

JB Panels 777 Panel for Microsoft Flight Simulator X

The JB Panels 777 panel provides a functional high resolution panel option for 777 models running on FSX with Service Pack 2 (SP2) or Acceleration.

The 4:3 aspect ratio panel was designed at 2048 by 1536 pixels and will look best on displays of 1600 by 1200 pixels and up. The 16:9 aspect ratio panel is designed for 1920x1080 displays.

This document provides a description of the key features of the 777 Panel.

Revision 1.0 of the panel includes a Flight Management System (FMS). The FMS provides flight planning and control functions and access to navigational data contained in the FSX GPS database. Refer to the FMS document (JB777_FMS.pdf) for a description of the FMS and Control Display Unit (CDU) and the sample flight document (JB777_SampleFlight.pdf) for a usage example.

The readme.txt file included with this panel package provides installation instructions, information on aircraft model compatibility, and release notes.

Table of Contents

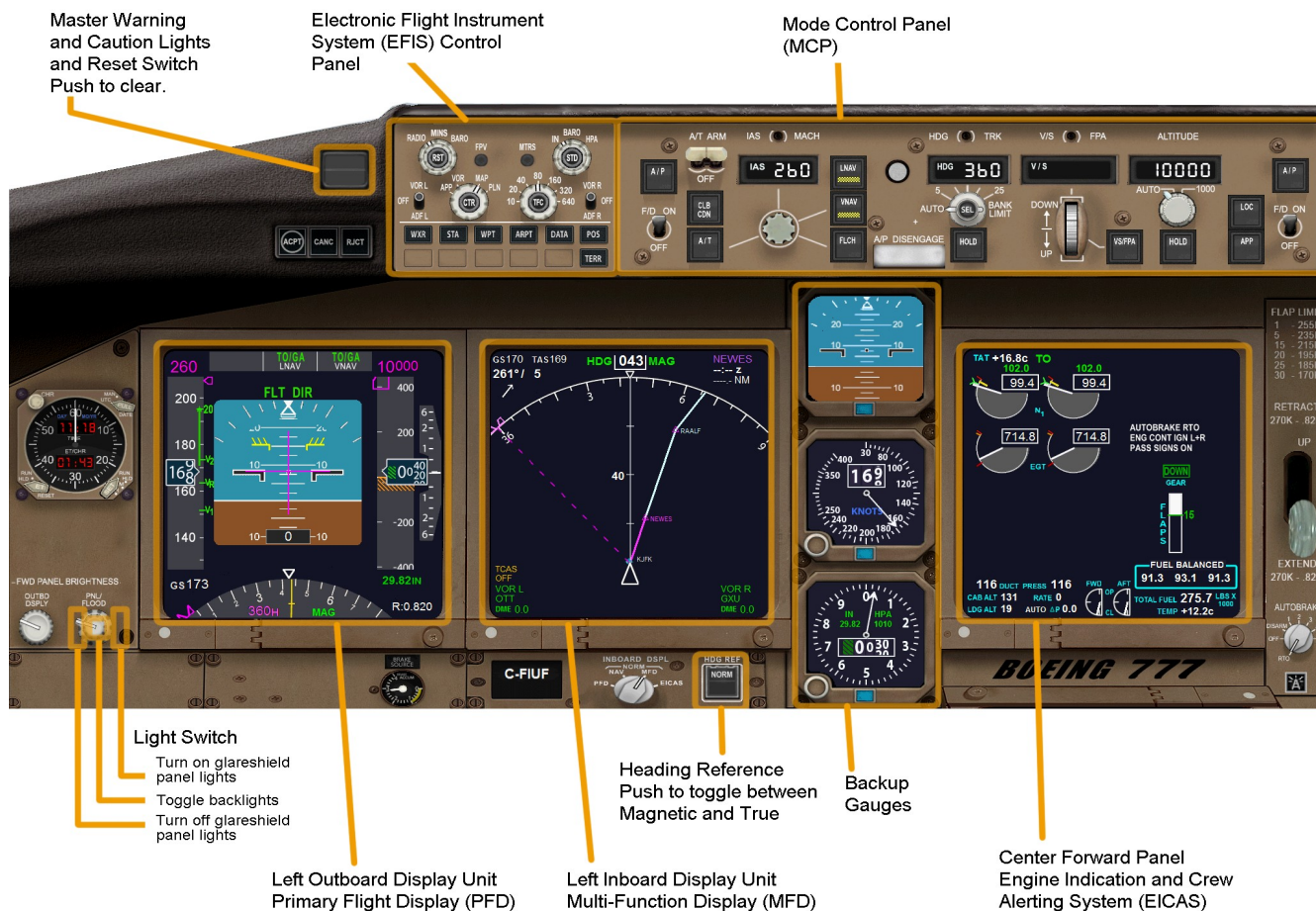
1	OVERVIEW.....	3
2	Electronic Flight Instrument System (EFIS) Control Panel.....	4
	EFIS Clickspots.....	5
	EFIS Barometric Reference Adjustment.....	6
	EFIS Map Buttons.....	7
3	Mode Control Panel (MCP).....	9
4	Display Switch Panel (DSP).....	12
5	Checklist Display.....	15
6	Primary Flight Display (PFD).....	18
7	Navigation Display (ND).....	19
8	Engine Indication and Crew Alerting System (EICAS).....	20
9	Ground Proximity Warning Panel.....	22
10	Inboard Display Selector.....	23
11	Icon Panel.....	24
12	Overhead Panel.....	25
	Electrical System.....	26
	Electrical Control Panel and Synoptic.....	28
	Hydraulic System.....	31
	Hydraulic Control Panel and Synoptic.....	32
	RAM Air Turbine.....	34
	Pneumatic (Air) System.....	35
	Air Control Panel and Synoptic.....	36
	Bleed Air.....	37
	Air Conditioning.....	38
	Pressurization.....	39
	Anti-Ice System.....	40
	Anti-Ice Control Panel and Displays.....	41
	Fuel System.....	42
	Fuel Control Panel and Synoptic.....	42
	Fuel Imbalance.....	44
	Fuel Jettison.....	45
	Engine Start and Control.....	47
	Engine Start Procedure.....	47
	Windmill Start.....	49
	Door Synoptic.....	50
	Gear Synoptic.....	51
13	Throttle Control Panel.....	52
14	EICAS Messages.....	53
	Warning Messages.....	53
	Caution Messages.....	54
	Advisory Messages.....	55
	Memo Messages.....	57
15	Autopilot Key Support.....	58

1 OVERVIEW

16:9 Aspect Ratio Panel Configuration



4:3 Aspect Ratio Panel Configuration

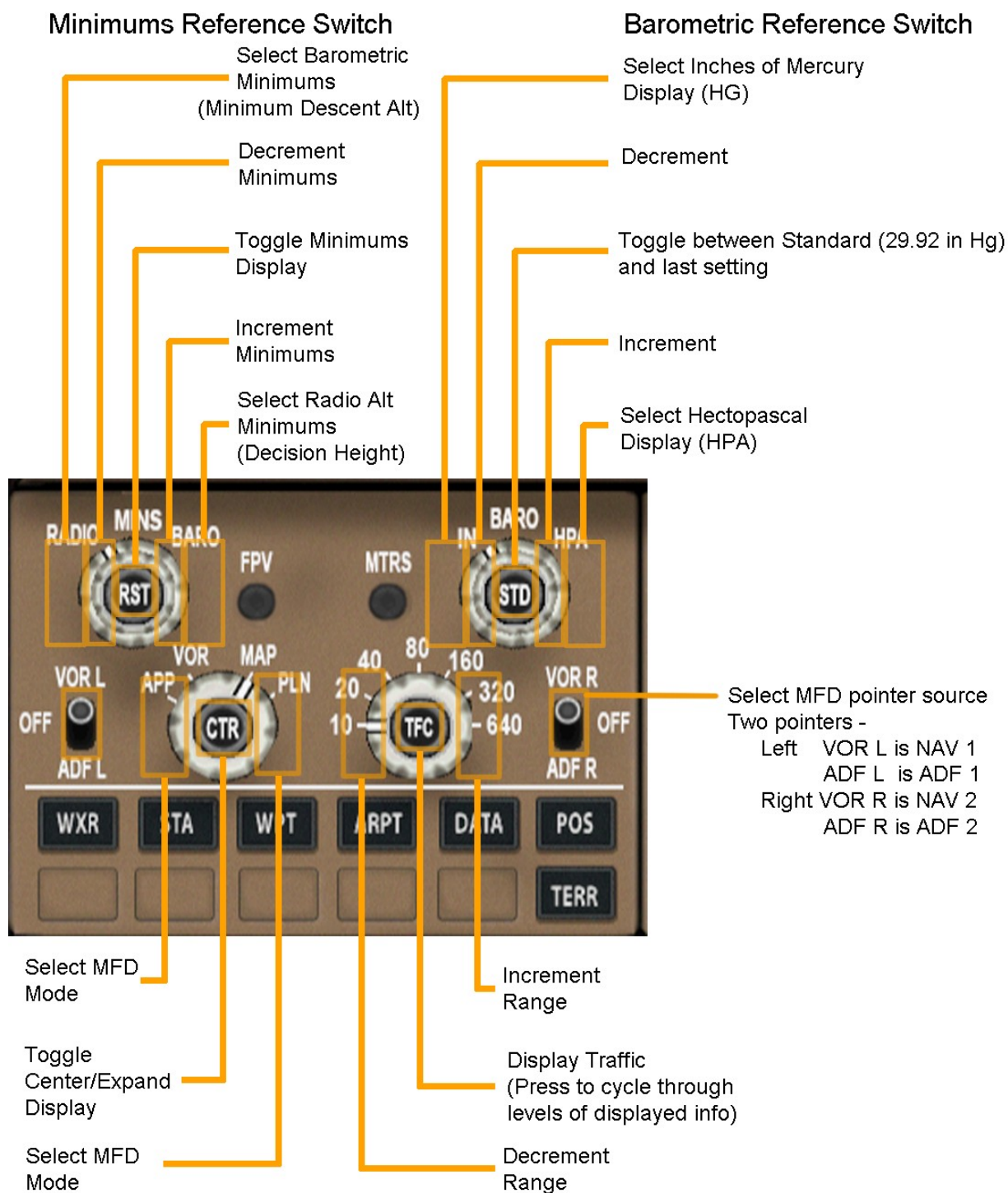


2 Electronic Flight Instrument System (EFIS) Control Panel

The EFIS control panel provides control for the following functions:

- minimum altitude alert settings for barometric or radio altitude. The mode and altitude selected appears on the PFD.
- Control of barometric pressure scale and setting. The scale and setting appears on the PFD.
- Flight path vector display (FPV). Not modelled.
- Metric altitude display. Not modelled.
- Select NAV display left and right bearing pointer radio source. There are two bearing pointers available on the NAV display that point to a VOR or ADF radio source. A VOR pointer is green. An ADF pointer is blue. VOR/ADF data is shown at the bottom left and right corners of the display.
- Select NAV display mode.
 1. APP – approach mode
 2. VOR – VOR track mode
 3. MAP – MAP mode (default)
 4. PLAN – North-up oriented MAP mode with the aircraft at the center
- Select MAP and PLAN mode range scale.
- Select centered or expanded display mode.
- Select traffic display.
- Select display of weather (not modelled), VOR and NDB stations, intersections, airports, flight path, position and terrain data when in MAP mode.

EFIS Clickspots



EFIS Barometric Reference Adjustment



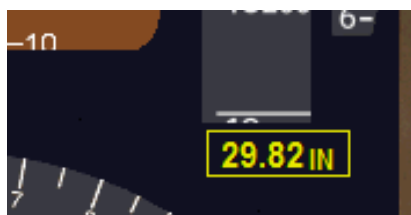
On the ground, the LAI provides feedback on proper barometric correction.

Position of LAI for correct baro reference.

Landing Altitude Indicator (LAI)

Barometer setting

The barometric reference setting on the PFD is amber with an alert box when passing the transition altitude (approximately 18000 feet).



When climbing past the transition altitude, press the baro reference STD switch to reference the standard setting of 29.92.



When descending below the transition altitude, press the baro reference STD switch to reference the corrected setting.

EFIS Map Buttons



The EFIS Map Buttons select info for display on the navigation display when in MAP mode.

WXR No-op (weather radar).

STA Display NDB and VOR stations.

WPT Display intersections.

APRT Display airports with towers and hard-surfaced runways.

DATA Cycles through various levels of information for the display elements.

POS Displays water masses in blue.

TERR Displays ground proximity data as a color coded relative altitude map.

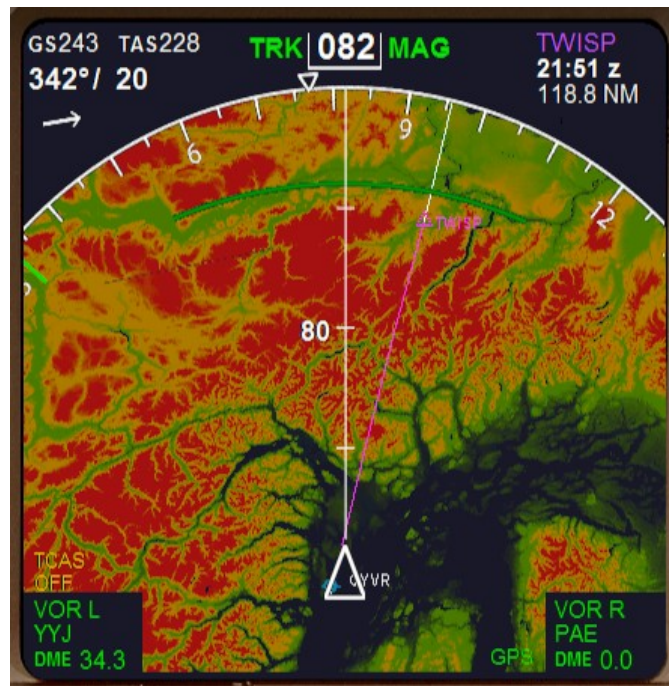
NO COLOR terrain elevation 2000 ft below current aircraft altitude (or water at unknown elevation – use POS display to determine water position)

GREEN terrain elevation less than 2000 ft and greater than 500 ft below current aircraft altitude

AMBER terrain elevation less than 500 ft below and not more than 1500 ft above current aircraft altitude

RED terrain elevation more than 1500 ft above current aircraft altitude

WHITE terrain elevation more than 10000 ft above SEA LEVEL - elevation relative to aircraft not shown

