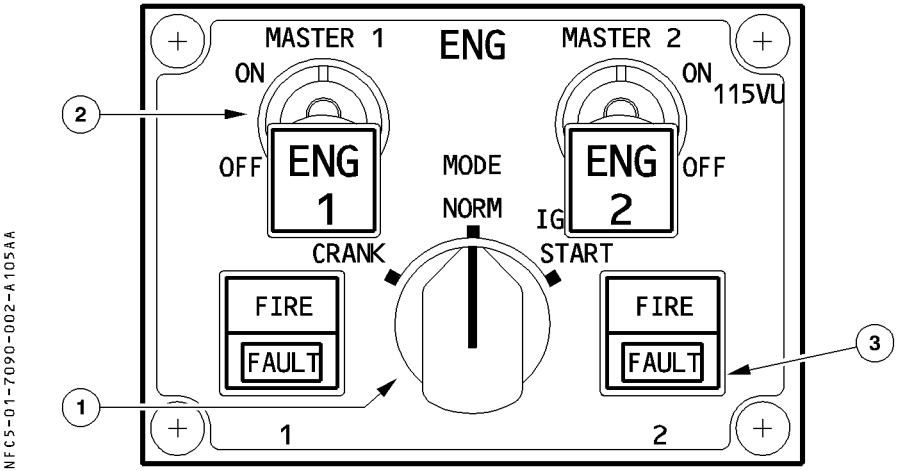
(Refer to 1.70.30).

(2) Reverser latching levers

These permit the pilot to override the stop at the forward idle position to select reverse thrust.
This stop resets when the pilot moves the lever back into the forward thrust area.

(3) Autothrust instinctive disconnect pb

(Refer to 1.22).



(1) ENG MODE selector

CRANK : The start valve opens, if the MAN START pushbutton is ON. Ignition does not fire.

NORM : This turns on continuous ignition (A and B) when the engine is running, and :
- A flame-out is detected, or
- An EIU fails.

IGN START : If the MASTER switch is ON and N2 ≥ idle, this position selects continuous ignition (A and B).
- During an automatic start :
  - On ground, when N2 passes 16 %, ignition switches to A or B. However, if there is an ignition delay during the start sequence, ignition is continuous (A and B).
  - In flight, continuous ignition (A and B) begins when the start sequence begins.
- During a manual start, ignition begins when the MASTER switch is turned ON.

The pack valve closes automatically during the start sequence. (See 1.21.10).

Note : On ground, ignition shuts off automatically at the end of the start sequence (N2 > 50 %).

(2) ENG MASTER sw 1 (2)

ON : LP fuel valve opens (if the ENG FIRE pushbutton is in).
- During an automatic start, the HP fuel valve opens if :
  - The ENG MODE selector is at IGN/START.
  - N2 is above the following threshold :
    - 22 % on the ground
R - 15 % in flight
- During a manual start, the HP FUEL valve opens if :
  - The ENG MODE selector is at IGN/START.
  - The MAN START pushbutton switch is ON.

OFF : Close signals go directly to the HP fuel valve and the LP fuel valve. These signals cause both channels of the FADEC to be reset.

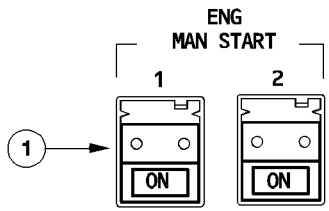
Note : Releasing the ENG FIRE pushbutton allows flight crew to shut down the engine by closing the LP fuel valve. There is a time delay of about 60 seconds at ground idle as the engine burns the fuel left between the LP valve and the nozzles.

(3) FAULT lt 1 (2)

FAULT lt : This amber light comes on, and a caution appears on ECAM, if there is:
- an automatic start abort
- a disagreement between the HP fuel valve position and its commanded position.

OVERHEAD PANEL

NFC5-01-7090-004-A005AA



(1) ENG MAN START pb sw

ON : The start valve opens if the ENG MODE selector is set to CRANK or IGN/START and N2 < 20 %.
Both pack valves close during the start sequence.

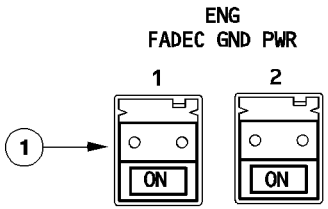
Note : The start valve closes automatically when N2 ≥ 50 %.

The blue ON light comes on.

Off : When the ENG MAN START pushbutton switch is set to OFF during a manual engine start, the start valve closes if the MASTER switch is OFF.

