

	ELECTRICAL DESCRIPTION	1.24.10	P 1
		SEQ 001	REV 08

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.

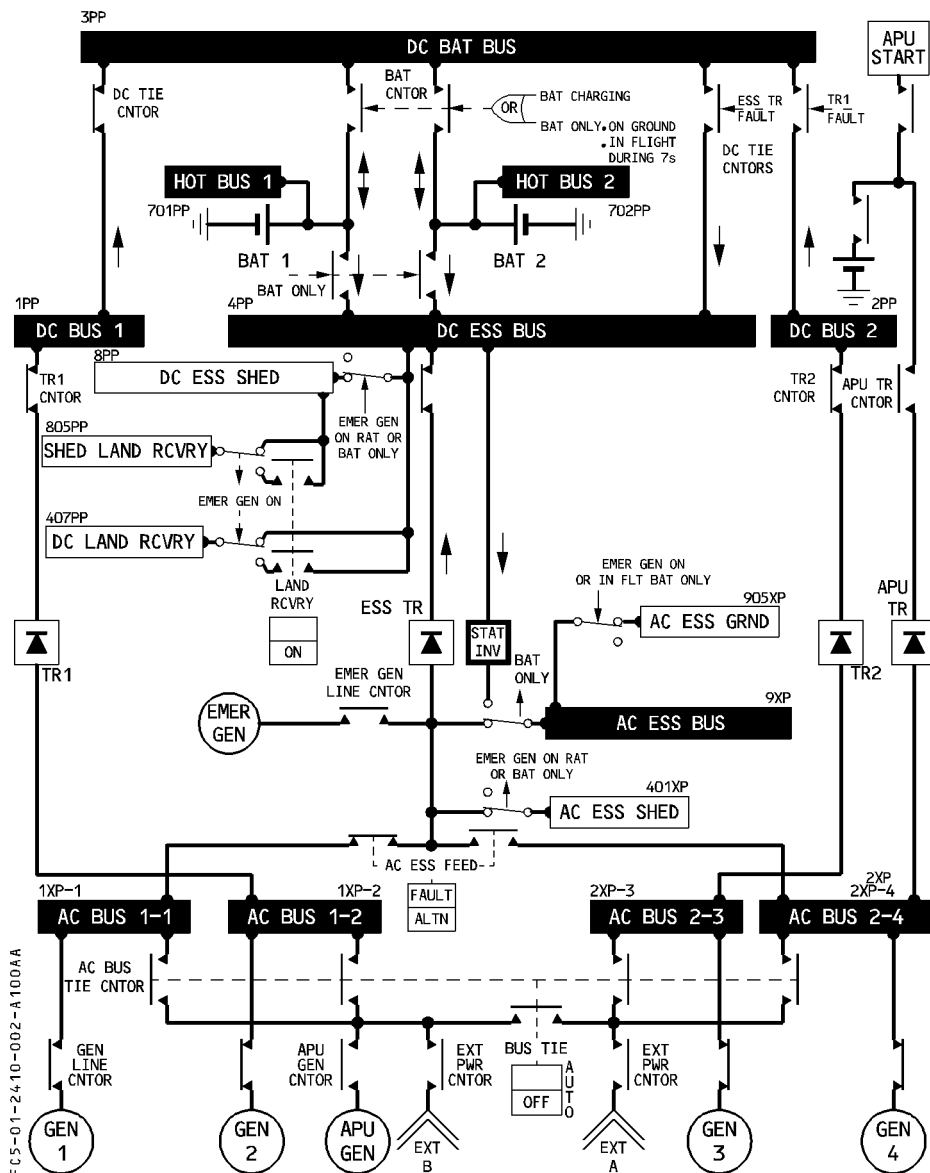
Normally, the system produces alternating current, some of which it then transforms into direct current for certain applications.

At least two generators are required to supply all electrical bus bars.

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



	ELECTRICAL		1.24.10	P 3
	DESCRIPTION		SEQ 200	REV 17

GENERATION OF ELECTRICAL POWER

AC GENERATION

ENGINE – DRIVEN GENERATORS

Four three-phase AC generators (GEN1, GEN2, GEN3, and GEN4), 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.

Four generator 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 fifth generator (APU GEN), driven directly by the APU and producing up to 115 KVA of three phase 115/200-volt 400 hertz power, can replace one or more main engine generators at any time.

Two ground power connectors near the nosewheel allow ground power to be supplied to all busbars (with some galleys shed in case of overload). Two ground power units (90 kVA max each) can supply the aircraft.

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 green 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 8.6 KVA of three-phase 115/200-volts 400-hertz power, except when the Ram Air Turbine powers the green hydraulic circuit, and the aircraft speed is below 260 knots ; in this case, the emergency generator supplies 3.5 KVA, leading to some shedding.

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.
- Controls the emergency generator start-up.

	ELECTRICAL		1.24.10	P 4
	DESCRIPTION		SEQ 100	REV 16

STATIC INVERTER

A static inverter transforms DC power from the DC ESS bus into 2.5 KVA of single-phase 115-volt 400-hertz AC power, which is then supplied to part of the AC essential bus. In flight, the inverter is automatically activated, if nothing but the batteries is supplying electrical power to the aircraft, regardless of the position of the BAT 1 and BAT 2 pushbuttons.