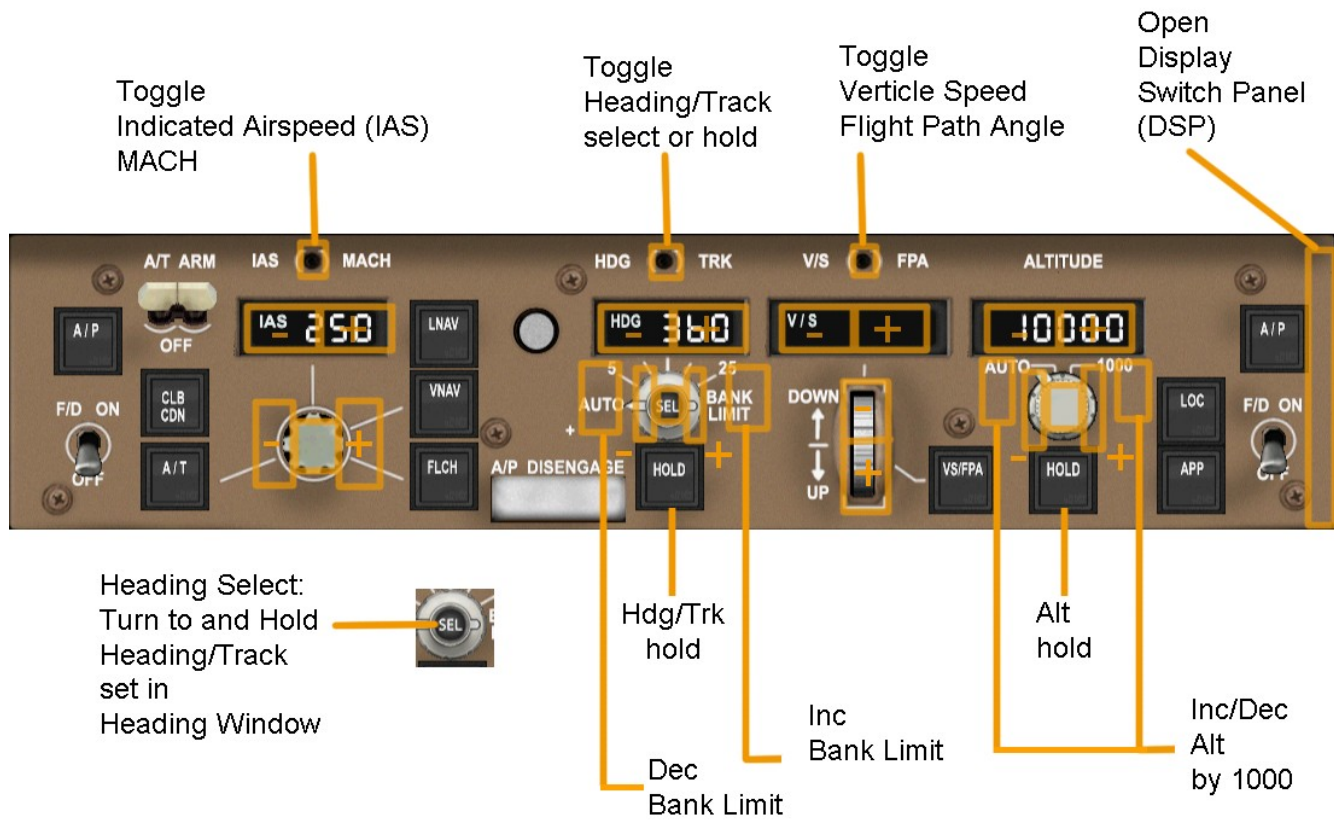


Navigation Display TERR Data

3 Mode Control Panel (MCP)

The MCP is the primary interface for control of the autopilot and flight director system. It provides mode and set data to the Primary Flight Display.

Mode Control Panel



- A/P** Engage the autopilot to control the roll and pitch of the aircraft according to the selected modes. Cannot be engaged below 50 ft AGL.
- Press a second time to disengage, or lower the A/P DISENGAGE bar, or push and hold control yoke/joystick past 60% of full throw.
- F/D ON** Display horizontal and vertical magenta bars on the PFD display to guide the pilot in manually maintaining aircraft attitude. When on the ground, turning on the flight director will set the autopilot to takeoff mode with takeoff/go-around (TO/GA) pitch mode 8 degree nose up, and TO/GA roll mode wings level.

A/T ARM	Arm the autothrottle
CLB/CON	Press to change the engine thrust limit to CLB (default 96% of N1)
A/T	Engage the autothrottle to command the throttle levers to maintain the speed set in the speed window. Speed limits override the setting in the speed window. Engages when TO/GA is invoked or VNAV or FLCH is pressed. Press a second time to disengage or move the throttle control lever(s). When climbing in IAS mode near mach 0.84, the autothrottle changes to mach mode. The current speed must be within 6 knots of the set speed. Conversely, when descending in mach mode at or above 310 knots, the autothrottle changes to IAS mode.
LNAV	Invokes the lateral navigation system to follow the loaded flight plan (LNAV). If no loaded flight plan, a radial can be tracked to/from a VOR signal received by NAV radio 1. Use the MFD VOR display mode and CRS click points on the MFD to set the radial. LNAV can be armed on the ground and will engage above 50 ft AGL if a flight plan is loaded or VOR signal is present. LNAV can be used with the FMS for lateral control when following a flight plan. Refer to the FMS document (JB777_FMS.pdf) for further details. For more free-form flying, use the FSX GPS rather than the FMS. LNAV can be used to fly an approach. Select, load and activate the approach using the GPS. If flying an ILS approach, set the ILS frequency in the NAV 2 radio to display the LOC and G/S pointers on the PFD. When lined up with the localizer, load the ILS frequency in the NAV 1 radio and press APP to arm the ILS approach autopilot. Ensure the vertical descent profile, or current altitude will intercept the G/S at least 5nm from the threshold as the G/S tracking controller takes some time to stabilize. Weight and speed will affect time to stabilize.
VNAV	Uses pitch and throttle to maintain or change altitudes. The autothrottle must be armed before VNAV can be engaged. VNAV has two modes of operation. With the FMS active (flightplan loaded and non-zero cruise altitude entered), VNAV allows the FMS to send altitude and speed control signals to the autopilot to follow a vertical flight path. Refer to the FMS document (JB777_FMS.pdf) for further details.

If the FMS is not active (no flightplan or zero cruise altitude entered), VNAV will follow the altitude set in the MCP altitude window. Altitude changes will occur when the set altitude is changed. The rate of climb/descent can be overridden by setting a V/S in the V/S window.

FLCH	Uses pitch and throttle to climb/descent to the altitude set in the altitude window. Once the altitude is reached, ALT HOLD mode is invoked. The rate of climb/descent can be overridden by setting a V/S in the V/S window. The autothrottle must be armed before FLCH can be engaged.
HDG HOLD	Commands wings level and holds the heading or track when wings are level.
HDG SEL	Turns to and holds the heading or track set in the heading window.
VS/FPA	Uses pitch to initiate a climb or descent at the rate set in the V/S window. Once the altitude set in the altitude window is reached, ALT HOLD mode is invoked. The typical operational sequence to change altitude using V/S pitch mode is set altitude in altitude window, set desired V/S in V/S window, then press VS/FPA to initiate the climb or descent. Use FPA mode to alter the pitch of the aircraft. First press VS/FPA, then set desired pitch in the FPA window. Unlike the prototype, FPA mode in this implementation simply controls the aircraft pitch not the flight path angle.
ALT HOLD	Holds the altitude of the aircraft when the button was pressed. The set altitude in the altitude window is unchanged.
LOC	Used to initiate a localizer only approach. Arms the localizer and activates it when the signal is present and the aircraft is within capture boundaries. When captured, the roll mode will change to LOC and the localizer heading will appear in the heading window. The localizer frequency must be entered into the NAV 1 radio. Recommend arming and intercepting at least 7 nm from the threshold.
APP	Arms localizer and glideslope track modes. The aircraft will capture and track the localizer and glideslope beams. If the approach continues, the aircraft will land automatically. At 1500 ft AGL “LAND 3” will display on the PFD and ROLLOUT and FLARE modes will arm. If the localizer and/or glideslope deviation are not within acceptable bounds at 600 ft AGL, the autoland mode will disengage and “NO AUTOLAND” will be displayed on the PFD. In order to capture the glideslope, the aircraft must first capture the localizer and then intercept from below the glideslope beam. The ILS

frequency must be entered into the NAV 1 radio. Recommend arming and intercepting at least 7 nm from the threshold.

A/P DISENGAGE When the bar is down, the autopilot is prevented from engaging. Toggle the bar down and up to clear an “AUTOPILOT DISCONNECT” EICAS warning message.

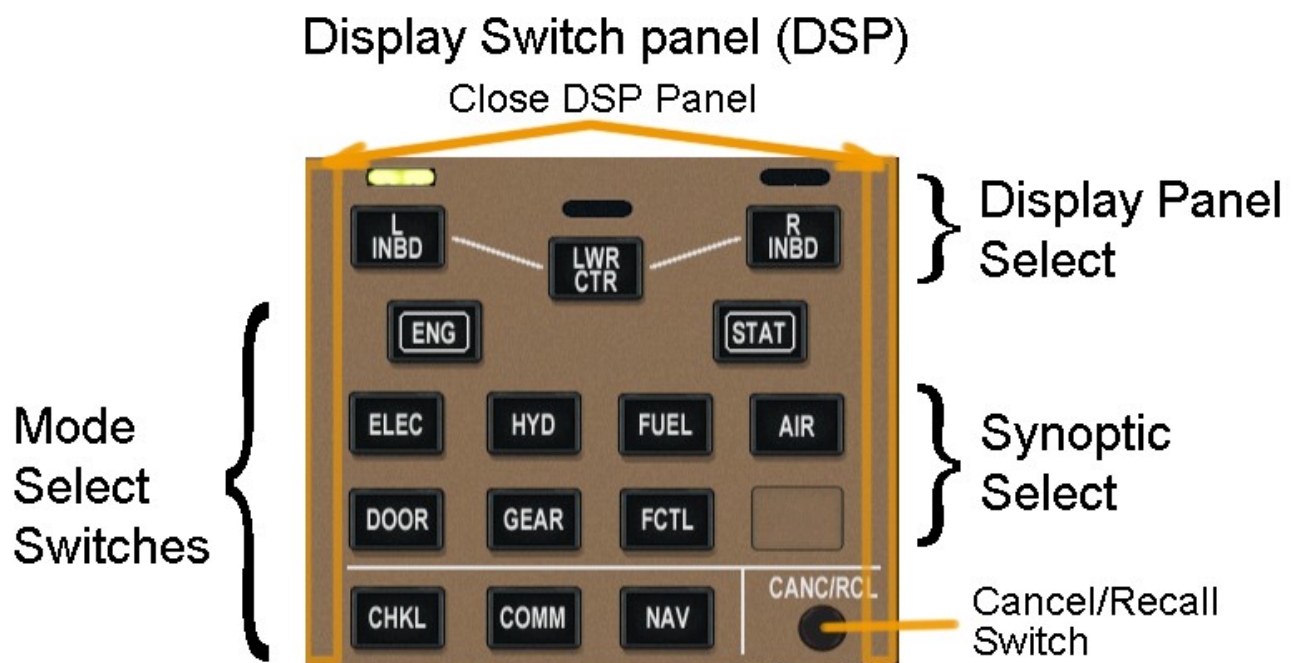
4 Display Switch Panel (DSP)

The DSP provides the ability to select various status, navigation and synoptic pages for display on the left and lower center display units.

The panel can be opened by pressing shift+7 or clicking on the hotspot on the far right of the MCP on the 4:3 panel. The 16:9 panel has the DSP integrated into the main panel.

This release implements the left inboard (L INBD) and lower center (LWR CTR) displays.

All synoptic displays are implemented. Refer to the Overhead panel systems section for more information.



Display Panel Select

Select Left Inboard Display (L INBD) or lower center (LWR CTR) display. Then select desired page to display. Pressing a mode select button a second time will return to the Navigation Display on the L INBD or the secondary engine display on the LWR CTR.

ENG/STAT Select

ENG Display the secondary engine format. Toggles display of detailed engine stats on the EICAS.

STAT Status page is not implemented.

Synoptic Select

ELEC Display the electrical synoptic.

HYD Display the hydraulic synoptic.

FUEL Display the fuel synoptic.

AIR Display the air synoptic.

DOOR Display the door synoptic.

GEAR Display the gear synoptic.

FCTL Display the flight controls synoptic.

Page Select

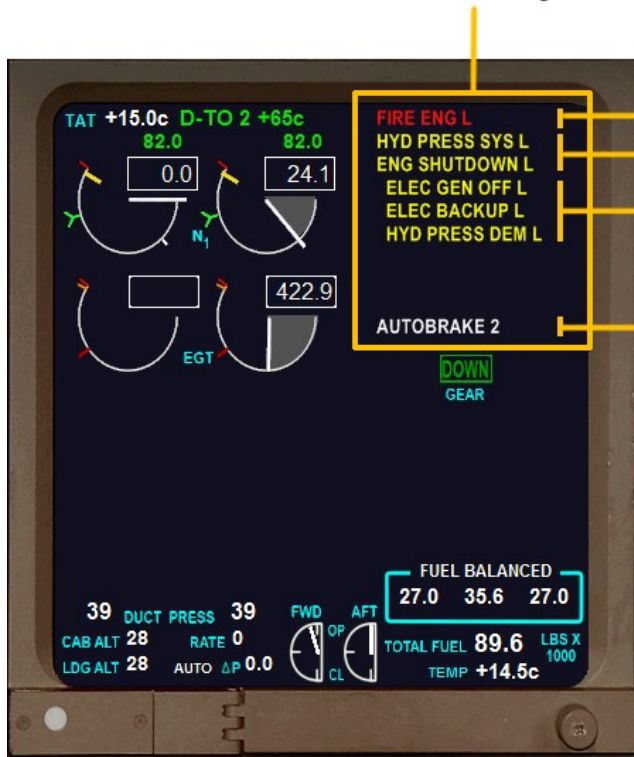
CHKL Display the checklists display.

COMM Communications function not implemented.

NAV Display the navigation display on the L INBD. To improve efficiency and frame rates, the navigation display cannot be displayed on the LWR CTR display.

CANC/RCL Cancel/Recall switch is used to cancel or recall EICAS messages in the upper right quadrant of the display. Warning and Memo messages are not cancelled. If multiple pages of messages exist, pressing this switch will display the next page. When the last page has been cancelled, pressing the switch again will recall the first page of messages if they still exist.

EICAS Message Area



Warning Messages (RED) at the top

Caution Messages (Amber)

Advisory Messages (Amber) indented following Caution messages

Memo Messages (White) at the bottom

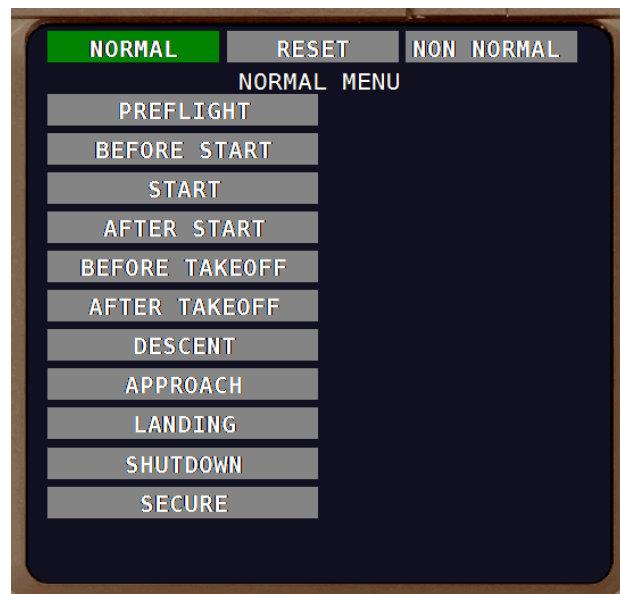
5 Checklist Display

Checklists can be displayed on the left inboard (L INBD) or lower center (LWR CTR) display using the DSP CHKL switch.