MAINTENANCE PANEL

NFC5-01-7090-004-B005AA



(1) FADEC GND PWR pb sw

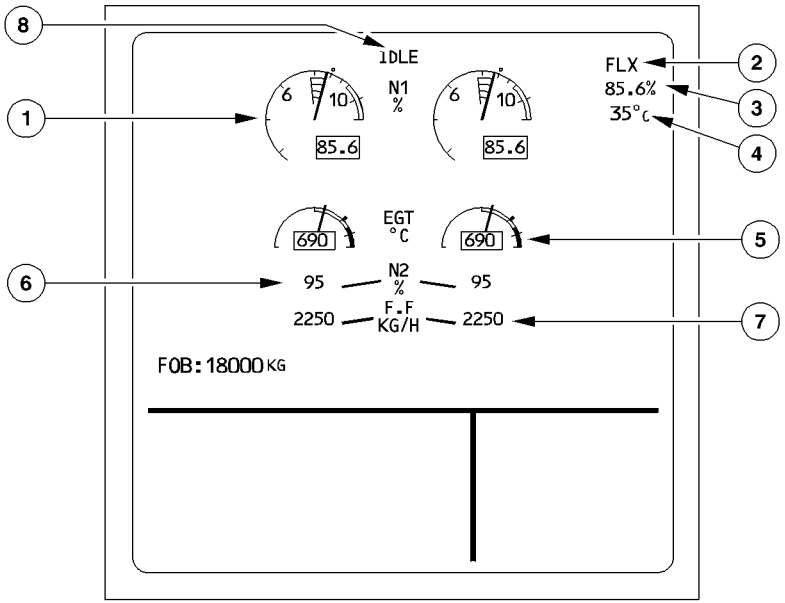
ON : FADEC has electrical power on the ground if the ENG FIRE pushbutton is not released.

ECAM

GENERAL

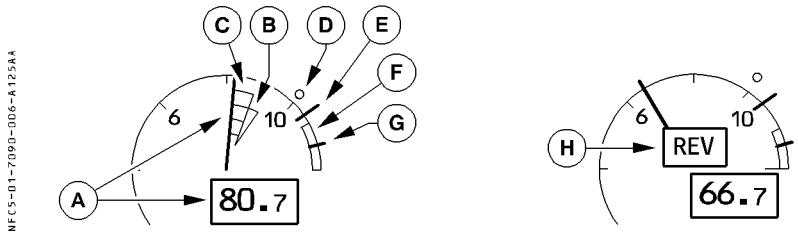
The ECAM's upper E/WD permanently displays the engines' primary parameters. The ECAM's lower SD displays the secondary parameters, either when they are automatically selected by the system, or manually selected by the flight crew.

PRIMARY PARAMETER



NFC5-01-7090-005-A113AA

(1) LP rotor speed (N1)



(A) Actual N1 : The N1 needle and N1 digital indication are normally in green. They pulse in :
- Amber, when the actual N1 is above the N1 (see E) ;
- Red, when the actual N1 is above the N1 RED line (104 %).
  When the N1 is degraded (in case both N1 sensors fail), the last digit of the digital display is dashed in amber.

(B) N1 Command (N1 trend) : The green needle corresponds to the N1 demanded by the FADEC. In addition, next to the N1 trend needle, a green triangle indicates the tendency of N1 command. These symbols are displayed when A/THR is active.

(C) Transient N1 : Symbolizes the difference between the N1 command and the actual N1. It is only displayed when A/THR is active.

(D) N1 TLA (blue circle) : N1 corresponding to the thrust lever position.

(E) Max N1 : The Max N1 amber index is the N1 limit value, corresponding to the full forward position of the thrust levers.

(F) Max permissible N1 : The N1 redline is represented by a red arc at the end of the scale, beginning at 104 %.

(G) N1 exceedance : If 104 % is exceeded, a red mark appears and remains at the maximum value achieved. It will disappear after a new start on ground or after maintenance action via the MCDU.