On ground, the inverter is activated, if only the batteries are supplying electrical power to the aircraft, and both BAT 1 and BAT 2 pushbuttons are on.

DC GENERATION

TRANSFORMER RECTIFIERS (TR)

Two main Transformer Rectifiers TR1 and TR2 (200 A) and one essential TR (100 A), supply the aircraft's electrical system with DC current.

A fourth TR (100A) is dedicated to APU start or APU battery charging.

Each TR controls its contactor by internal logic.

BATTERIES

Two main batteries, each with a normal capacity of 50 Ampere-hours, are permanently connected to the two hot busses.

An identical third battery (50 Ah) is dedicated to APU start.

Each battery has an associated Battery Charge Limiter (BCL).

The BCL monitors battery charging and controls its battery contactor.

CONTACTORS

Two identical Electrical Contactor Management Units (ECMUs) provide:

- AC and DC contactors control (excepted TR contactors, which are controlled by the TR itself).
- Galley shedding control.
- No Break Power Transfer control (NBPT).
- Monitoring and indicating.

	ELECTRICAL DESCRIPTION	1.24.10	P 5
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For this purpose, each ECMU receives the following information:

- Voltage of all normal busbars
- Position of all AC and DC contactors
- Availability of all generators, or power source (from GCU or GAPCU)
- Position of all galley contactors
- TR status
- Pushbutton position (BUS TIE, GALLEY SHED and COMMERCIAL)
- Flight/ground signal from associated LGCIU.

AC AND DC CONTACTOR CONTROL

- | | | |
|-----------------|---|--|
| ECMU 1 controls | : | <ul style="list-style-type: none"> – The Generator Line Contactor (GLC) 1 and 2. – The AC Bus Tie Contactor (BTC) 1 and 2. – The APU Generator Contactor. – The external power B Contactor – Both DC Tie Contactors – The BUS Tie Contactor. |
| ECMU 2 controls | : | <ul style="list-style-type: none"> – The Generator Line Contactor (GLC) 3 and 4 – The AC Bus Tie Contactor (BTC) 3 and 4 – The external power A Contactor – Both DC Tie Contactors. |

NO BREAK POWER TRANSFER

This function avoids busbar power interruption during supply source transfer on ground in normal configuration. It is inhibited in flight.

The ECMU controls the simultaneous connection of the two sources for a short time. To achieve this, both sources are synchronized on a frequency reference signal sent by the GAPCU.

Synchronization may take up to 15 seconds for the APU GEN with GPU, and some milliseconds in all other cases.

If synchronization is not achieved within the allowed time, transfer is performed anyway (without simultaneous connection of the two sources). This function has a backup in the GCU.

MONITORING AND INDICATING

Each ECMU sends the following information to the ECAM :

- Busbars supplied or not
- Contactor status
- Galley supply status, and galley switch position.

	ELECTRICAL		1.24.10	P 6
	DESCRIPTION		SEQ 001	REV 08

CIRCUIT BREAKERS

All circuit breakers are in the electronic equipment bay.

A Circuit Breaker Monitoring Unit (CBMU) monitors the circuit breaker status. It sends this information to the ECAM system.

OPERATIONS

GENERAL

Each AC BUS is supplied in priority order by :

- the corresponding engine generator.
- the APU generator or the external power A (if both are connected, the APU generator has priority for the left side bars, and the external power has priority for the right side bars).
- the external power B (if both external powers are connected, B has priority for the left side bars and A has priority for the right side bars).
- the engine generator located on the same side.
- the other side outer engine generator.

The APU generator or an external power may supply all the network.

Two generators can supply all the network (with galley shedding in case of overload detection).

When only one engine generator is available it supplies only its side.

The generators cannot be connected in parallel (except on ground during No Break Power Transfers).

NORMAL CONFIGURATION

IN FLIGHT

Each engine driven generator supplies its associated AC BUS (1.1, 1.2, 2.3, 2.4) via its Generator Line Contactor (GLC 1 and GLC 2, GLC 3 and GLC4).

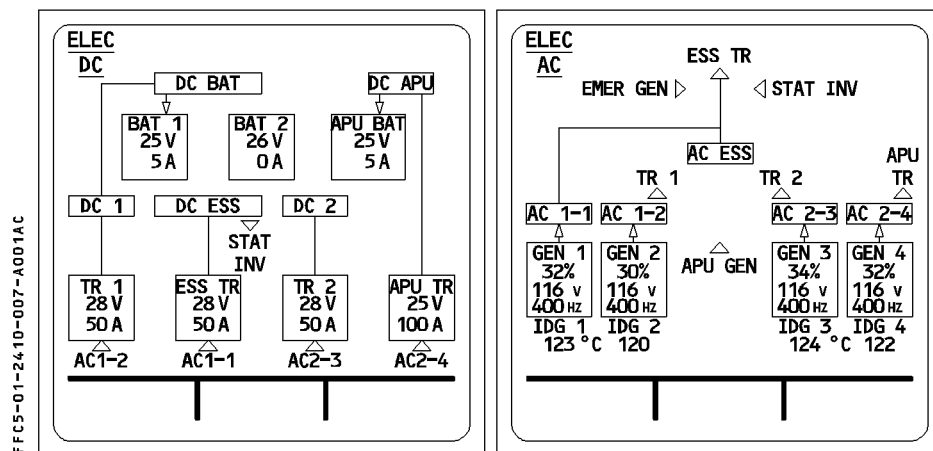
AC BUS 1.1 normally supplies the AC ESS BUS via a contactor.