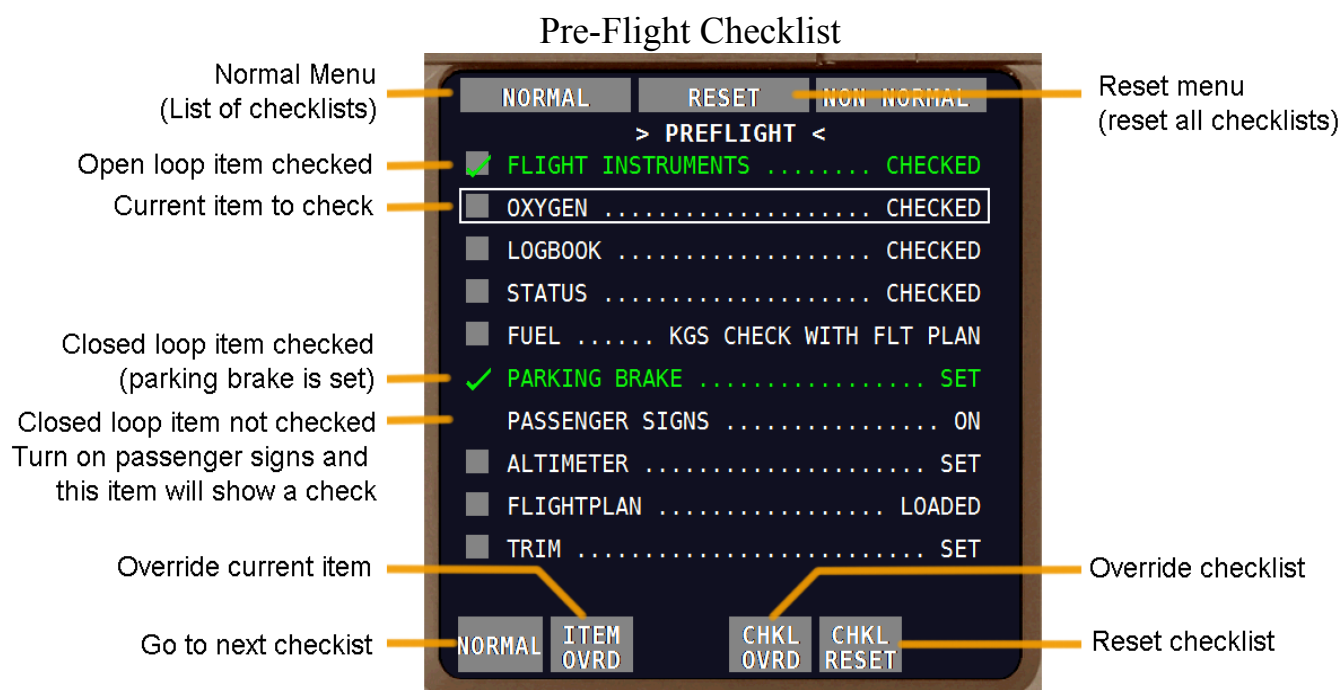
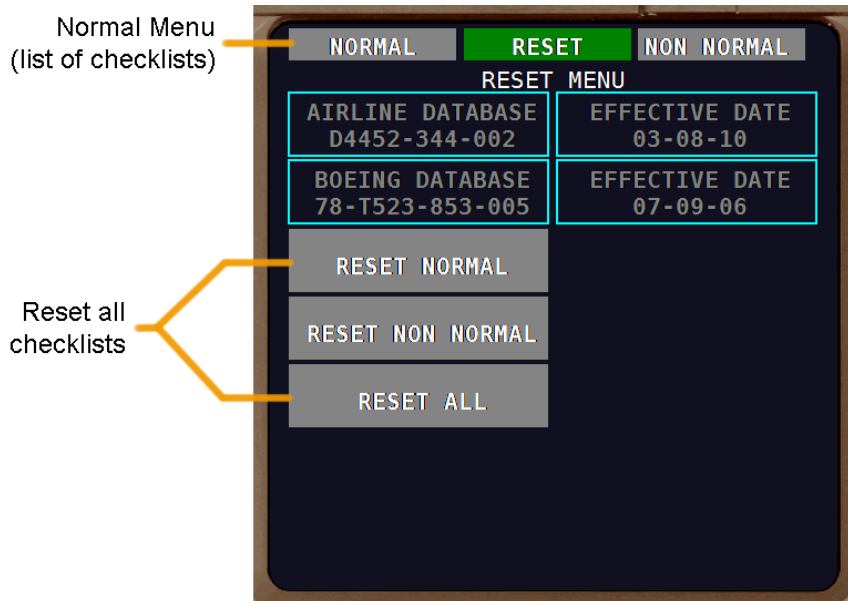
The checklist display implements normal checklists that are used to aid the crew in the operation of the aircraft under normal conditions. They ensure that important procedural steps have been completed. They are usually customized according to specific airline procedures. The checklists implemented with this panel take into consideration the limits of FSX and this panel.

Checklists are arranged according to phase of flight. Click on 'NORMAL' on the top left corner to open the list of checklists. Then click on the checklist to open it.

Normal Menu: List of checklists



Reset Menu: Reset all checklists



Checklists contain two types of check items: open-loop and closed-loop.

Open-loop check items are preceded by a grey square. They must be checked by clicking on the item.

Closed-loop check items do not have the grey square. They are linked to the switch or simulation condition that is required to satisfy the check item. When the condition satisfies the check item, the item is checked.

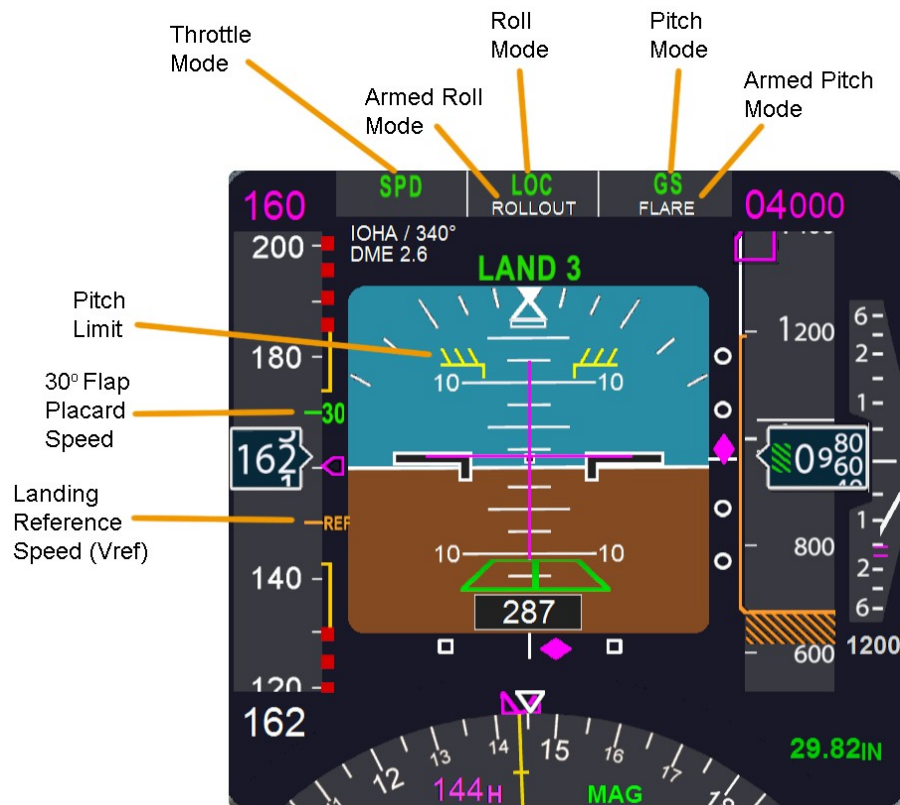
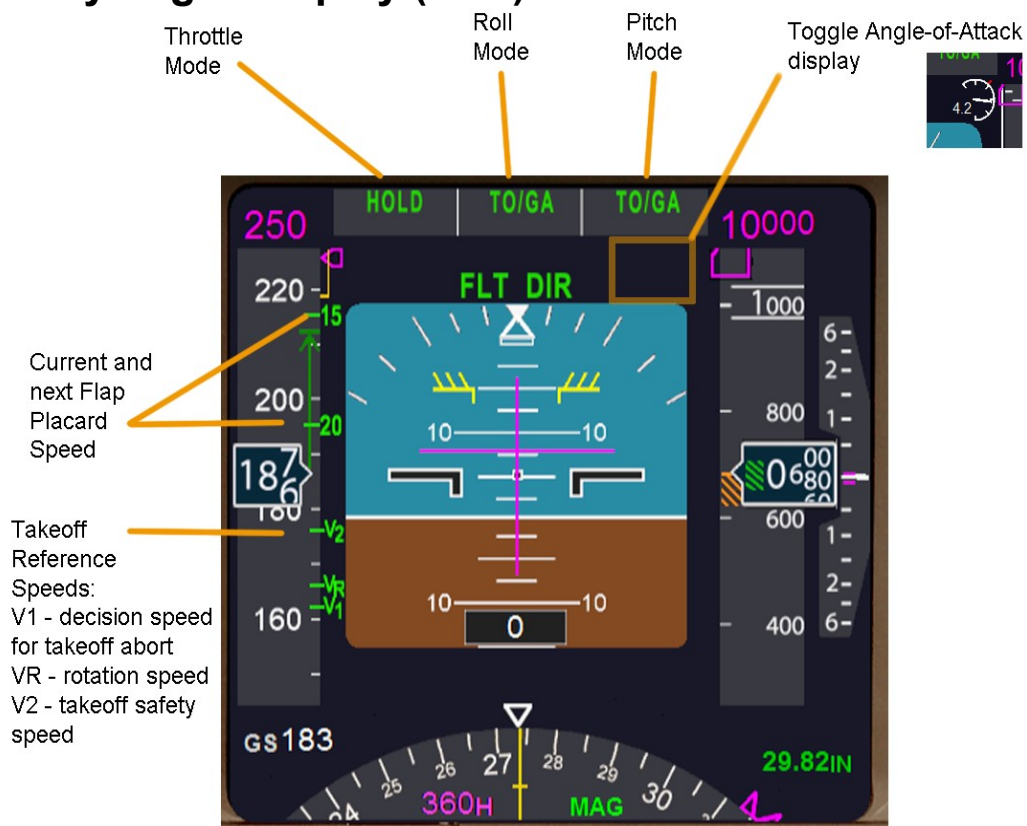
A white box surrounds the next item to check. It may be an open-loop or closed-loop item. The item may be overridden by clicking on the 'ITEM OVRD' click-box at the bottom of the display.

Check items may be checked in any order. When all items have been checked or overridden, the checklist is complete and locked. Click the 'NORMAL' click-box at the **bottom** of the display to go to the next checklist.

A different display can be selected with the DSP at any time during the checklist. The checklist can be recalled at it's current position by selecting the display (L INBD, LWR CTR) then pressing the CHKL button. The panel maintains a single checklist state object which can be displayed on either or both displays.

Checklist completion or lack thereof does not affect the operational aspects of the simulation.

6 Primary Flight Display (PFD)



7 Navigation Display (ND)

Clickspots are provided on the ND to adjust the course pointer when in approach (APPR) or VOR modes.



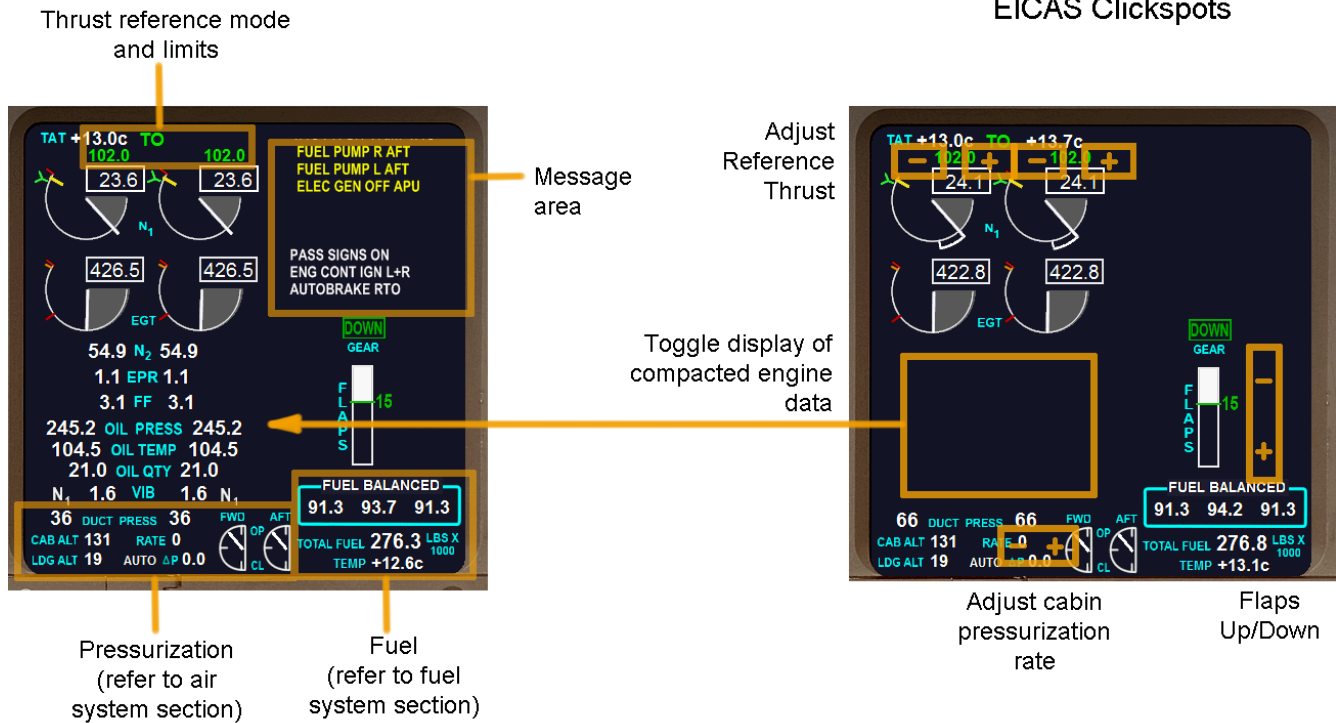
8 Engine Indication and Crew Alerting System (EICAS)

The EICAS is setup with a configuration that would typically be used for 777s with GE-90 series engines. N1 and EGT are displayed full time. Thrust reference is based on N1 setting.

The EICAS provides the following information:

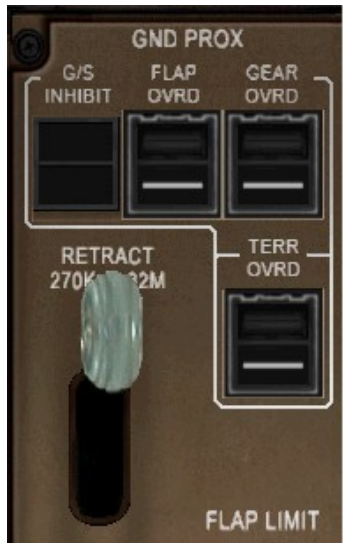
- Total air temperature and assumed temperature
- Thrust reference mode
 1. TO - Takeoff with default thrust reference N1 of 102%
 2. CLB - Climb with default thrust reference N1 of 96%
 3. CRZ - Cruise with default thrust reference N1 of 94%
 4. GA - Go Around with default thrust reference N1 of 98%
 5. GA-2 - Go Around thrust limit mode
- Thrust Reverser indication
- Engine operating parameters (General Electric 90 engine layout)
- Anti-ice indication
- Alerting messages
- Windmill engine start envelope
- Pressurization and fuel status
- Gear and flap position

EICAS Clickspots



9 Ground Proximity Warning Panel

The ground proximity warning panel provides control and indication of ground proximity alerting system.