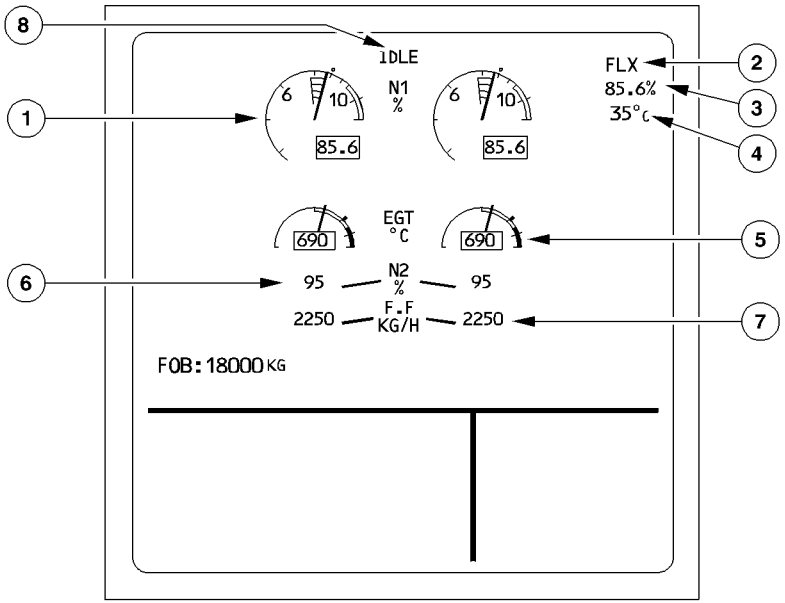
(H) REV indication : It is displayed in amber, when at least one reverser cowl is unstowed or unlocked.
It becomes green, when the reverser cowls are fully deployed.
(If unlocked in flight, the indication first flashes for 9 seconds and then remains steady).

ECAM

GENERAL

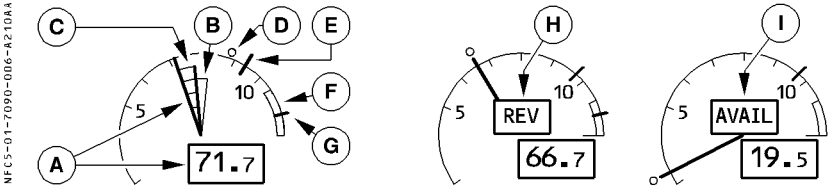
The ECAM's upper E/WD permanently displays the engines' primary parameters. The ECAM's lower SD displays the secondary parameters, either when they are automatically selected by the system, or manually selected by the flight crew.

PRIMARY PARAMETER



NFC5-01-7090-005-A113AA

(1) LP rotor speed (N1)



(A) Actual N1 : The N1 needle and N1 digital indication are normally in green. They pulse in :
- Amber, when the actual N1 is above the N1 (see E) ;
- Red, when the actual N1 is above the N1 RED line (104 %).

When the N1 is degraded (in case both N1 sensors fail), the last digit of the digital display is dashed in amber.

(B) N1 Command (N1 trend) : The green needle corresponds to the N1 demanded by the FADEC. In addition, next to the N1 trend needle, a green triangle indicates the tendency of N1 command. These symbols are displayed when A/THR is active.

(C) Transient N1 : Symbolizes the difference between the N1 command and the actual N1. It is only displayed when A/THR is active.

(D) N1 TLA (blue circle) : N1 corresponding to the thrust lever position.

(E) Max N1 : The Max N1 amber index is the N1 limit value, corresponding to the full forward position of the thrust levers.

(F) Max permissible N1 : The N1 redline is represented by a red arc at the end of the scale, beginning at 104 %.

(G) N1 exceedance : If 104 % is exceeded, a red mark appears and remains at the maximum value achieved. It will disappear after a new start on ground or after maintenance action via the MCDU.

(H) REV indication : It is displayed in amber, when at least one reverser cowl is unstowed or unlocked.
It becomes green, when the reverser cowls are fully deployed.
(If unlocked in flight, the indication first flashes for 9 seconds and then remains steady).

(I) AVAIL indication : Displayed in green to indicate a successful engine start on ground. It pulses in green to indicate a successful engine relight in flight. It is triggered when the engine is at, or above, idle.

(2) Thrust limit mode

TOGA, FLX, CL, MCT, or MREV limit mode, selected by the position of whichever thrust lever is farther forward, is displayed in blue.

(3) N1 rating limit

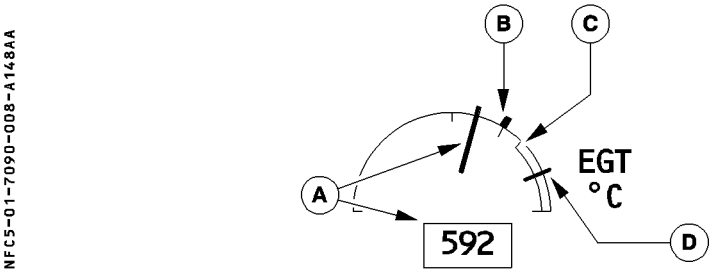
It is computed by the FADEC for the present thrust lever angle, and is displayed in green.

Note : When the aircraft is on ground with the engines running, the N1 rating limit displayed here corresponds to the TOGA thrust limit, regardless of the thrust lever position.
When the aircraft is on ground with the engines running and FLEX mode is selected, this number is the FLEX N1, regardless of the thrust lever position between idle and FLX/MCT.

R (4) FLEX temperature

R If FLX mode is selected, the flexible takeoff temperature selected through the MCDUs is
R displayed in blue.