AC BUS 1.2 supplies TR 1 which normally supplies DC BUS 1, DC BAT BUS.

AC BUS 2.3 supplies TR 2 which normally supplies DC BUS 2.

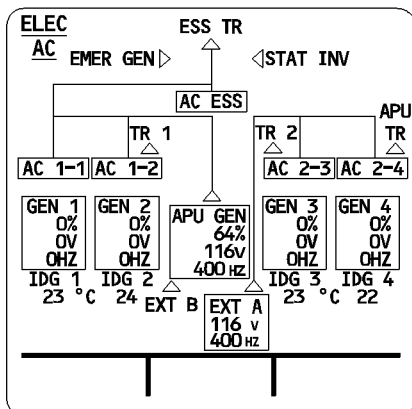
AC BUS 1.1 supplies ESS TR which normally supplies DC ESS BUS.

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.

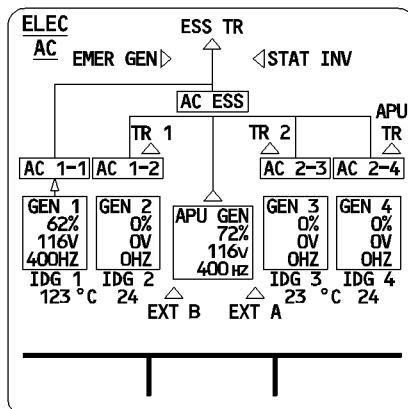


ON GROUND

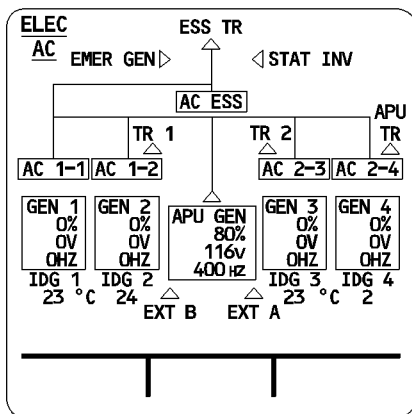
Either the APU generator or external power may supply the complete system (with some galley shedding in case of overload).



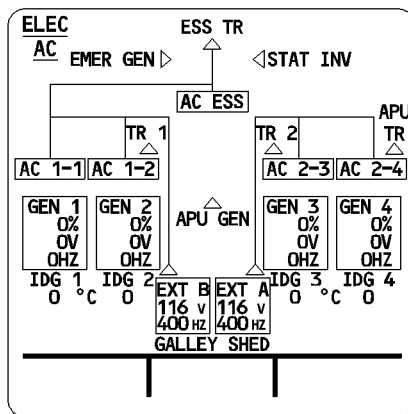
APU GEN + EXTERNAL POWER



APU GEN + GEN 1



APU GEN ONLY



EXTERNAL POWER ONLY

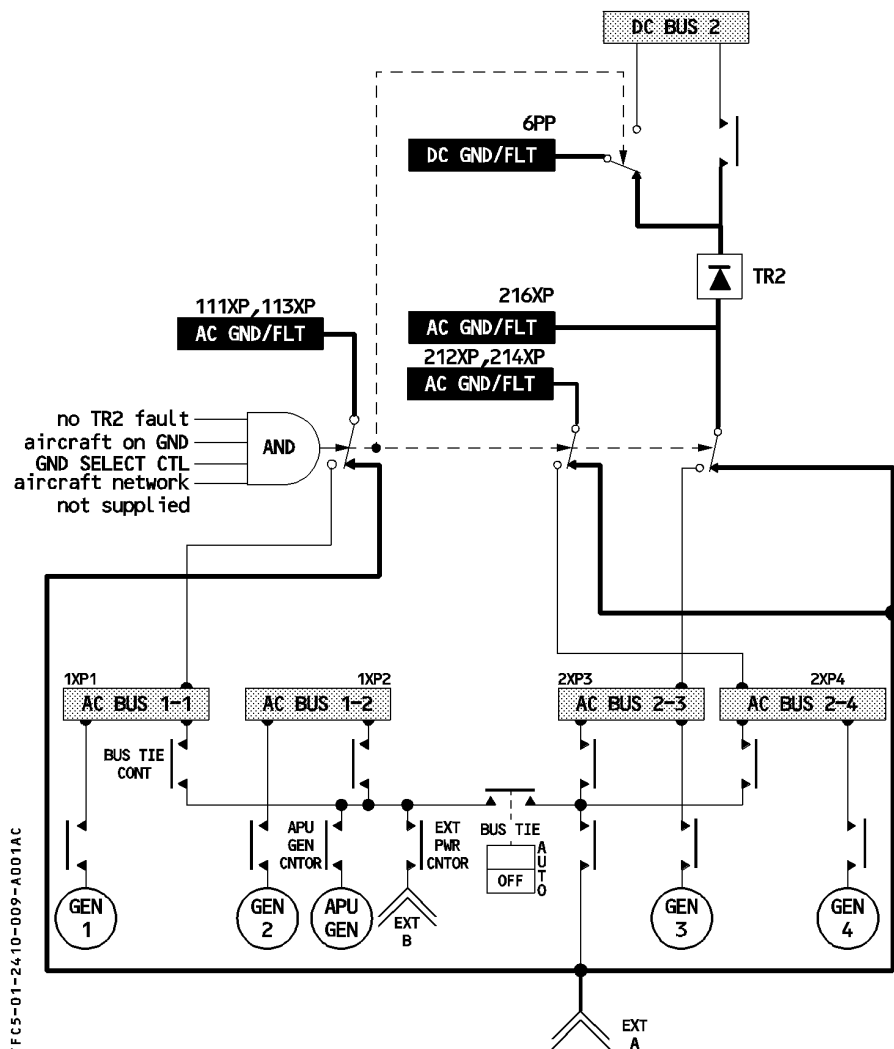
If external power A and external power B plus APU supply the complete system, the APU has priority over external power B.