- | | |
|--------------------|--|
| G/S INHIBIT | <p>When pressed, ground proximity warning due to excessive deviation below glide slope is suppressed.</p> <p>The FSX GPWS aural tones are also suppressed.</p> <p>A GPWS section is required in the aircraft.cfg file of the aircraft model in order to activate the FSX GPWS system. Refer to the FSX Simobject Container SDK: Aircraft Configuration Files section for additional information.</p> |
| FLAP OVRD | <p>When pressed, the 'CONFIG FLAPS' EICAS alert message is suppressed. The OVRD light illuminates.</p> <p>Normally the warning is displayed when the aircraft is configured for landing and the flaps setting is less than 20 degrees.</p> |
| GEAR OVRD | <p>When pressed, the 'CONFIG GEAR' EICAS warning message is suppressed. The OVRD light illuminates.</p> <p>Normally the warning is displayed when the aircraft is configured for landing and the landing gear is not down.</p> |
| TERR OVRD | <p>When pressed, terrain proximity warnings are suppressed. The OVRD light illuminates.</p> |

10 Inboard Display Selector

The inboard display selector is used to select the display format for the inboard display unit. It is located on the main panel below the left inboard display unit.



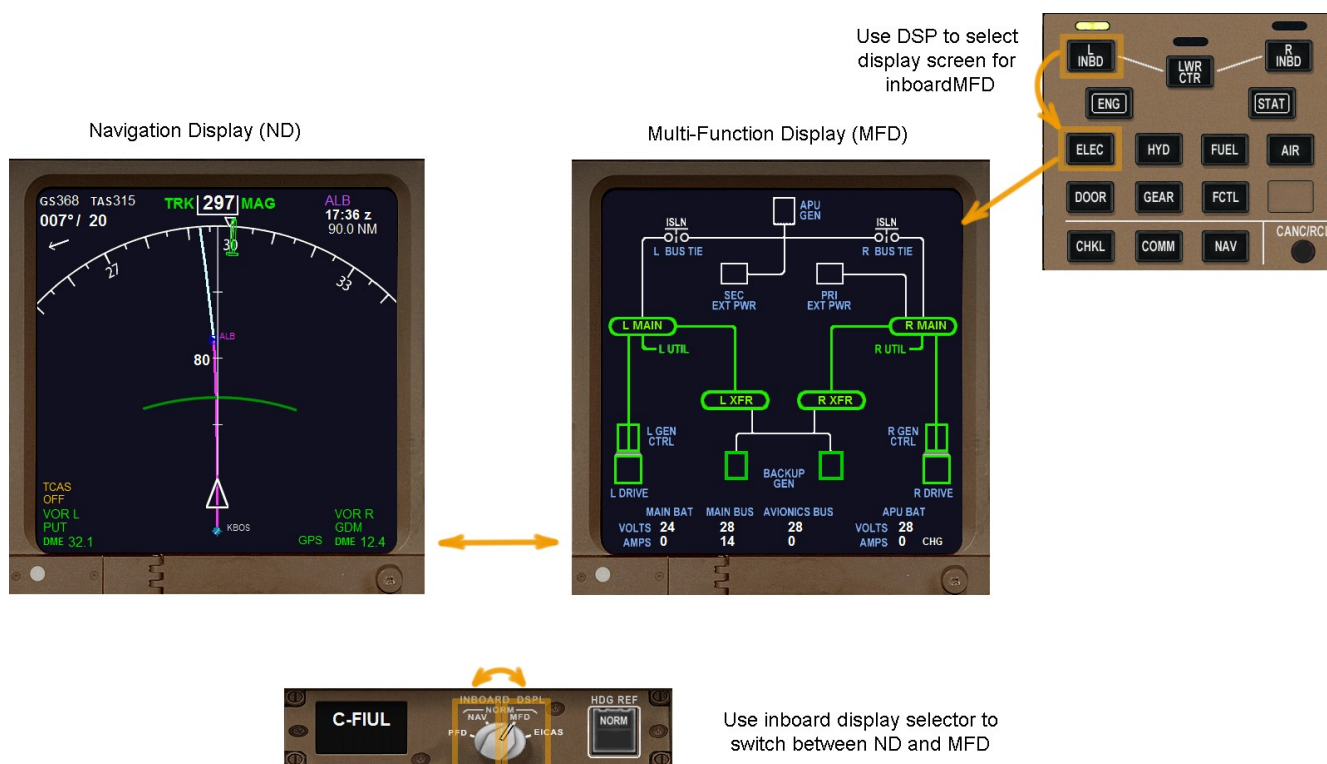
PFD No-op.

NAV Display the navigation display.

MFD Display the Multi-Function display (MFD). The MFD can display any page format (navigation display, synoptics, secondary engine display, or checklists).

EICAS No-op.

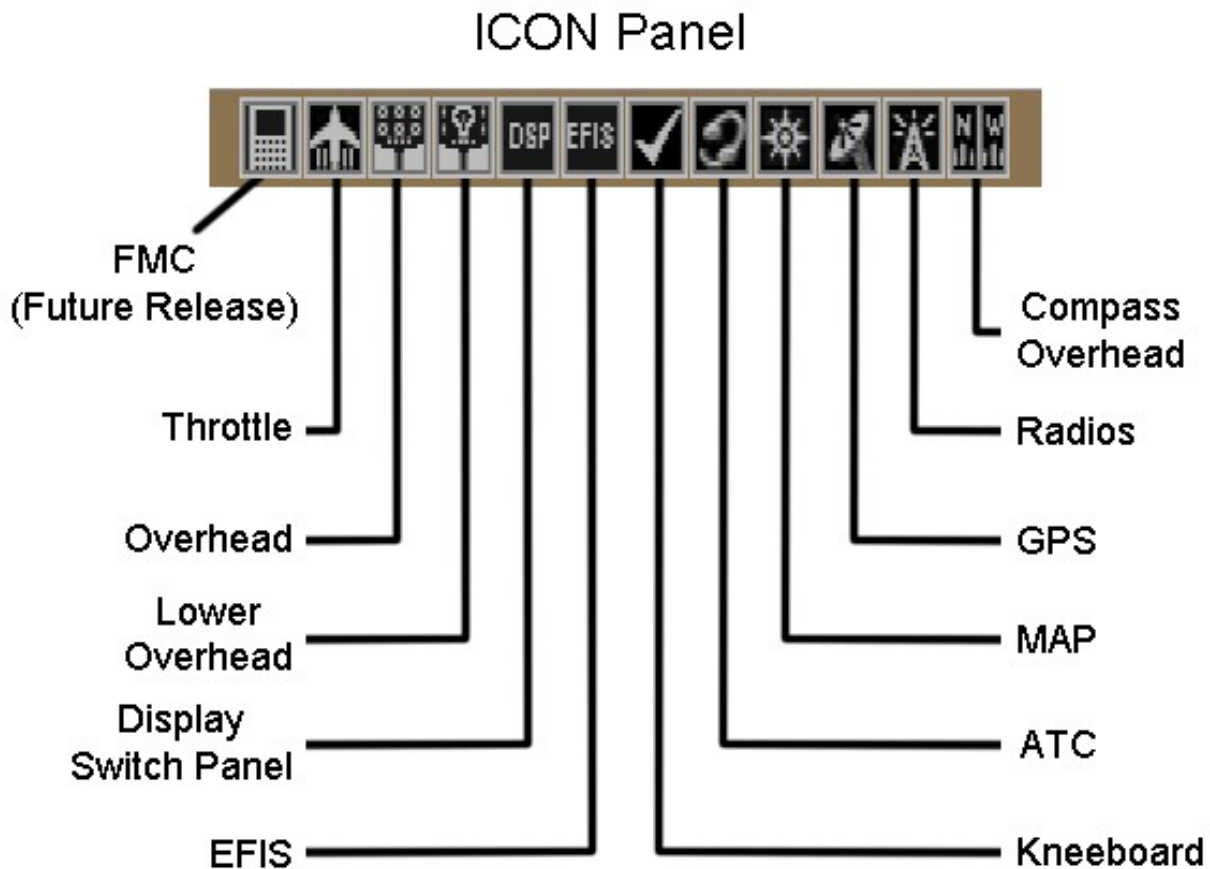
Example of use of the inboard display selector (IDS). The MFD is setup to display the electrical synoptic. The IDS then can be used to switch between synoptic and navigation display.



11 Icon Panel

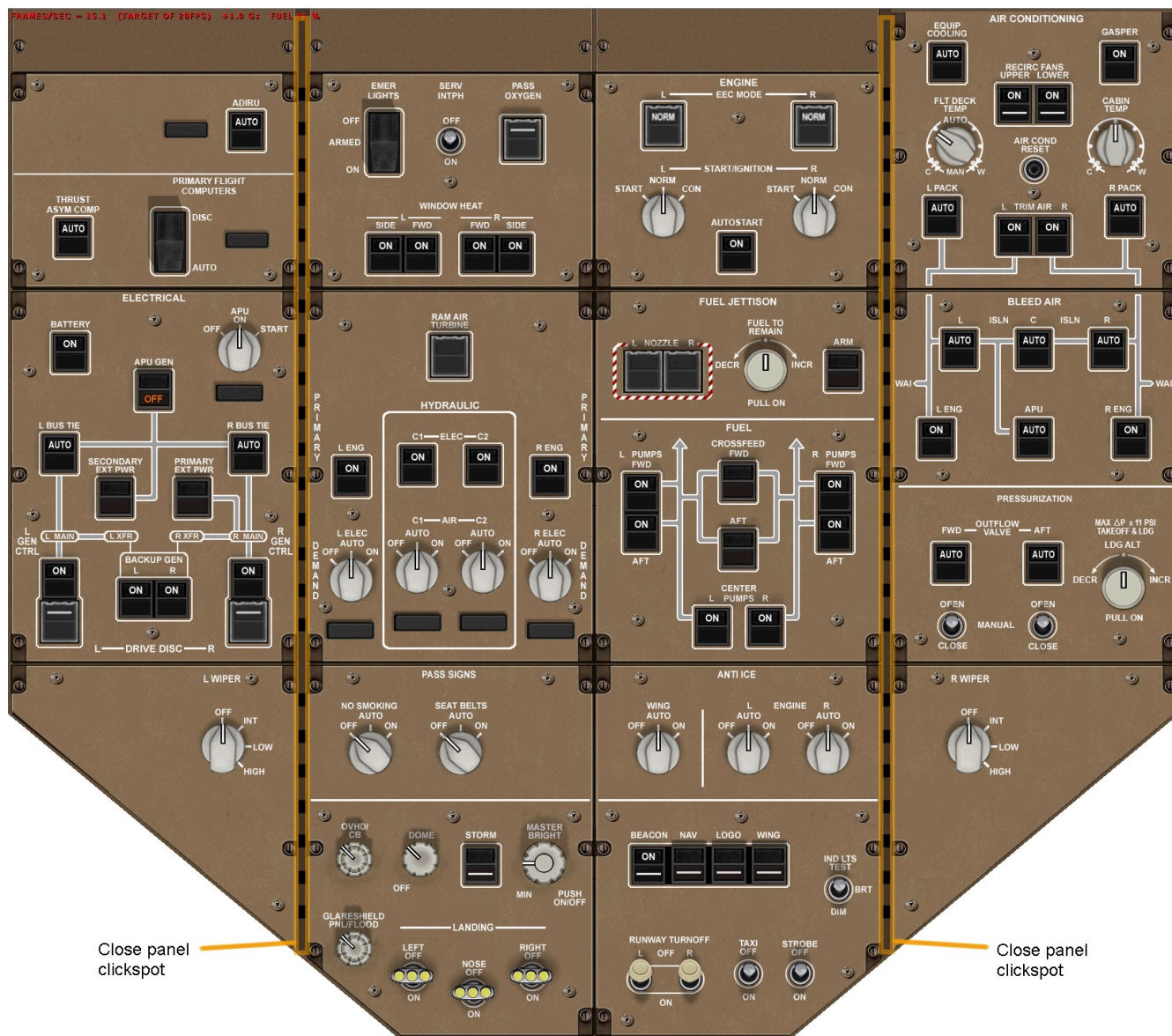
The small icon panel normally appear at the upper center of the display. It allows selection of the sub-panels. Useful for controlling gauges when using the VC.

Press shift+9 to toggle display of the icon panel.



12 Overhead Panel

The overhead panel provides control of the aircraft systems. Use the overhead panel icon or press shift+5 to display the overhead. The 16:9 panel segments the overhead into an upper and lower section. An icon is provided for each segment or press shift+5 for the upper section or shift+6 for the lower section.



Guarded Pushbutton Access

Several switches have plastic guards covering them to prevent their accidental operation. A two step process is required to operate the button or switch.

First open the guard, then press/toggle the switch.

To flip the guard open or closed, right-click the mouse over the switch. To toggle the switch, left-click the mouse.



Electrical System

The electrical power system consists of power sources and consumers connected together via electrical buses. Alternating Current (AC) buses carry power to AC devices and Direct Current (DC) buses carry power to DC devices. Rectifiers convert AC power supplied by generators to DC and when required, inverters convert DC power supplied by batteries to AC.

The system normally operates as two independent left and right power channels. However the channels can be connected together to share power sources when required. Automatically controlled Bus Tie breakers (BTB) connect channels together.

The power sources controlled and simulated by this panel are:

- Main Battery
- Engine powered generators
 - Main integrated drive generator (IDG)
 - Backup generator
- Auxiliary Power Unit (APU) generator
- External Power Sources (ground power)
- Ram Air Turbine Generator (RAT)

The main power sources are the engine IDGs and APU generator and, when on the ground, the external power sources. Backup power is supplied by the engine backup generators.

Standby power is supplied by the main battery and RAT.

The main battery has a very limited capacity in FSX and will typically last 10 to 15 minutes. When the voltage drops to approximately 17 volts, the panel will go dark. The battery load and charge/discharge status is shown on the electrical synoptic. With a dark

panel and main battery discharged, the APU can be started to restore power and begin re-charging the main battery.

The RAT is an air-driven turbine with a 1 meter diameter propeller that supplies standby power when there is a loss of ac power. It also has a hydraulic pump (refer to the hydraulic systems section for more info).

The RAT deploys automatically from the underside of the center fuselage area behind the right wheel well when the airspeed is greater than 80 knots and either of the following conditions exist:

- loss of backup power
- low hydraulic pressure in the center hydraulic system

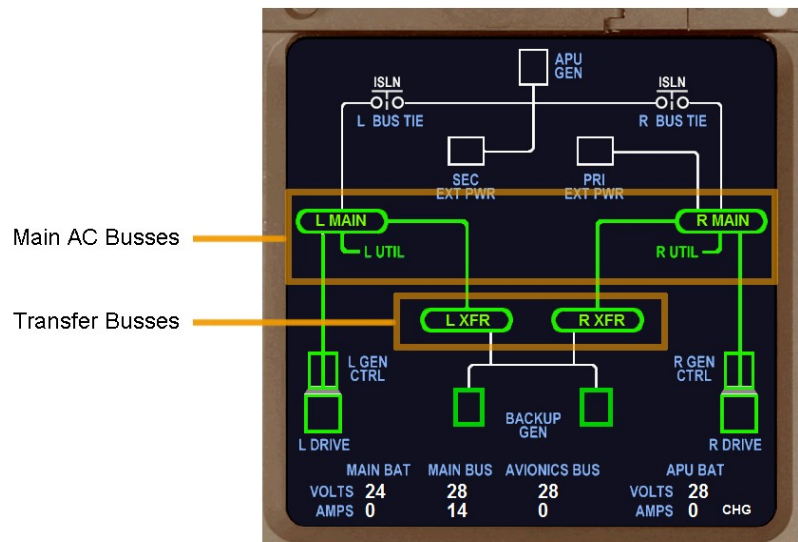
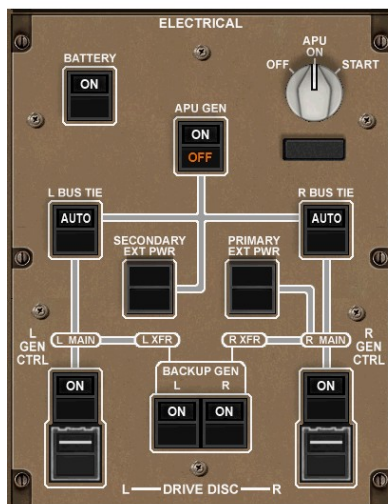
The RAT can also be deployed manually using the RAM switch on the hydraulic control panel. Once deployed, it cannot be stowed while the aircraft is in flight. On the prototype, the RAT is stowed on the ground using controls located in the right wheel well. In this implementation, the RAT will stow automatically when the airspeed is below 30 knots.