R (5) EGT indicator



(A) Actual EGT
- It is normally green.
- It pulses amber above 915° C except for high power operation (FLEX TO or thrust lever above MCT or at MAX REV, or activation of alpha floor).
- It pulses amber above 725° C during start sequence.
- It pulses red above 950° C, and the numerical value becomes red.

(B) Max EGT
The amber index appears at 725° C during engine start, then at 915°C.

(C) Max permissible EGT
The EGT red line is at 950° C. Display shows red arc from 950° C to the end of the scale.

(D) EGT exceedance
If the EGT goes over 950°C, a red mark appears at its maximum value. It disappears after a new takeoff, or after a maintenance action through the MCDU.

R (6) HP rotor speed N2

The numbers are normally green. (During the start sequence, they are green on a grey background).
When N2 is above 105 %, the indication turns red and a red cross appears next to it.
When the N2 value is degraded (if both N2 sensors fail), the last digit is amber and is dashed.

R (7) Fuel flow

These numbers are green.

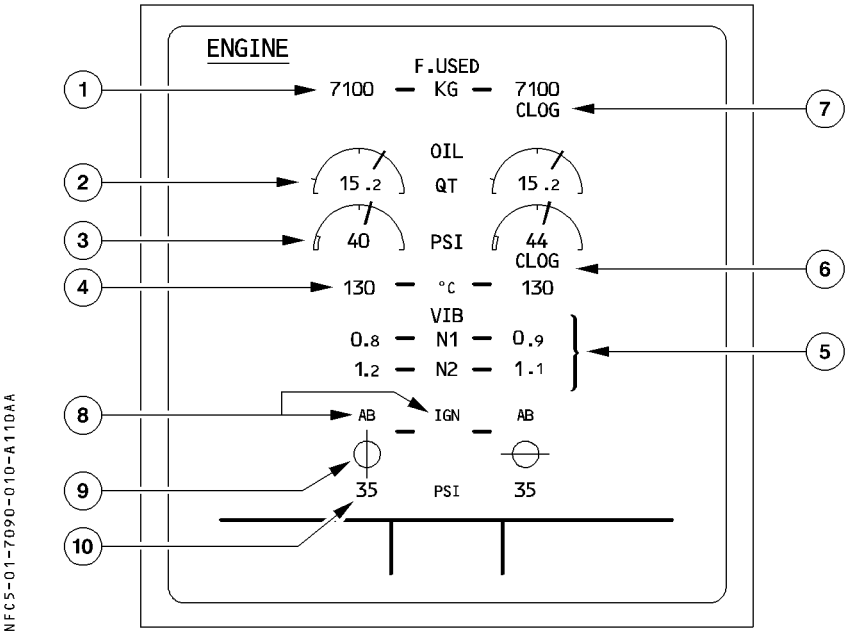
Note : If the system detects a discrepancy between the N1, N2, EGT and fuel flow values on the FADEC-DMC bus and the corresponding displayed values, an amber CHECK appears underneath the affected parameter.

R (8) IDLE indication

This legend appears in green when both engines are at idle. It flashes for 10 seconds, then remains steady.

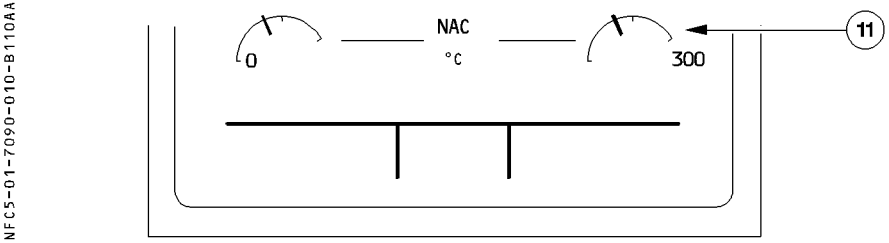
SECONDARY PARAMETERS

START CONFIGURATION



NFC5-01-7090-010-A110AA

AFTER START CONFIGURATION



NFC5-01-7090-010-B110AA

R (7) Fuel flow

These numbers are green.