Situation then will be as displayed for case APU plus external power.

On ground, when only ground services are required, external power can supply the AC and DC GND / FLT busses directly without supplying the entire aircraft network.

Personnel select this configuration with the GND SELECT CTL selector in the forward entrance area.

FOR INFO



ABNORMAL CONFIGURATIONS

ENGINE GENERATOR FAILURES

ECMU provides automatic reconfiguration.

Complete network remains supplied provided at least two generators (including APU generator) are available.

Some galleys are automatically shed.

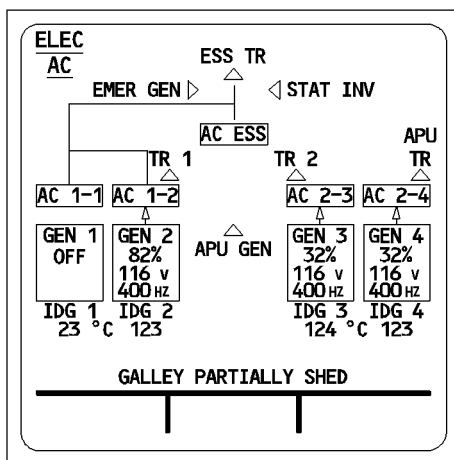
Note : If a generator is lost due to overcurrent detection, reconfiguration does not occur and the related AC BUS is lost.

Failure of one engine generator

The system automatically replaces the failed generator by the other engine generator of the same side, through the associated AC BUS or the APU generator if available.

Failure of two engine generators located on opposite sides

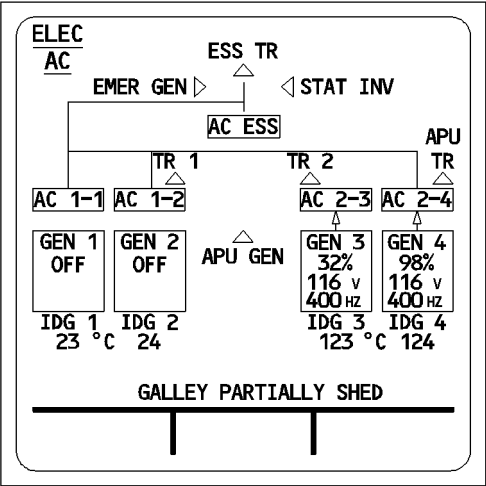
The system automatically replaces each failed generator by the other engine generator of its side, or by the APU generator if available.



FFCS-01-2410-010-A001AC

Failure of two engine generators located on the same side

The system automatically replaces the failed generators by the outer engine generator of the other side, or by the APU generator if available.



FFCS-01-24.10-011-A001AB

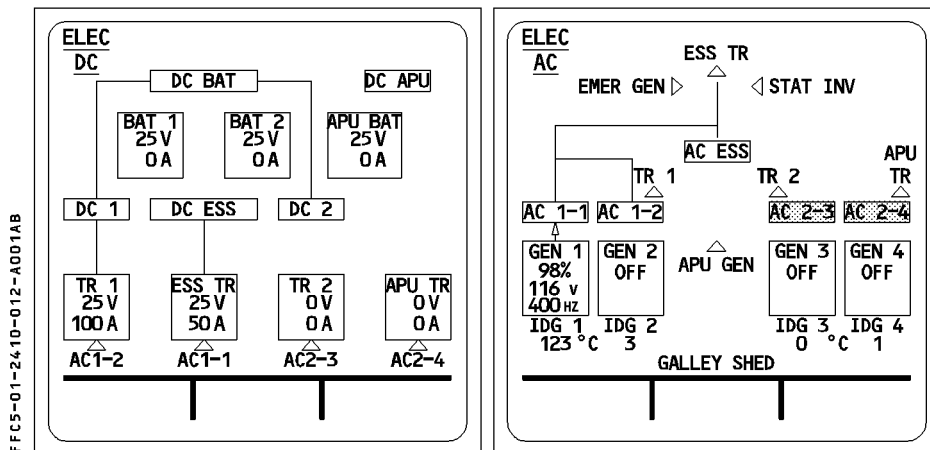
	ELECTRICAL DESCRIPTION		1.24.10	P 12
			SEQ 001	REV 08

Failure of three engine generators

If APU generator is available it replaces all failed engine generators.