Electrical Control Panel and Synoptic

The electrical control panel controls the aircraft electrical systems. The electrical synoptic provides a simplified view of the system. It is displayed on the MFD using the ELEC switch on the DSP.

The synoptic displays power sources as green boxes and powered buses and connections as green symbols and lines. Un-powered connections are white and limited or standby powered connections are amber.

The main battery and RAT are not shown on the synoptic. When active they power the standby transfer bus.



BATTERY Connect the main battery to the battery bus to supply backup dc power and limited standby ac power via the static inverter.

APU Start control for the Auxiliary Power Unit (APU). The APU is a self contained turbine engine located in the tail of the aircraft. It has an ac generator that can provide backup or supplemental power for the ac and dc systems. It can supply bleed air up to an altitude of 22000 feet.

OFF APU is turned off. If the APU is running when the switch is turned to the OFF position, it will enter a cool-down period of approximately 95 seconds and the bleed air valve will close. After which the APU will shutdown. An EICAS memo message APU COOLDOWN displays while the APU is in the cool-down period.

ON APU is able to run. The APU will start automatically when the

aircraft is airborne if not already running. The APU will run normally if the switch is turned from OFF to ON while the APU is in the cool-down period.

START Momentary switch position initiates the APU automatic start sequence. The APU has an electrical starter and pneumatic turbine starter. Preference is given to the turbine starter if sufficient air duct pressure is available. The APU has a battery that powers the electric starter if required.

BUS TIE Controls the connection between left and right main ac buses. Normally pushed in to the AUTO position allowing the ac power control system to manage bus isolation based on the available power sources.

EXT PWR Connects external power sources, when available, to the main ac bus(es). Two power sources, primary and secondary, may be connected. When an external power source is available, a green AVAIL light will illuminate. Push the switch to connect the power source and a green ON light will illuminate.

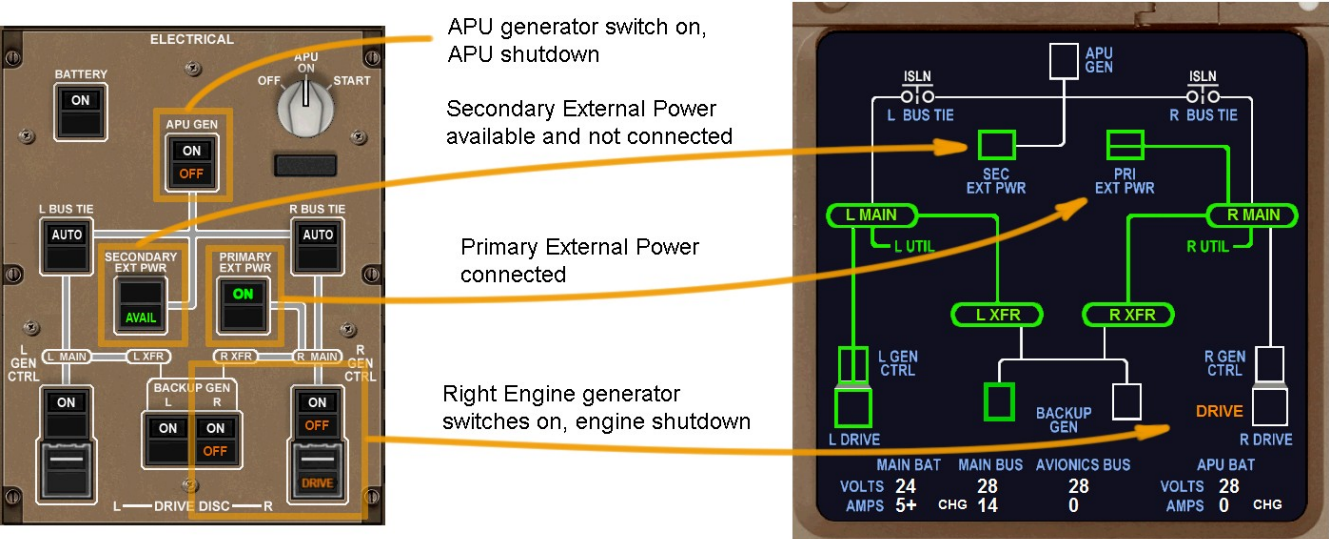
External power is available automatically several minutes after the aircraft has stopped and the parking brake has been set.

GEN CTRL Control the engine integrated drive generator (IDG). Each engine has an IDG that normally supplies power to one side of the electrical system. In the pushed in, ON position, the IDG can be connected to the electrical bus by the power management system.

DRIVE DISC Guarded switch that, when pushed, disconnects engine gear drive from the IDG thus disabling it. On the prototype ground maintenance service is required to reconnect the drive. In this implementation, pushing the switch again reconnects the drive.

BACKUP GEN Control the engine backup generator. Each engine has a backup generator that supplies power to the transfer bus when there is a loss of power or during system redundancy such as during autoland. In the pushed in, ON position, the backup generator control system is armed.

Electrical Panel and Synoptic Example



Hydraulic System

The hydraulic systems provide pressurized hydraulic fluid to power the following systems:

- Flight controls
- Main and nose gear steering
- Wheel brakes
- Spoilers
- Leading edge slats
- Trailing edge flaps
- Gear actuation (raise and lower)
- Thrust reversers

There are three hydraulic systems: left, center and right. Each operates independently and has a reservoir and primary and demand pumps.

Primary pumps operate continuously while demand pumps operate when additional capacity is required or anticipated. Demand pumps also operate when the primary pumps are inoperative. The center hydraulic system also has a RAM air turbine driven pump that operates when center hydraulic pressure is low.

The pump allocation for each hydraulic system is as follows:

System	Mode	Pump	Type
Left	Primary	L ENG	Engine driven
	Demand	L ELEC	Electric
Center	Primary	C1	Electric
	Primary	C2	Electric
	Demand	C1	Air
	Demand	C2	Air
	Demand	RAT	Air-turbine
Right	Primary	L ENG	Engine driven
	Demand	L ELEC	Electric

Demand pump activation occurs when slats, flaps or gear is actuated. Anticipated

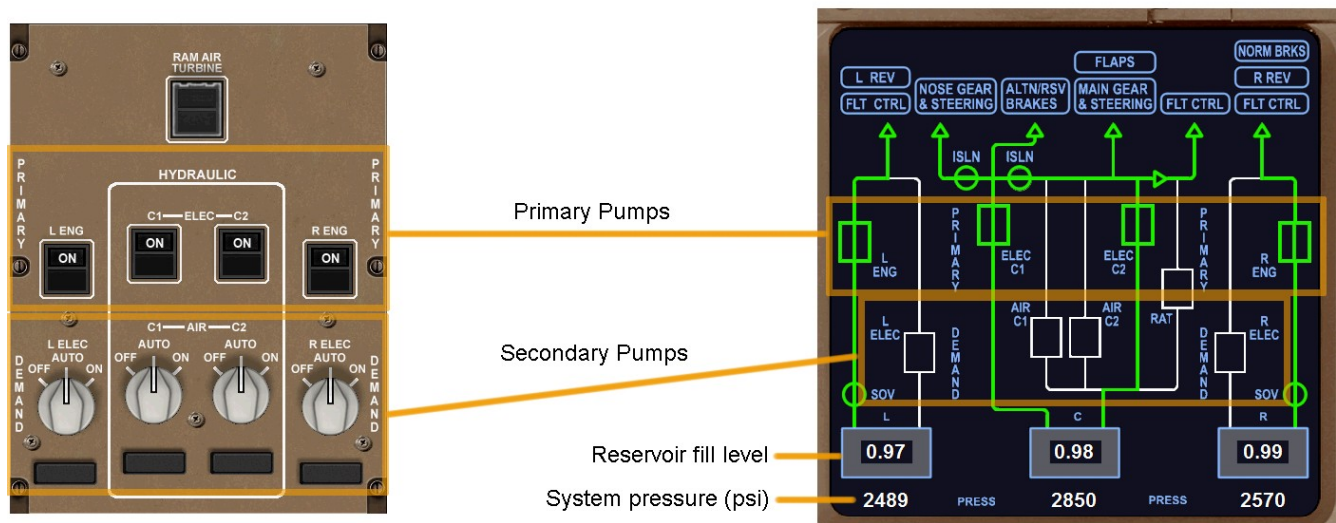
demand actuation occurs during takeoff roll and prior to touchdown. Refer to the hydraulic synoptic for pump status.

Hydraulic Control Panel and Synoptic

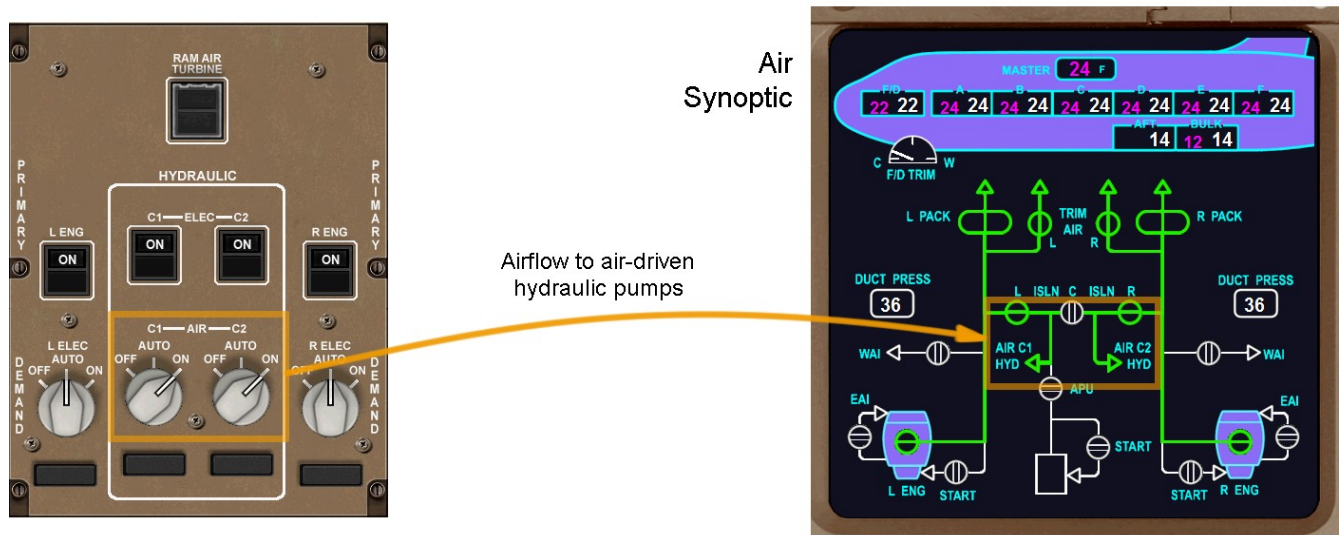
The hydraulic control panel provides control of and status for the hydraulic pumps. Normally, the primary pump switches are ON and the demand pump switches are set to AUTO. When set to AUTO, the pumps operate in demand mode and the hydraulic interface module controls their operation. When set to ON the pumps operate continuously. When set to OFF the pumps do not operate.

Each switch has a FAULT light that illuminates when the pump is switched off, the pump is inoperative due to lack of power, or pump output pressure is low.

The hydraulic synoptic shows hydraulic system status and pump state. Pressurized flows are shown in green. Active pressurized pump is a green box.



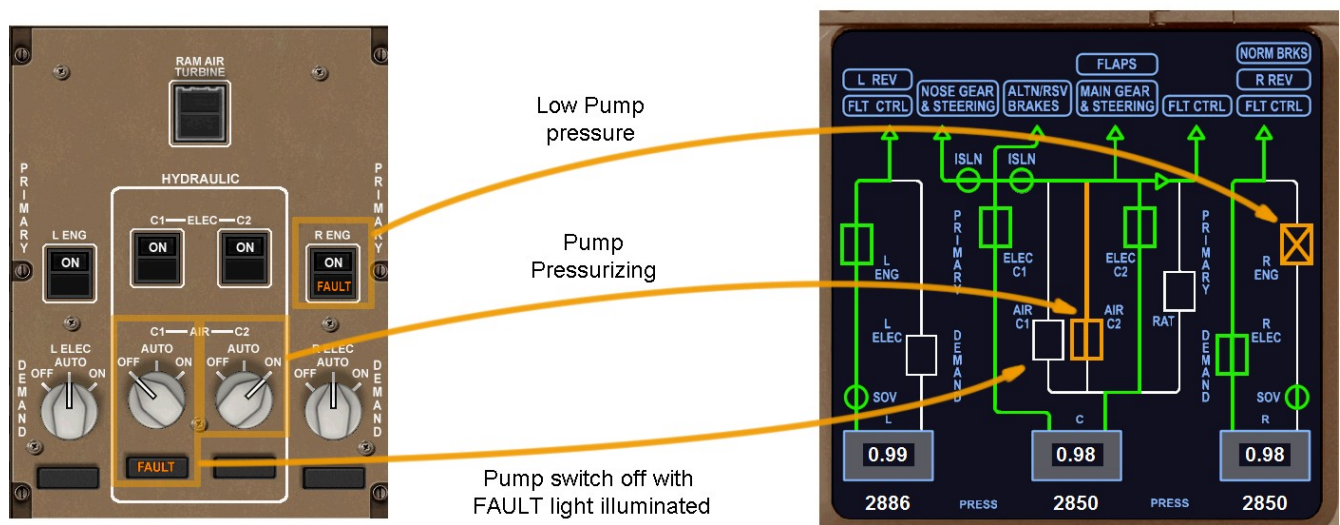
Airflow for the center air-driven pumps, C1 and C2 is shown on the air synoptic.



Hydraulic system failures can be simulated with the FSX aircraft failure menu. Use the ALT key to display the menu, select AIRCRAFT and in the drop down list select FAILURES.

Hydraulic Panel and Synoptic Example

In this example the right engine is shutdown. The right demand pump is operating to provide right hydraulic system power. The Center 2 (C2) demand pump is set to operate continuously. The Center 1 (C1) demand pump is off with fault light illuminated.



RAM Air Turbine

The RAM air turbine (RAT) supplies an emergency source of hydraulic power when the center hydraulic system pressure is low. It also has an electric generator (refer to the electrical systems section for more info).

The RAT is an air-driven turbine with a 1 meter diameter propeller.