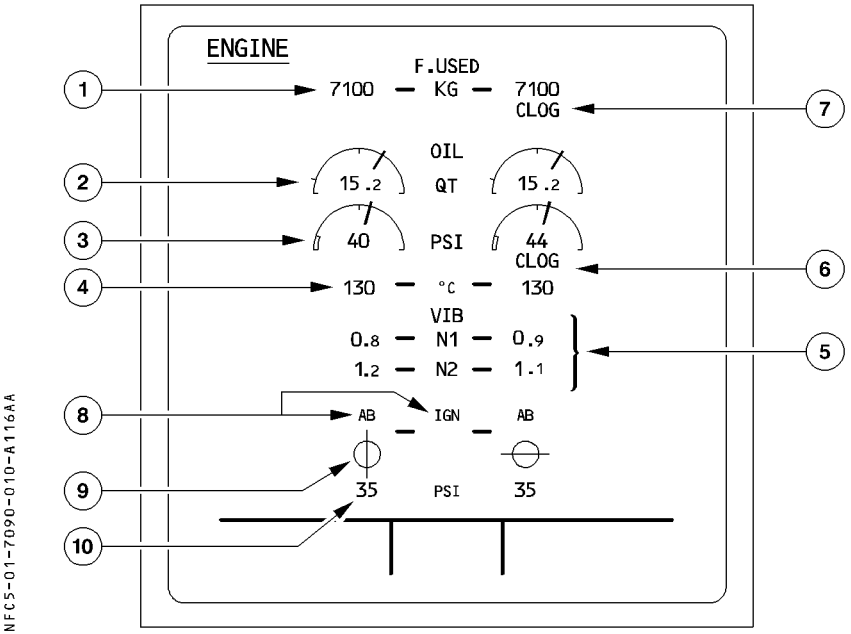
Note : If the system detects a discrepancy between the N1, N2, EGT and fuel flow values on the FADEC-DMC bus and the corresponding displayed values, an amber CHECK appears underneath the affected parameter.

R (8) IDLE indication

This legend appears in green when both engines are at idle. It flashes for 10 seconds, then remains steady.

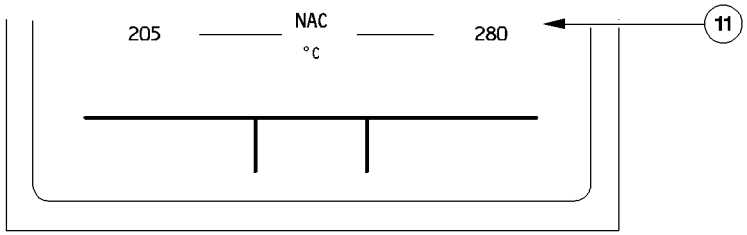
SECONDARY PARAMETERS

START CONFIGURATION



NFC5-01-7090-010-A116AA

AFTER START CONFIGURATION



NFC5-01-7090-010-B116AA

(1) Fuel used

The green number is the fuel used as computed by the FADEC.
It resets when the engine starts (MASTER switch ON) on the ground.
It is frozen at its last value (until the next engine start) when the engine shuts down. (The ECAM CRUISE page also displays it).
The two last digits are dashed if the fuel-used indication is inaccurate due to the loss of fuel flow data for more than one minute.

(2) Oil quantity

The needle and the numbers are normally green.
The indication pulses when oil quantity goes below three quarts (decreasing) or above five quarts (increasing).

(3) Oil pressure

The needle and the numbers are normally green.
The digital indication pulses if :
– oil pressure exceeds 90 psi (increasing) or 85 psi (decreasing).
– oil pressure drops below 16 psi (decreasing) or 20 psi (increasing).
The indication turns red and a warning appears on ECAM if the oil pressure drops below 13 psi.

(4) Oil temperature

These numbers are normally green.
They pulse above 140°C (increasing) or 135° C (decreasing).
They turn amber and a warning appears on ECAM if the temperature exceeds :
– 140° C for more than 15 minutes, or
– 155° C without delay.

(5) VIB

The legend is green.
VIB N1 pulses above 6.
VIB N2 pulses above 4.3.
(These numbers also appear on the ECAM CRUISE page).

Note : An MCDU procedure may reduce the advisory threshold to the level of vibration reached during the last flight.
If this function has been activated, the N1 and N2 VIB indications pulse below 6 and 4.3, respectively.

(6) Oil filter clog

CLOG appears in amber, if there is an excessive pressure loss across the main oil scavenge filter.

(7) Fuel filter clog

CLOG appears in amber, if there is an excessive pressure loss across the fuel filter.

(8) Ignition

IGN appears in white during the start sequence.
The letters A, B, or AB appear in green, when the respective igniters are firing.

(9) Start valve position

In line – Green : The valve is fully open.
Crossline – Green : The valve is fully closed.

(10) Engine bleed pressure

The green numbers indicate the bleed pressure upstream of the precooler.
They become amber, when the pressure drops below 21 psi with N2 ≥ 10 %, or if there is an overpressure.

(11) Nacelle temperature

It is displayed, except during the start sequence, and is normally in green.
It is normally green.
A nacelle temperature above 240°C pulses in green. The advisory threshold is indicated by a white check mark.