If APU generator is not available, the AC NORM BUS on one side are lost.

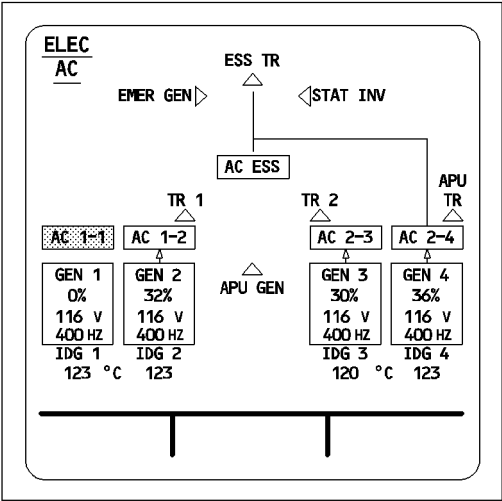
Example : GEN 1 remaining



Note : If the remaining generator is on the right side, the AC ESS BUS is automatically supplied by the AC BUS 2.4.

FAILURE OF THE AC BUS 1.1

The AC BUS 2.4 automatically supplies the AC ESS BUS and the ESS TR



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	ELECTRICAL DESCRIPTION		1.24.10	P 14
			SEQ 001	REV 16

TR FAILURES

The contactor of each TR automatically opens, in case of :

- Overheat
- Minimum current
- Overcurrent
- Open or short circuit.

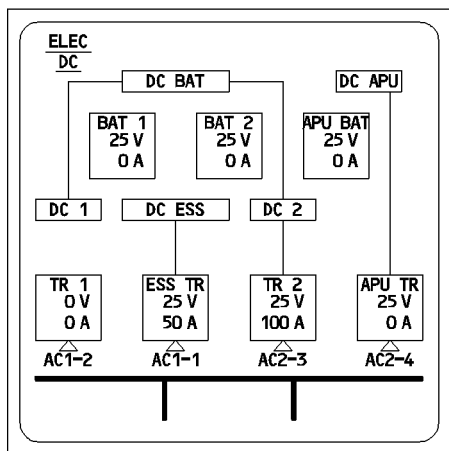
The ECMU provides automatic reconfiguration (except for APU TR).

Note : If a TR is lost due to overcurrent detection, reconfiguration does not occur and the related DC BUS and DC BAT BUS are lost.

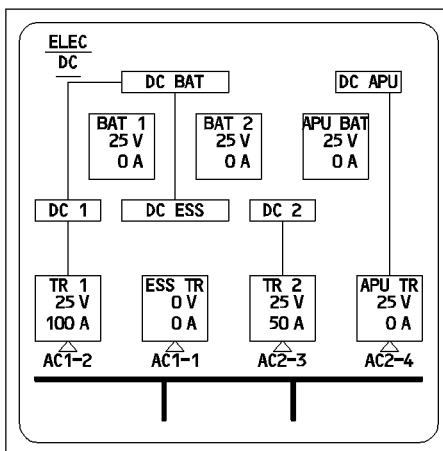
Failure of one TR

- TR 1 or 2 lost : The available TR replaces the faulty one.
- ESS TR lost : TR 1 replaces the ESS TR.

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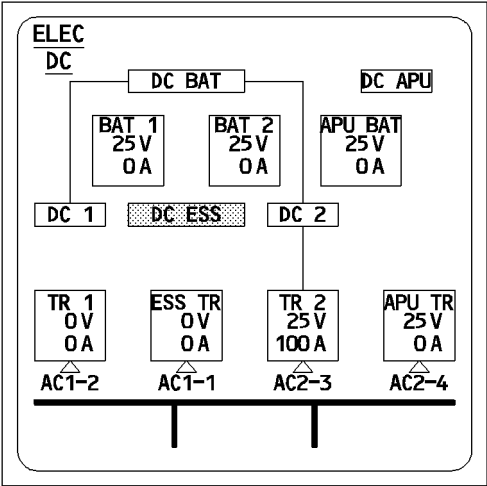
TR1 FAULT



ESS TR FAULT

Failure of ESS TR and TR 1 (or TR 2)

The remaining TR supplies the two DC norm busses and the DC BAT bus.
The DC ESS bus is lost.



FFCS-01-2410-015-A001AA

EMERGENCY GENERATION AFTER LOSS OF ALL MAIN GENERATORS

If both buses, AC1.1 and 2.4, are lost and if the engines 1 and 4 are lost, the ram-air turbine (RAT) extends automatically.