The RAT deploys automatically from the underside of the center fuselage area behind the right wheel well when the airspeed is greater than 80 knots and either of the following conditions exist:

- loss of backup power
- low hydraulic pressure in the center hydraulic system

The RAT can also be deployed manually using the RAM switch on the hydraulic control panel. The switch has an unlock light (UNLCK) that displays when the RAT is deployed. The switch also has a hydraulic pressure light (PRESS) that illuminates when the RAT hydraulic pump is pressurized. The switch is guarded. Right-click to open/close the guard.



RAM Air Turbine Switch

Once the RAT is deployed, it cannot be stowed while the aircraft is in flight. On the prototype, the RAT is stowed on the ground using controls located in the right wheel well. In this implementation, the RAT will stow automatically when the airspeed is below 30 knots.

Pneumatic (Air) System

The pneumatic system supplies a source of compressed air (bleed air) used to:

- pressurize the cabin
- start the engines and APU
- heat/cool cabin, cargo area and equipment
- power air driven pumps
- provide a heat source for anti-ice systems

The sources of compressed air are:

- engine compressors
- APU compressor
- ground air cart

The engine compressors are the main source of bleed air.

The APU can supply bleed air to all sources and start the engines up to an altitude of 22000 feet.

The ground air supply is available when the aircraft is stopped and the parking break is set. It is automatically connected to the air system when no other source of bleed air is present. Ground air can supply all sources and start the engines.

A series of isolation valves control the flow of bleed air based on the sources available and the state of the engine and APU starters. The valves are normally controlled automatically.

Air Control Panel and Synoptic

The air control panel controls the aircraft pneumatic systems. It is divided into three sections:

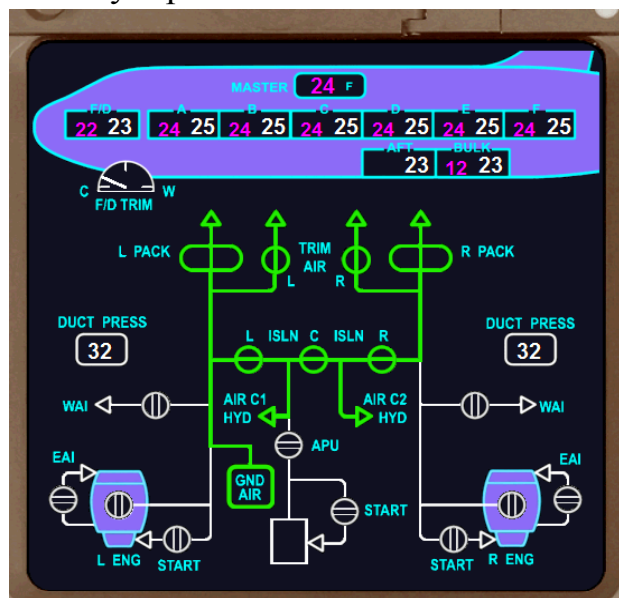
- air conditioning
- bleed air
- pressurization

The air synoptic shows:

- deck temperatures and set points
- air duct pressure and flow in green
- air duct valve position
- duct pressure

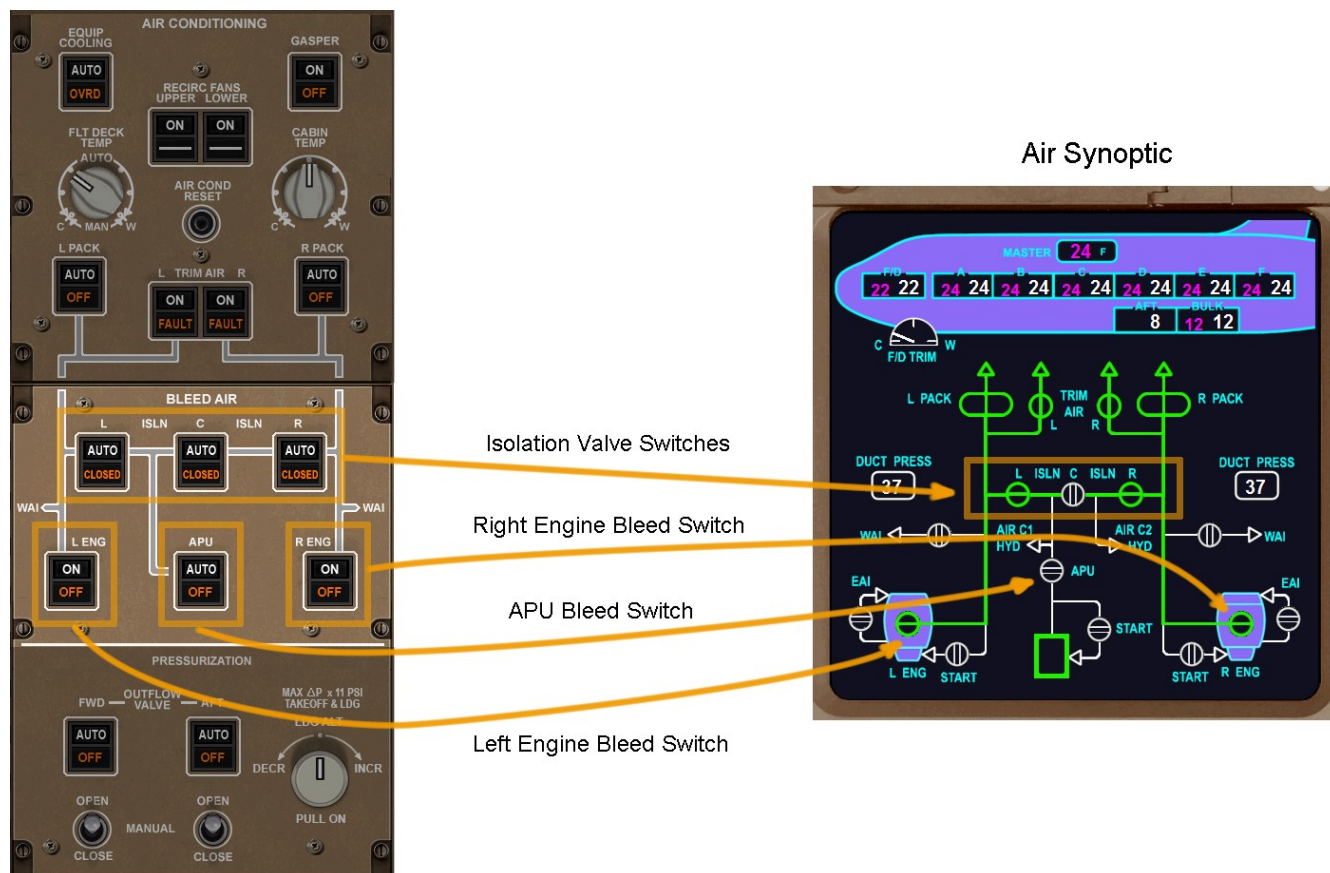
Ground air cart connection is shown on the air synoptic when available.

Air Synoptic: Ground Air Connected



Bleed Air

The bleed air section of the panel controls the air sources and isolation valves.

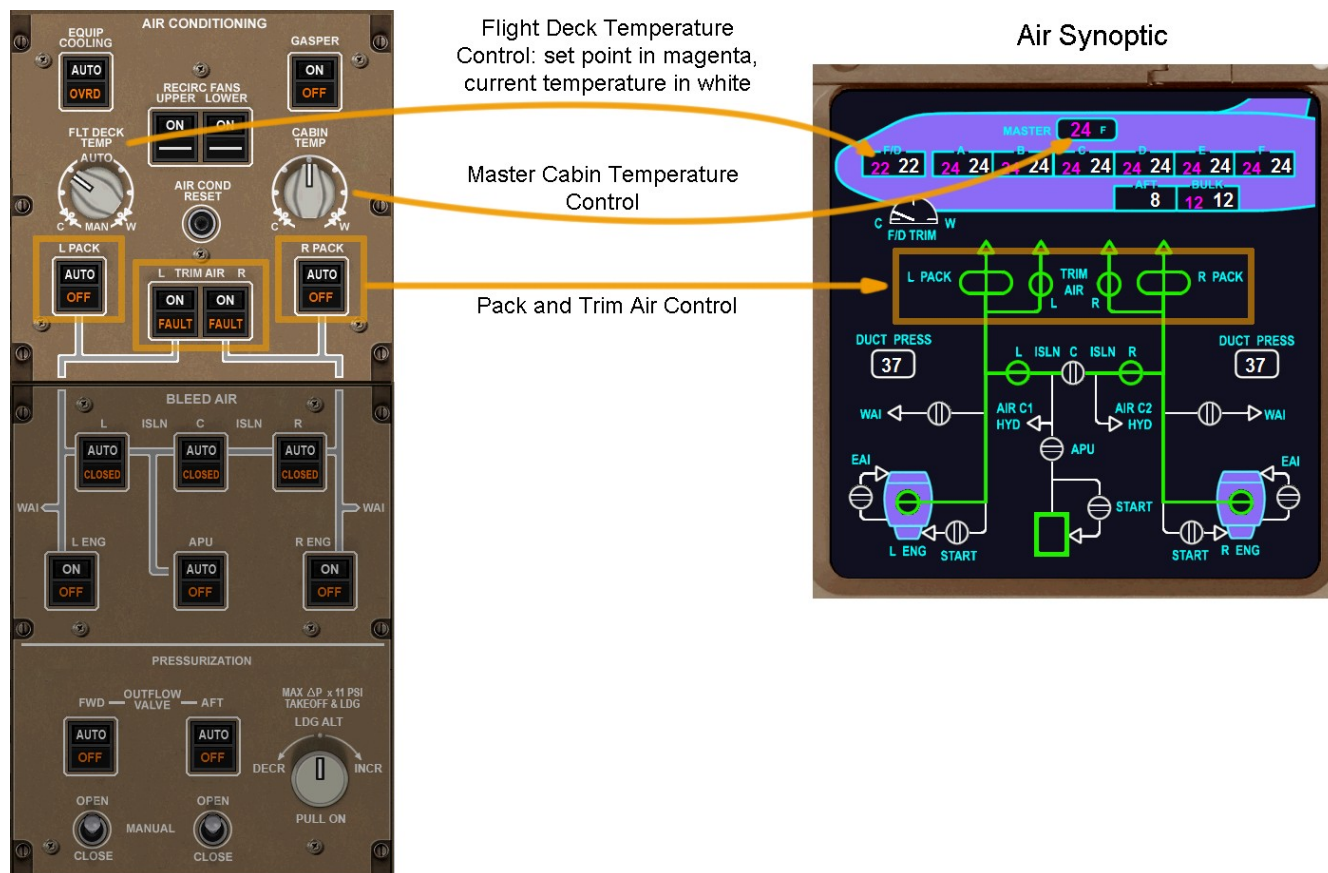


Bleed Air Panel and Air Synoptic

- ISLN** Left (L), Center (C) and Right (R) isolation valve switches control air flow between air sources and left and right air ducts. Normally in the pushed in, AUTO state, the valves are automatically controlled to channel air according to the sources available. In the off state, the valve is closed and the CLOSED light illuminates.
- L ENG** Controls the supply of bleed air from the left engine. Normally in the ON state. When off, the OFF light illuminates.
- APU** Controls the supply of bleed air from the APU. Normally in the AUTO state the valve is automatically controlled to channel air according to the sources available. When off, the OFF light illuminates. Set the switch to off to perform a cross-bleed start when on the ground with the APU running.
- L ENG** Controls the supply of bleed air from the left engine. Normally in the ON state. When off, the OFF light illuminates.

Air Conditioning

The air conditioning section of the panel controls the air conditioning, flight deck and cabin temperature and air flow.



EQUIP COOLING In the AUTO position equipment cooling is controlled automatically. In the off position, equipment cooling fans run continuously if power is available. The override (OVRD) light illuminates. Function not simulated.

GASPER Controls air flow to the cabin duct system providing air to the valves above each passenger seat.

RECIRC FANS Controls air recirculation fans, 50% of the cabin air is recirculated.

FLT DECK TEMP Controls the flight deck temperature set point shown in magenta on the air synoptic. Range is 18 to 29 degrees Celsius.

CABIN TEMP Controls the cabin master temperature set point shown in magenta on the air synoptic. Range is 18 to 29 degrees Celsius.

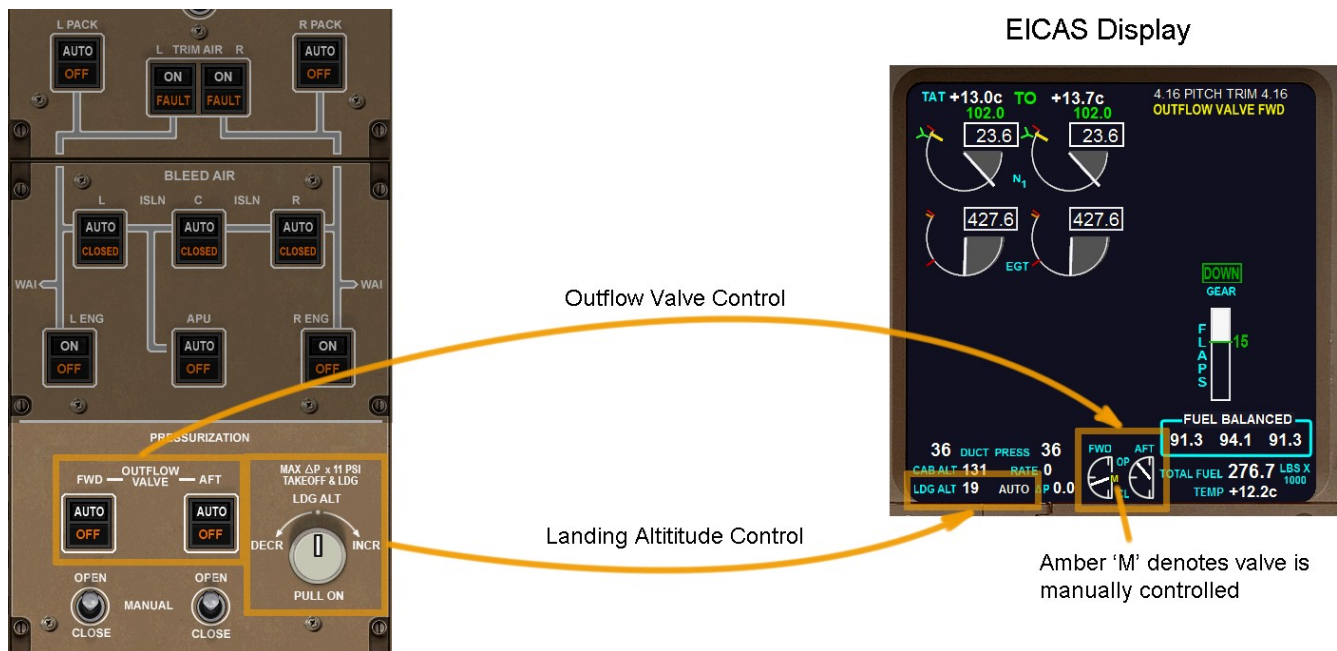
L, R PACK Controls air flow to the left and right air conditioning packs. The packs

condition the bleed air providing cooling, dehumidifying, and removing ozone as required. In the off position, the OFF light illuminates and aircraft internal temperature tends towards outside air temperature. The valves close automatically during engine start.

L, R TRIM Controls hot bleed air flow into the air conditioning system. Trim air is used to modulate the cool air passing through the packs to control flight deck and cabin air temperature.