(1) Fuel used

The green number is the fuel used as computed by the FADEC.
It resets when the engine starts (MASTER switch ON) on the ground.
It is frozen at its last value (until the next engine start) when the engine shuts down. (The ECAM CRUISE page also displays it).
The two last digits are dashed if the fuel-used indication is inaccurate due to the loss of fuel flow data for more than one minute.

(2) Oil quantity

The needle and the numbers are normally green.
The indication pulses when oil quantity goes below three quarts (decreasing) or above five quarts (increasing).

(3) Oil pressure

The needle and the numbers are normally green.
The digital indication pulses if :
– oil pressure exceeds 90 psi (increasing) or 85 psi (decreasing).
– oil pressure drops below 16 psi (decreasing) or 20 psi (increasing).
The indication turns red and a warning appears on ECAM if the oil pressure drops below 13 psi.

(4) Oil temperature

These numbers are normally green.
They pulse above 140°C (increasing) or 135° C (decreasing).
They turn amber and a warning appears on ECAM if the temperature exceeds :
– 140° C for more than 15 minutes, or
– 155° C without delay.

(5) VIB

The legend is green.
VIB N1 pulses above 6.
VIB N2 pulses above 4.3.
(These numbers also appear on the ECAM CRUISE page).

Note : An MCDU procedure may reduce the advisory threshold to the level of vibration reached during the last flight.
If this function has been activated, the N1 and N2 VIB indications pulse below 6 and 4.3, respectively.

(6) Oil filter clog

CLOG appears in amber, if there is an excessive pressure loss across the main oil scavenge filter.

(7) Fuel filter clog

CLOG appears in amber, if there is an excessive pressure loss across the fuel filter.

(8) Ignition

IGN appears in white during the start sequence.
The letters A, B, or AB appear in green, when the respective igniters are firing.

(9) Start valve position

In line – Green : The valve is fully open.
Crossline – Green : The valve is fully closed.

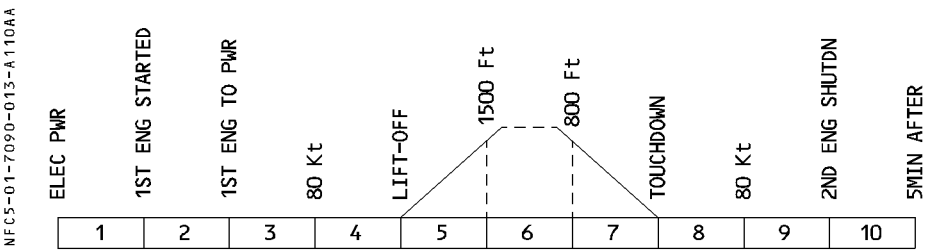
(10) Engine bleed pressure

The green numbers indicate the bleed pressure upstream of the precooler.
They become amber, when the pressure drops below 21 psi with N2 ≥ 10 %, or if there is an overpressure.

(11) Nacelle temperature

The values in green indicate the nacelle temperature. These values are displayed if not during start sequence, and if one nacelle temperature is at, or above, the advisory threshold (240°C).
The nacelle temperature pulses in green at, or above, the advisory threshold.