If powered by the RAT only, the emergency generator is inhibited when slats are extended.

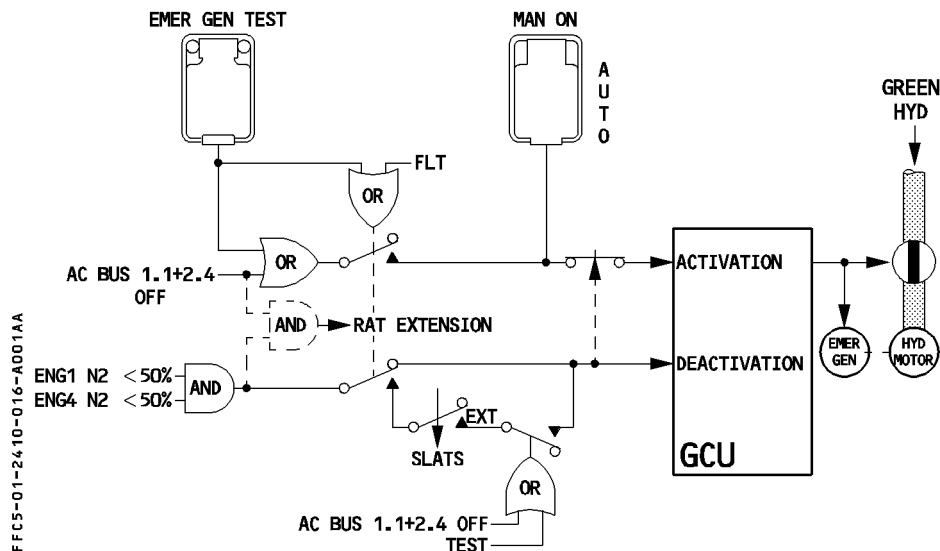
The emergency generator can be manually activated through the MAN ON pushbutton.

Emergency generator deactivation occurs only automatically :

- In flight : at slats extension if powered by the RAT only (engines 1 and 4 lost). It can be reactivated after slats retraction through the MAN ON pushbutton.
- On the ground : after engine 1 and 4 shutdown.

EMER GEN TEST pushbutton allows to activate the emergency generator and to connect it to the essential network. This test is inhibited when the slats are extended.

FOR INFO



- The AC ESS GND is lost.



virgin atlantic A340-600 <i>Flight Crew Operating Manual</i>	ELECTRICAL		1.24.10	P 18
	DESCRIPTION		SEQ 105	REV 16

FLIGHT WITH BATTERIES ONLY

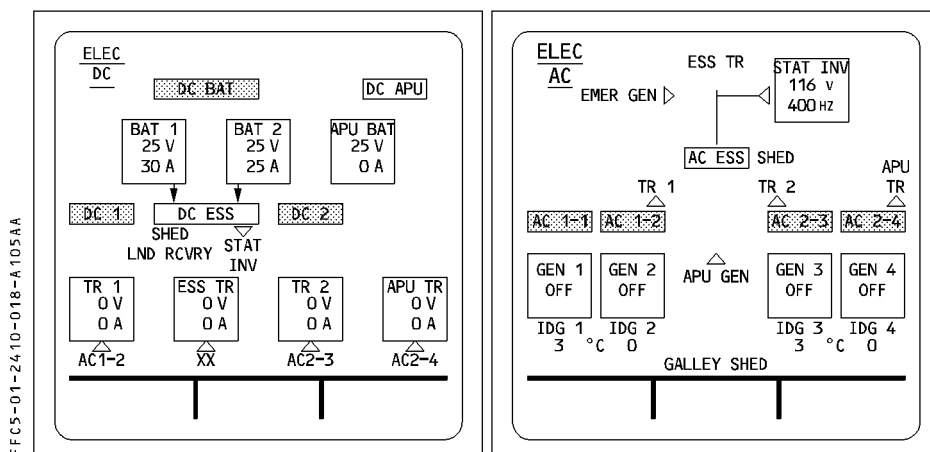
When the emergency generator is not available, batteries supply the DC ESS BUS and, through the STAT INV, the AC ESS bus.

The AC ESS SHED and the DC ESS SHED are not supplied.

The DC LAND RECOVERY bus is shed and is partially recovered when the LAND RECOVERY pushbutton is pressed.

The AC ESS GND is lost.

Example : Flight with batteries only, with LAND RECOVERY selected :



virgin atlantic A340-600 Flight Crew Operating Manual	ELECTRICAL DESCRIPTION	1.24.10	P 19
		SEQ 200	REV 16

ON GROUND, BATTERIES ONLY

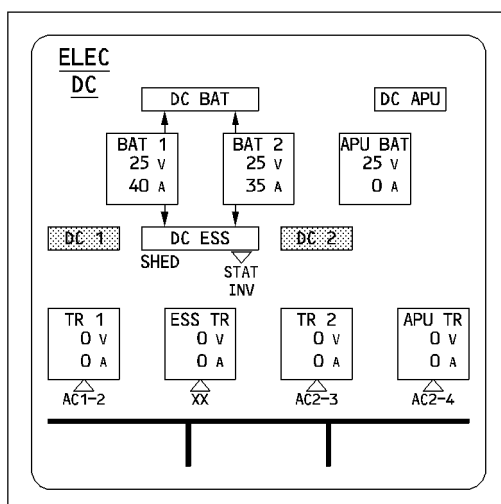
Provided they are both selected AUTO, batteries supply the :

- DC ESS BUS
- DC BAT BUS
- DC LAND RECOVERY (whatever the position of the LAND RECOVERY pushbutton).