Pressurization

The cabin is pressurized by bleed air flowing through the air conditioning packs. Cabin pressurization is controlled by allowing pressurized air out of the airplane via outflow valves. There are forward and rear outflow valves.



OUTFLOW VALVE Normally in the pushed in, AUTO position, the outflow valves open and close as required to maintain cabin altitude. The EICAS display shows the valve position, cabin altitude and pressurization differential. When the switch is off, the valve is controlled manually using the toggle switch located below.

LANDING ALT The landing altitude knob controls the landing altitude setting for the pressurization system. Normally the knob is pushed in and landing altitude is obtained automatically from the flight plan destination altitude. To set landing altitude manually, click on the knob to pull it out then click

left to lower altitude and right to increase altitude.

Anti-Ice System

The anti-ice system uses electric heaters and hot bleed air to heat critical components and airframe surfaces to prevent ice accumulation.

The electrically heated anti-ice systems are:

- pitot-static system heat
- window heat

The pitot-static system senses ambient and forward velocity air pressure to determine altitude and speed. The sensors are heated to keep the airways free from ice. The heaters are activated automatically when an engine is started or the aircraft is airborne. There is no switch on the panel to manually control the heaters.

The window anti-ice and fog system uses electric heaters in the lamination's of the flight deck windows. The window heat switches control the heaters for forward and side windows. A WINDOW HEAT EICAS advisory message displays if the switches are off.



The bleed air driven anti-ice systems require an air source to function. They are:

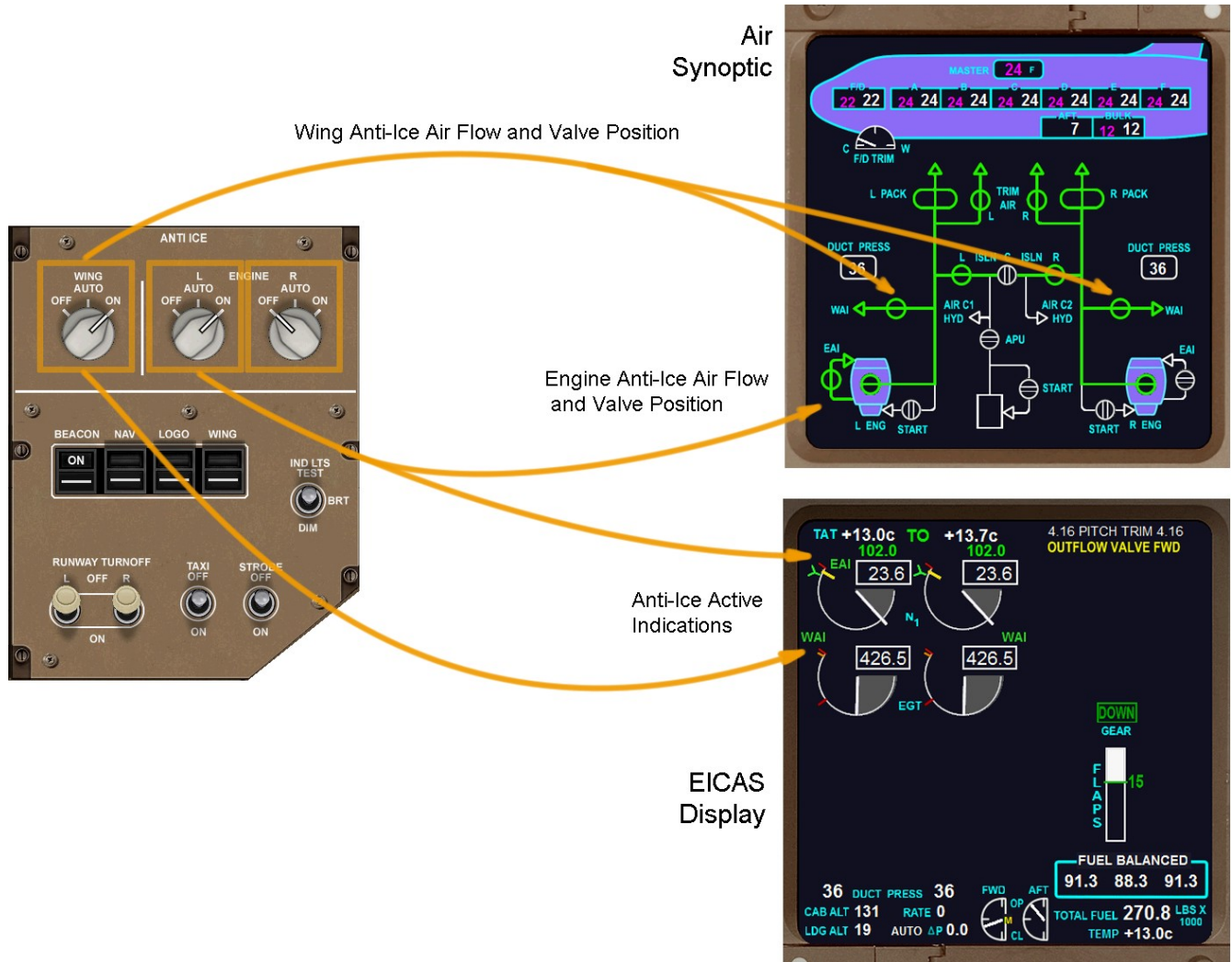
- engine anti-ice
- wing anti-ice

The engine anti-ice system supplies hot air to the engine cowling. The engine must be running.

The wing anti-ice system supplies hot air to the central slats on the leading edge of the wing. The left and right air ducts must be pressurized for the system to function.

Anti-Ice Control Panel and Displays

The anti-ice control panel allows control of the engine and wing anti-ice systems. Operating indications are shown on the EICAS display and air synoptic.



WING Controls the wing anti-ice system. In the AUTO position, the system is activated when ice is detected.

L, R ENG Controls the engine anti-ice system. In the AUTO position, the system is activated when ice is detected.

Fuel System

The fuel system consists of fuel tanks, pumps, valves, fuel manifolds and associated sensors and controllers.

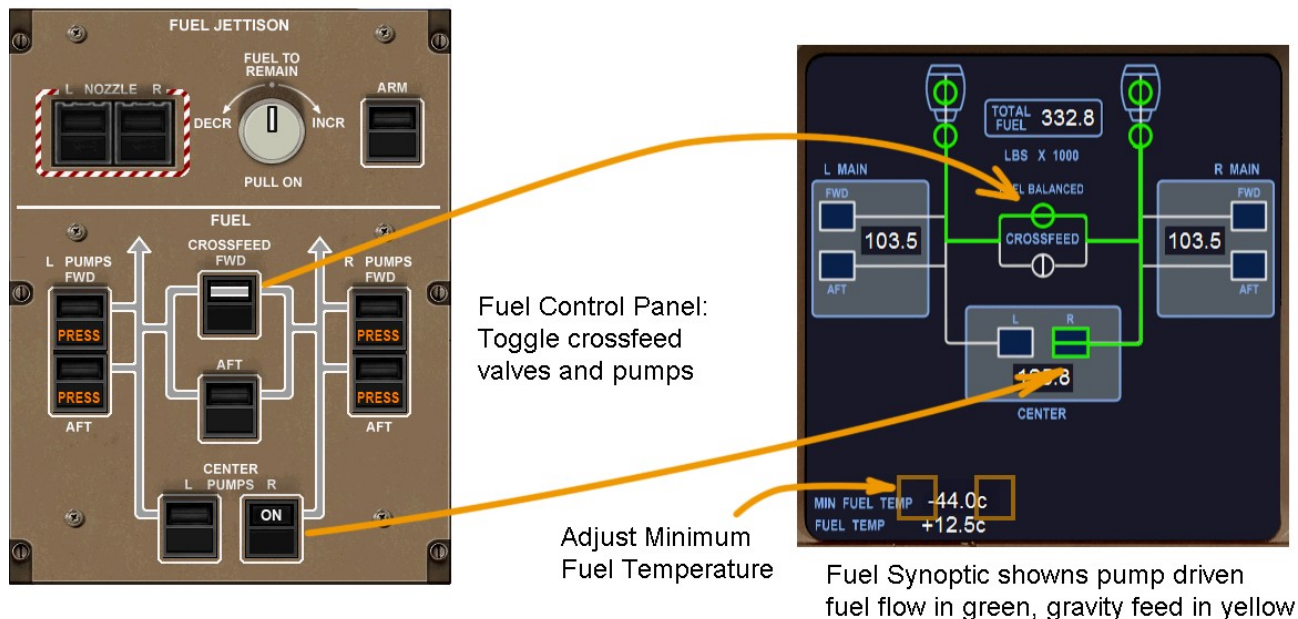
The basic fuel storage layout consists of a main tank in each wing and a center tank in the center wing section. The capacity of each tank depends on the 777 variant and is specified in the FSX model's aircraft.cfg file.

Each main tank has two fuel boost pumps, forward and aft, and a fuel jettison pump. The center tank has two pumps, left and right. The left pump supplies fuel to the left fuel manifold and the the right pump to the right manifold. The APU has a dc pump that draws fuel from the left main tank and operates when there is no ac power available to power the left main forward pump.

Crossfeed valves allow fuel to flow between left and right manifolds. There are two crossfeed valves, forward and aft.

Normally the fuel pumps feed the engines fuel under pressure, but if no AC power is available or there is a pump failure, the engines can use suction feed to obtain fuel from the main tanks. The engines cannot suction feed from the center tank.

Fuel Control Panel and Synoptic



The fuel control panel controls fuel tank pumps and crossfeed valves. It also controls fuel jettison. The fuel control panel can be displayed by typing shift+7. The fuel synoptic is displayed on the MFD using the FUEL switch on the DSP.

The synoptic shows green boxes for operating pumps with normal output pressure.

Amber boxes are shown for pumps with low output pressure, usually due to depleted tank or lack of power. Pressurized fuel flows are shown in green. Gravity/suction feed fuel flows are amber. When the APU control switch found on the electrical panel is in the ON position an APU section is displayed on the synoptic.

Normally, all pump switches are pushed in to their ON position and the crossfeed valves are closed (off). When the APU is on, the left main forward pump operates automatically regardless of switch position. If a pump is off (main tank pumps) or has low output pressure, an amber PRESS light illuminates on the associated pump switch. An amber VALVE light illuminates on the crossfeed and jettison valve switches when they are not in the commanded position.

The center tank pumps have a higher output pressure than main tank pumps, and therefore when all pumps are on, fuel from the center tank(s) will be consumed first. Center tank pumps should be turned off when the center tank is depleted.

Fuel Imbalance

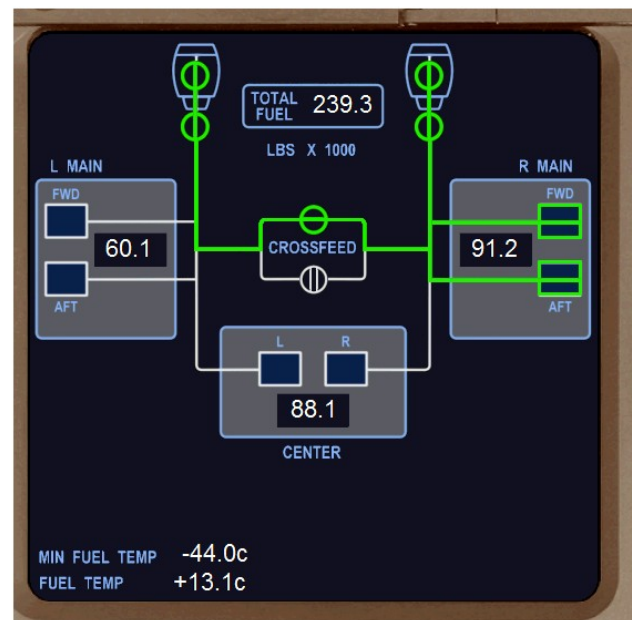
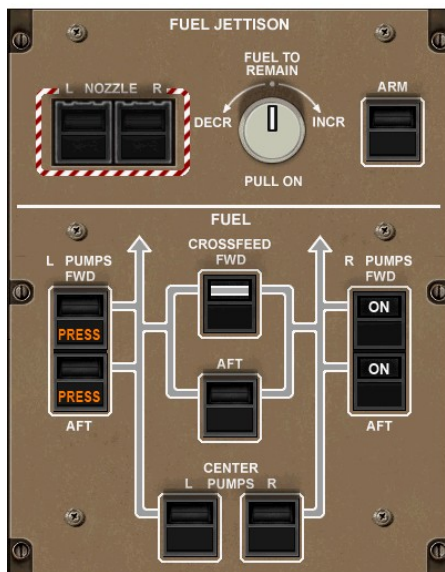
Fuel Quantity box shows when a fuel imbalance exists. The arrow shows the direction of fuel flow to correct the imbalance. The arrow flashes when the imbalance is increasing.

To correct a fuel imbalance:

1. Turn crossfeed valve on.
2. Turn pumps on in tank with high fuel level.
3. Turn pumps off in tank with low level.
- 3a. If left is the low tank, turn APU switch off to turn off left fwd pump.
4. Turn center tank pumps off.

Fuel is fed to the engines from the high tank. When the fuel imbalance has been corrected:

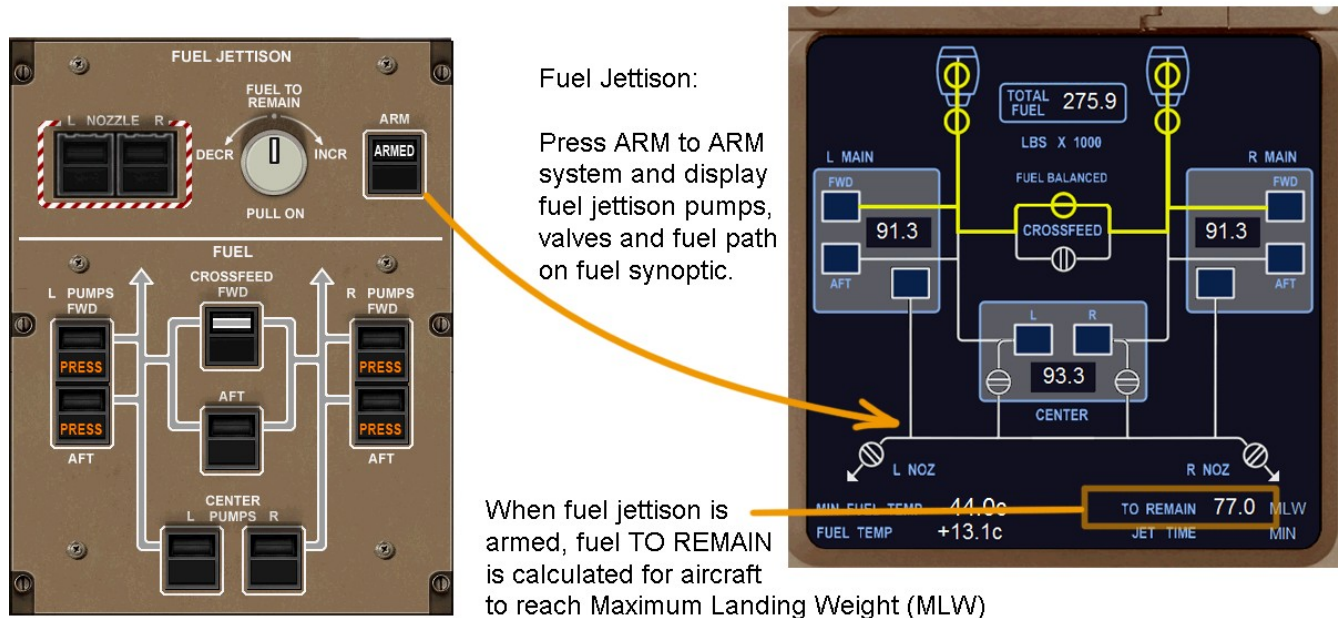
5. Turn on all pumps.
6. Turn off crossfeed valve.