WARNINGS AND CAUTIONS



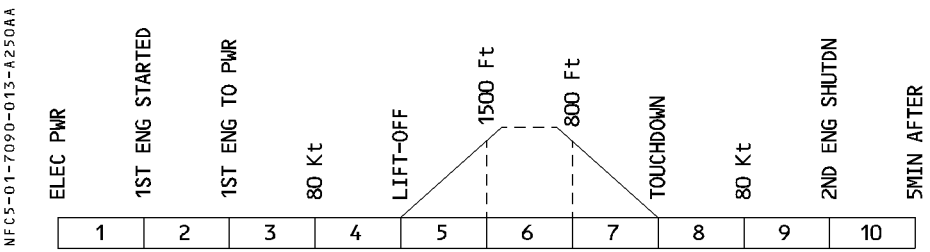
R

E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
ENG DUAL FAILURE	CRC	MASTER WARN	ENG	Associated with GEN FAULT lts and PACK FAULT lt	NIL
ENG 1(2) OIL LO PR Oil low pressure triggered at 13 psi by the oil press switch.				NIL	1, 10
ENG STALL	SINGLE CHIME	MASTER CAUT		Associated FAULT lt on ENG panel on pedestal (exception case of starter time exceeded)	3, 4, 5, 7, 8
ENG 1(2) HP FUEL VALVE HP fuel valve failed closed.					
ENG 1 (2) START FAULT Start fault due to : No light up, or . Eng stall or overtemp (above 725°C), or . Starter time exceeded . Thrust lever not at idle . Low start air press					3, 4, 5, 6, 7, 8
ENG 1(2) START VALVE FAULT Position disagree.					3, 4, 5, 7, 8
ENG 1 (2) THR LEVER DISAGREE Disagree between both resolvers of a thrust lever.				NIL	4, 5, 8
ENG 1(2) OIL HI TEMP Oil temp between 140 and 155° C for more than 15 min, or oil temp above 155° C.					4, 5, 7, 8
ENG 1(2) FADEC FAULT Both channels failed.					
ENG 1(2) LOW N1 No N1 rotation during start.					4, 5, 6, 7, 8, 9, 10
ENG THRUST LOCKED Thrust levers are not moved within 5 sec, following an unvoluntary disconnection of the A/THR (or disconnection through the FCU pb).	SINGLE CHIME every 5 sec	MASTER CAUT every 5 sec	NIL		1, 2, 3, 4, 8, 9, 10
ENG FLEX TEMP NOT SET Flex temp has not been entered on the MCDU.	SINGLE CHIME	MASTER CAUT			1, 4, 5, 6, 7, 8, 10
ENG 1(2) FADEC HI TEMP					3, 4, 5 7, 8
ENG TYPE DISAGREE Rating discrepancy between the two engines.					3 to 10

R

E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
ENG 1(2) THR LEVER FAULT Both resolvers on one thrust lever have failed.	SINGLE CHIME	MASTER CAUT	NIL	NIL	5
ENG 1(2) FAIL Eng core speed below idle, with master sw ON and fire pb not pushed.					1, 10
ENG 1(2) SHUT DOWN Eng master at off in phases 3 to 8, or eng fire pb pushed in phases 1, 2, 9 and 10.					
ENG 1(2) REVERSE UNLOCKED One or more reverser doors not locked in stowed position in flight, or on ground with no deploy order.					8
ENG 1(2) REV PRESSURIZED Reverser system is pressurized, while rev doors are stowed and locked with no deploy order.					4, 5, 8
ENG 1(2) COMPRESSOR VANE Variable bleed valve sys or variable stator vane sys fault.					4, 5, 7, 8
ENG 1(2) N1 or N2 or EGT OVER LIMIT N1 above 104 % N2 above 105.0 % EGT above 950°C					4, 8
ENG 1(2) IGN A + B FAULT Both ignition circuits are failed.					3, 4, 5, 7, 8
ENG 1(2) CTL VALVE FAULT Burn stag valve failure or HPTC, or RAC system failure.					4, 5, 7, 8
ENG 1(2) FUEL CTL FAULT Fuel metering valve position disagree.					
ENG 1(2) SENSOR FAULT PS 3 or T 25 or T3 or N1 or N2 data unavailable on both channels.					
ENG 1(2) PROBES FAULT T 12 or PO PT 2 data unavailable on both channels.					
ENG 1(2) N1 (N2, EGT, FF) DISCREPANCY Discrepancy between real and displayed values.					3, 4, 5, 8
ENG 1(2) BLEED STATUS FAULT Bleed, X Bleed, pack, anti-ice valve position status not received by FADEC active channel.					3, 4, 5, 7, 8
ENG 1(2) FUEL FILTER CLOG	NIL	NIL	ENG		4, 5, 7, 8
ENG 1(2) OIL FILTER CLOG					
ENG VIB SYS FAULT Failure of vibration detection system.			NIL		3, 4, 5, 6, 7, 8, 9
ENG 1(2) OVSPD PROT FAULT Loss of overspeed protection.					4, 5, 7, 8
ENG 1(2) IGN A(B) FAULT Ignition circuit A or B failed.					3, 4, 5, 7, 8
ENG 1(2) FADEC ALTERNATOR Loss of electrical auto supply of either FADEC channel.					
ENG COMPRESSOR VANE Engine 1 and 2 VBV or VSV fault.					
ENG 1(2) FUEL RETURN VALVE Fuel return valve is failed in the not open, or not closed position.					