And through the static inverter, the :

- AC ESS BUS, and
- AC ESS GND

The AC ESS SHED, the DC ESS SHED and the SHED LAND RECOVERY are not supplied.



FFCS-01-2410-019-A200AA

Note : ELEC AC ECAM page is identical to the one for flight with batteries only.

On ground, the external horn is activated, if the following conditions are met :

- External power contactor OFF (ground power unit disconnected, or EXT PWR pushbutton at OFF) ;
- Generators not running ;
- BAT pushbutton switched to auto, and batteries connected to the aircraft network.

If the batteries are not switched off, the horn automatically stops after 5 minutes.

DISTRIBUTION TABLE

	AC BUS 1-1	AC BUS 1-2	AC BUS 2-3	AC BUS 2-4	AC ESS BUS	AC ESS GND	AC ESS SHED	DC BUS 1	DC BUS 2	DC BAT BUS	DC ESS BUS	DC ESS SHED
NORM CONFIG	GEN 1	GEN 2	GEN 3	GEN 4	GEN 1	GEN 1	GEN 1	TR 1 GEN 2	TR 2 GEN 3	TR 1 GEN 2	ESS TR GEN 1	ESS TR GEN 1
GEN 1 INOP (GEN 2 INOP:GEN 1 replaces GEN 2)	GEN 2 (3)	GEN 2	GEN 3	GEN 4	GEN 2 (3)	GEN 2 (3)	GEN 2 (3)	TR 1 GEN 2 (3)	TR 2 GEN 3	TR 1 GEN 2 (3)	ESS TR GEN 2 (3)	ESS TR GEN 2 (3)
GEN 3 INOP (GEN 4 INOP:GEN 3 replaces GEN 4)	GEN 1	GEN 2	GEN 4 (3)	GEN 4	GEN 1	GEN 1	GEN 1	TR 1 GEN 2	TR 2 GEN 4 (3)	TR 1 GEN 2	ESS TR GEN 1	ESS TR GEN 1
GEN 1 AND 2 INOP	GEN 4 (3)	GEN 4 (3)	GEN 3	GEN 4	GEN 4 (3)	GEN 4 (3)	GEN 4 (3)	TR 1 GEN 4 (3)	TR 2 GEN 3	TR 1 GEN 4 (3)	ESS TR GEN 4 (3)	ESS TR GEN 4 (3)
GEN 3 AND 4 INOP	GEN 1	GEN 2	GEN 1 (3)	GEN 1 (3)	GEN 1	GEN 1	GEN 1	TR 1 GEN 2	TR 2 GEN 1 (3)	TR 1 GEN 2	ESS TR GEN 1	ESS TR GEN 1
AC BUS 1-1 lost	-	GEN 2	GEN 3	GEN 4	GEN 4	GEN 4	GEN 4	TR 1 GEN 2	TR 2 GEN 3	TR 1 GEN 2	ESS TR GEN 4	ESS TR GEN 4
TR 1 FAULT	NOT AFFECTED							TR 2 GEN 3 (2)	TR 2 GEN 3	TR 2 GEN 3 (2)	ESS TR GEN 1	ESS TR GEN 1
TR 2 FAULT								TR 1 GEN 2	TR 1 GEN 2 (2)	TR 1 GEN 2	ESS TR GEN 1	ESS TR GEN 1
TR 1 + 2 FAULT								-	-	-	ESS TR GEN 1	ESS TR GEN 1
ESS TR								TR 1 GEN 2	TR 2 GEN 3	TR 1 GEN 2	TR 1 GEN 2 (2)	TR 1 GEN 2 (2)
TR 1 FAULT and ESS TR FAULT								TR 2 GEN 3 (2)	TR 2 GEN 3	TR 2 GEN 3 (2)	-	-
TR 2 FAULT and ESS TR FAULT								TR 1 GEN 2	TR 1 GEN 2 (2)	TR 1 GEN 2	-	-

FFCS-01-24.10-020-A001AA

White compartments : Same supply as in normal configuration.
Shaded compartments : Back up supply.