WARNINGS AND CAUTIONS



E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
ENG DUAL FAILURE	CRC	MASTER WARN	ENG	Associated with GEN FAULT lts and PACK FAULT lt	NIL
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ENG STALL	SINGLE CHIME	MASTER CAUT		Associated FAULT lt on ENG panel on pedestal (exception case of starter time exceeded)	3, 4, 5, 7, 8
ENG 1(2) HP FUEL VALVE HP fuel valve failed closed.					3, 4, 5, 6, 7, 8
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ENG 1(2) START VALVE FAULT Position disagree.					4, 5, 8
ENG 1 (2) THR LEVER DISAGREE Disagree between both resolvers of a thrust lever.				NIL	4, 5, 7, 8
ENG 1(2) OIL HI TEMP Oil temp between 140 and 155° C for more than 15 min, or oil temp above 155° C.					4, 5, 6, 7, 8, 9, 10
ENG 1(2) FADEC FAULT Both channels failed.					
ENG 1(2) LOW N1 No N1 rotation during start.					
ENG THRUST LOCKED Thrust levers are not moved within 5 sec, following an unvoluntary disconnection of the A/THR (or disconnection through the FCU pb).	SINGLE CHIME every 5 sec	MASTER CAUT every 5 sec	NIL		1, 2, 3, 4, 8, 9, 10
ENG THR LEVERS NOT SET The levers position does not correspond to T.O power mode.	SINGLE CHIME	MASTER CAUT			1, 4, 5, 6, 7, 8, 10
ENG 1(2) FADEC HI TEMP					3, 4, 5 7, 8
ENG TYPE DISAGREE Rating discrepancy between the two engines.					3 to 10

E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
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ENG 1(2) SHUT DOWN Eng master at off in phases 3 to 8, or eng fire pb pushed in phases 1, 2, 9 and 10.					
ENG 1(2) REVERSE UNLOCKED One or more reverser doors not locked in stowed position in flight, or on ground with no deploy order.					8
ENG 1(2) REV PRESSURIZED Reverser system is pressurized, while rev doors are stowed and locked with no deploy order.					4, 5, 8
ENG 1(2) COMPRESSOR VANE Variable bleed valve sys or variable stator vane sys fault.					4, 5, 7, 8
ENG 1(2) N1 or N2 or EGT OVER LIMIT N1 above 104 % N2 above 105.0 % EGT above 950°C					4, 8
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ENG 1(2) N1 (N2, EGT, FF) DISCREPANCY Discrepancy between real and displayed values.					3, 4, 5, 8
ENG 1(2) BLEED STATUS FAULT Bleed, X Bleed, pack, anti-ice valve position status not received by FADEC active channel.					3, 4, 5, 7, 8
ENG 1(2) FUEL FILTER CLOG	NIL	NIL	ENG		3, 4, 5, 7, 8
ENG 1(2) OIL FILTER CLOG					
ENG VIB SYS FAULT Failure of vibration detection system.			NIL		3, 4, 5, 6, 7, 8, 9
ENG 1(2) OVSPD PROT FAULT Loss of overspeed protection.					3, 4, 5, 7, 8
ENG 1(2) IGN A(B) FAULT Ignition circuit A or B failed.					3, 4, 5, 7, 8
ENG 1(2) FADEC ALTERNATOR Loss of electrical auto supply of either FADEC channel.					
ENG COMPRESSOR VANE Engine 1 and 2 VBV or VSV fault.					
ENG 1(2) FUEL RETURN VALVE Fuel return valve is failed in the not open, or not closed position.					

E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
ENG 1(2) FADEC A(B) FAULT One FADEC channel failed.	NIL	NIL	NIL	NIL	3, 4, 5, 7, 8
ENG 1(2) EIU FAULT Databus between EIU and ECU failed.					1, 3, 4, 5, 7, 8, 10
ENG 1(2) REVERSER FAULT Loss of thrust reverser on one engine, due to system components or input faults.					3, 4, 5
ENG 1(2) REV ISOL FAULT	SC	CAUT			3 to 7
ENG 1(2) REV SWITCH FAULT Failure of reverser permission switch	NIL	NIL			3, 4, 5, 6, 7, 8
ENG REV SET Reverse thrust has been selected in flight.					1 to 4 8 to 10
ENG 1(2) FUEL RETURN VALVE Failure of the fuel return valve in the open or closed position.					3, 4, 5, 7, 8
ENG 1(2) ONE TLA FAULT					3, 4, 5, 6, 7, 8
ENG 1(2) THR LEVER ABV IDLE One thrust lever is at or above idle while the other thrust lever is in the reverse detent.	SINGLE CHIME	MASTER CAUTION			1, 2, 3, 4, 5, 6, 7, 10

MEMO DISPLAY

IGNITION appears in green, when continuous ignition is activated on either engine.

BUS EQUIPMENT LIST

R

			NORM		EMER ELEC		
			AC	DC	AC ESS	DC ESS	HOT
FADEC	CHANNEL A	ENG 1 and 2				X	
	CHANNEL B	ENG 1		BAT			
		ENG 2		DC2			
EIU		ENG 1		BAT		X	
		ENG 2				X	
HP VALVES						X	
LP VALVES				DC2		X	
OIL PRESS/QTY		ENG 1		DC1			
		ENG 2		DC2			
IGNITION	A	ENG 1 and 2	AC ESS		AC ESS or AC STAT INV during RAT extension		
	B	ENG 1	AC1				
		ENG 2	AC2				
EVMU		ENG 1 and 2	AC1				