 <i>Flieger ohne Grenzen</i>	ELECTRICAL		1.24.10	P 21
	DESCRIPTION		SEQ 100	REV 16

DISTRIBUTION TABLE (cont'd)

EMER CONFIG	AC BUS 1-1	AC BUS 1-2	AC BUS 2-3	AC BUS 2-4	AC ESS BUS	AC ESS GND	AC ESS SHED	DC BUS 1	DC BUS 2	DC BAT BUS ⁽⁴⁾	DC ESS BUS	DC ESS SHED	DC LAND REC	SHED LAND REC
• BATTERIES ONLY (in flight)	–	–	–	–	STAT INV BAT 1-2	–	–	–	–	–	BAT 1-2	–	BAT 1-2	–
• EMER GEN SUPPLIED BY ENGINE DRIVEN PUMP	–	–	–	–	EMER GEN	–	EMER GEN	–	–	–	ESS TR EMER GEN	ESS TR EMER GEN	ESS TR EMER GEN ⁽¹⁾	ESS TR EMER GEN ⁽¹⁾
• EMER GEN SUPPLIED BY RAT	–	–	–	–	EMER GEN	–	–	–	–	–	ESS TR EMER GEN	–	ESS TR EMER GEN ⁽¹⁾	–
ONGROUND	AC BUS 1-1	AC BUS 1-2	AC ESS BUS 2-3	AC BUS 2-4	AC ESS BUS	AC ESS GND	AC ESS SHED	DC BUS 1	DC BUS 2	DC BAT BUS	DC ESS BUS	DC ESS SHED	DC LAND REC	SHED LAND REC
BAT only, V>50 Kt	–	–	–	–	STAT INV BAT 1-2	–	–	–	–	–	BAT 1-2	–	BAT 1-2	–
BAT only, V<50 Kt	–	–	–	–	STAT INV BAT 1-2	STAT INV BAT 1-2	–	–	–	BAT 1-2	BAT 1-2	–	BAT 1-2	–

(1) Supplied when the LAND RECOVERY pushbutton is at ON.

(2) Lost in case of overcurrent on the faulty TR.

(3) In case of differential protection failure :
. The affected generator is not replaced ;
. The associated TR is switched off.

(4) Lost after 7 seconds.

	ELECTRICAL		1.24.10	P 22
	DESCRIPTION		SEQ 100	REV 16

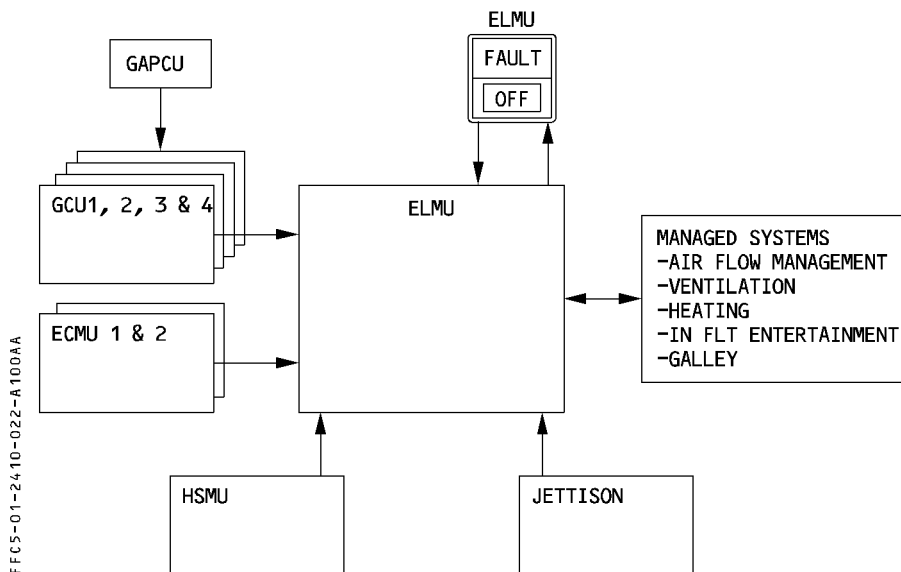
ELECTRICAL LOAD MANAGEMENT SYSTEM

The Electrical Load Management System (ELMS) is able to control the electrical supply of commercial loads to ensure optimum use of the available power sources.

ARCHITECTURE

The ELMS controls :

- Air flow management
- Ventilation
- Heating
- Inflight entertainment
- Galley



	ELECTRICAL DESCRIPTION	1.24.10	P 23
		SEQ 100	REV 16

ELECTRICAL LOAD MANAGEMENT

The ELMU (Electrical Load Management Unit) permanently monitors the power consumption of each main power source.

Shedding principle

In case of overload, the ELMU is capable of determining the overloaded power source and the overloaded value. Hence, the ELMU sheds some loads, based on the consumption priority criteria :
Finally, the ELMU is capable to shed the identified loads.

Note : *The overload situation may either result from engine/IDG loss, or from connection of too many consumers in degraded situations, or from heavy load demand.*

Reconnection principle

If some managed loads are candidates for the reconnection, the ELMU is able to determine the available power source on the concerned power source.

Hence, the ELMU first identifies the load to be reconnected, based on the consumption and priority criteria.

Finally, the ELMU is capable of reconnecting the identified loads.

Note : *The possibility of a reconnection may result from a connection of a new power source.*

Heavy load demand

Some load consumers are specifically-monitored :

- Electrical hydraulic pumps
- Jettison fuel pumps

In case the electrical hydraulic pumps or jettison fuel pumps are used, the ELMU may shed some loads, if necessary, to sustain the start and permanent consumption of these heavy-load consumers.