Fuel Jettison

The fuel jettison system allows fuel to be dumped overboard to reduce landing weight. Fuel jettison controls are on the upper section of the fuel control panel.

The fuel jettison arm switch arms the system and displays the fuel jettison components on the fuel synoptic.



Two jettison nozzle valves, left and right, allow fuel to flow through the jettison manifold and overboard. The nozzle switches control the valves and the main tank jettison pumps. The center tank pumps are controlled manually.

The jettison system calculates the fuel to remain to reach maximum landing weight (MLW). The fuel to remain can be manually adjusted by first clicking on the “fuel to remain” knob to put the system in manual mode (MAN replaces MLW on the fuel synoptic and EICAS) , then incrementing or decrementing the remaining fuel quantity. The quantity of fuel remaining cannot be less than 20,000 lbs.

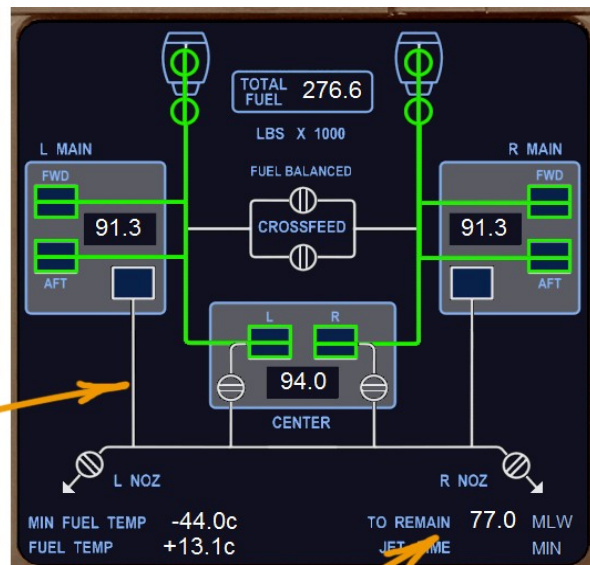
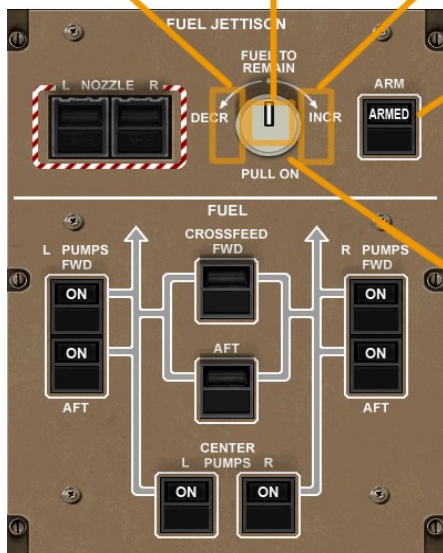
The fuel jettison system will automatically shut off the main tank jettison pumps and nozzles when the fuel to remain level is reached. An EICAS advisory message “JETTISON COMPLETE” will be displayed. The jettison nozzle switches must be turned off manually to extinguish the VALVE light and EICAS jettison valve messages.

Reduce fuel
TO REMAIN
after jettison

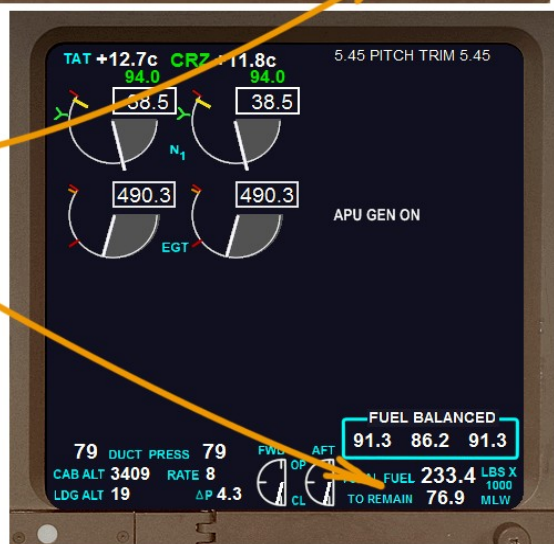
Toggle Manual
fuel TO REMAIN

Increase fuel
TO REMAIN
after jettison

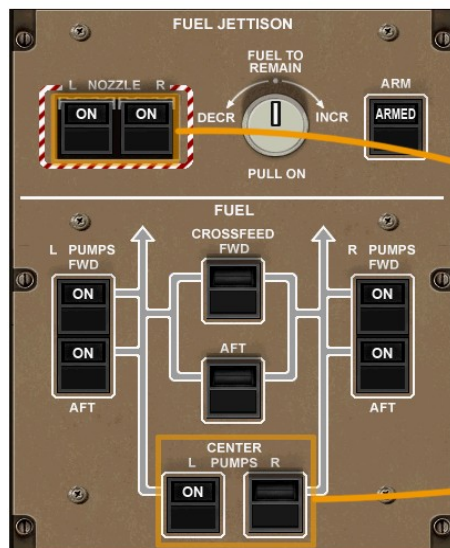
ARM Fuel Jettison



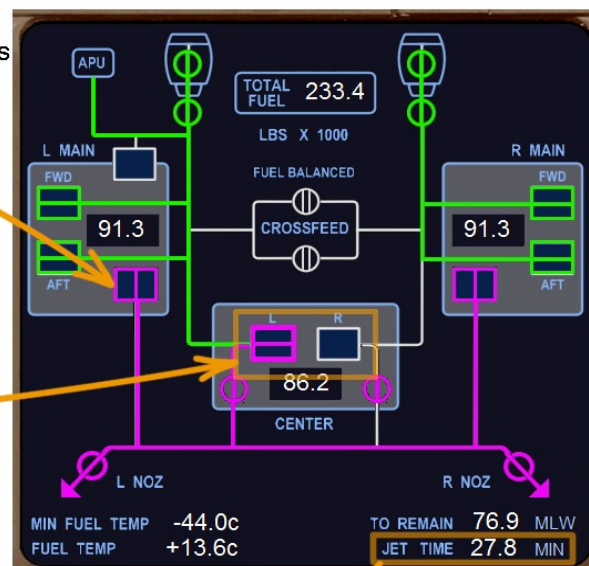
TO REMAIN
quantity shows
on fuel synoptic
and EICAS
displays



Press Nozzle switches
to open jettison nozzles
and turn on pumps



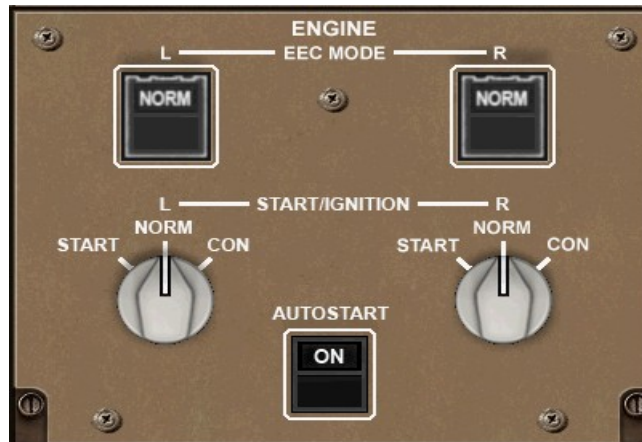
Center pump switches control fuel flow
to engines and jettison manifold.



Time remaining to
jettison fuel

Engine Start and Control

The engine start panel controls the engine starters.



EEC MODE	Electronic Engine Control manages throttles to achieve a specified thrust. Operates in normal and alternate modes.
START/IGNITION	Controls the engine starter and ignition system.
START	Opens the starter valve to begin engine rotation.
NORM	Normal operation, starter valve closed and ignition off.
CON	Continuous ignition. The igniters will fire automatically when required.
AUTOSTART	Normally in the ON position, autostart monitors engine start parameters and automatically introduces fuel and starts ignition at the appropriate time.

Engine Start Procedure

A source of pressurized air or bleed air is required to start the engines on the ground and outside of the windmill start envelope.

Air sources are: the other running engine (cross-bleed start), the APU when below 22000 feet, or when on the ground with the parking brake set, the ground air cart. Refer to the air synoptic to check proper air duct pressurization.

During engine start, monitor N2 rotation on the secondary engine display (use the DSP ENG switch to display). Optionally monitor air flow, duct pressure and valve status on the air synoptic.

Perform an engine start with the autostart switch ON:

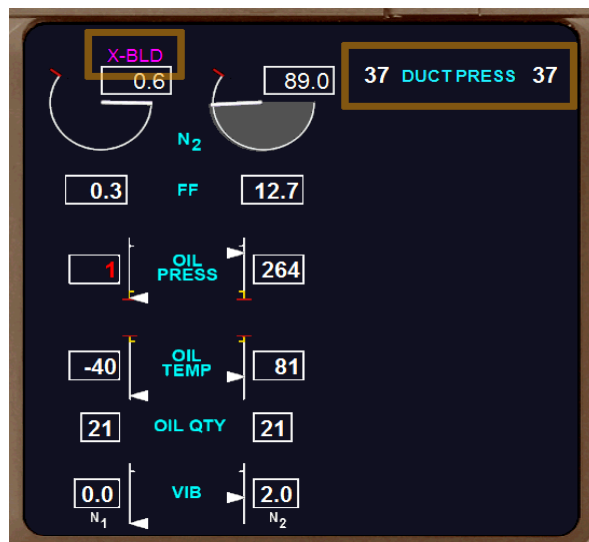
- move the fuel cutoff switch on the throttle panel to RUN,
- then initiate engine start by moving the START/IGNITION switch to START. Engine start will proceed automatically.
- The fuel cutoff switch will move to CUTOFF.
- The air isolation valves position to control airflow according to aircraft state and available air sources.
- When N2 reaches 16 – 22%, fuel is introduced and the igniter is activated.
- When N2 reaches 56% and EGT is within limits, the igniter is shutdown and the start switch moves to the NORM position.

If autostart is OFF, the pilot must manually introduce fuel at the appropriate N2 rotation.

- Move the fuel cutoff switch to CUTOFF.
- then initiate engine start by moving the START/IGNITION switch to START.
- The air isolation valves position automatically to control airflow according to aircraft state and available air sources.
- When N2 reaches 16 – 22%, move the fuel cutoff switch to RUN. Fuel is introduced and the igniter is activated.
- When N2 reaches 56% and EGT is within limits, the igniter is shutdown and the start switch moves to the NORM position.

The secondary engine display will indicate when a cross-bleed start will occur. X-BLD is shown in magenta above the N2 dial and the duct pressure displays.

Secondary Engine Display



Windmill Start

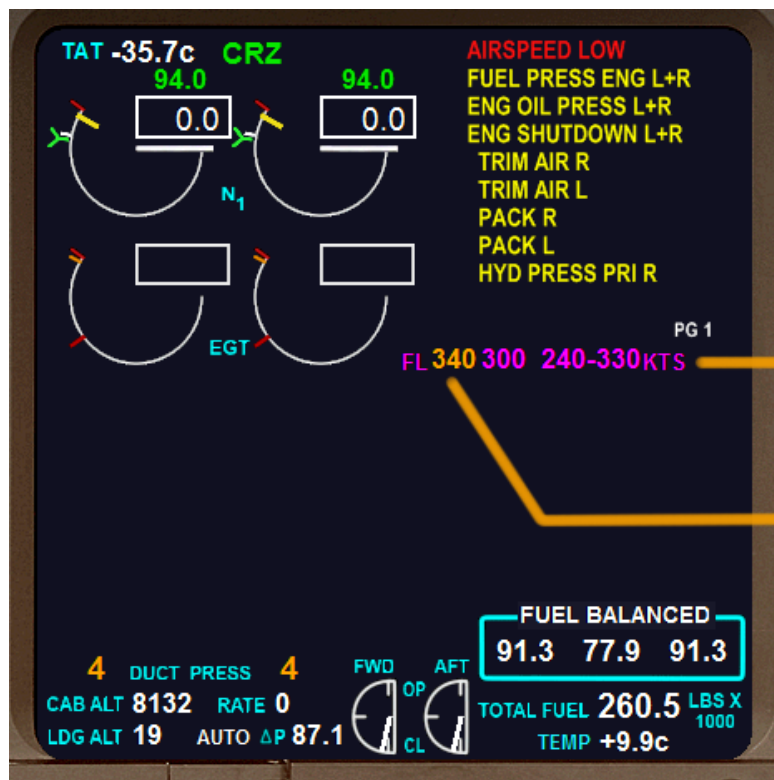
A windmill start can be accomplished without a pressurized air source if there is sufficient forward velocity and air density to spin the engine rotors to start velocity. The EICAS will display the windmill start envelope.

To initiate a windmill start:

- Move the fuel cutoff switch to RUN.
- Move the START/IGNITION switch to START.

The engine start will proceed automatically.

If outside the start envelope, adjust altitude and/or speed and the engines will start when the aircraft enters the start envelope.



EICAS Display

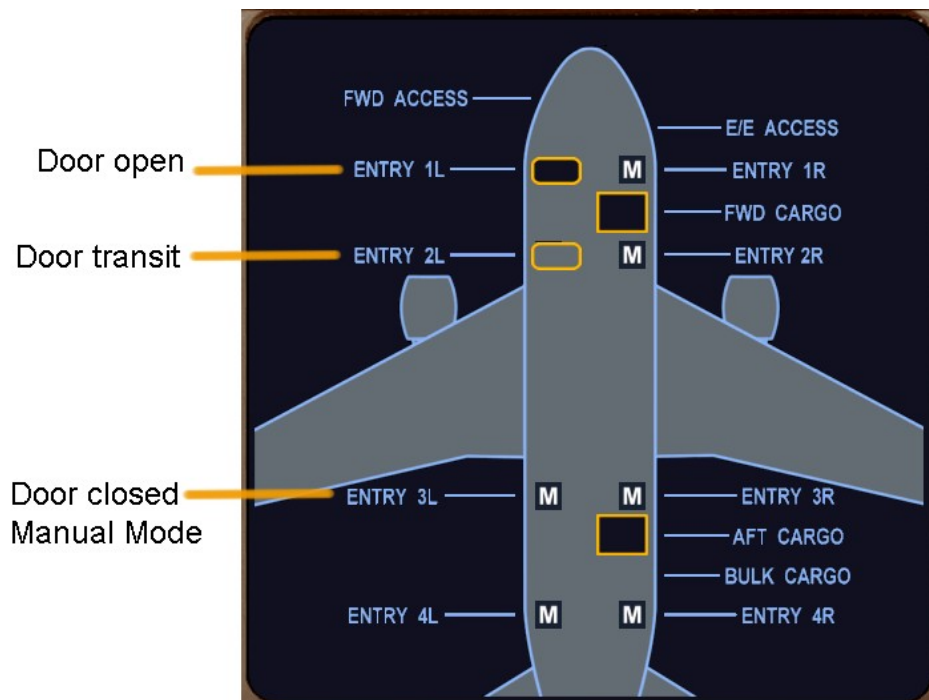
Windmill flight envelope
FL - flight level (100's of feet)
Speed range in knots

Current altitude displays
in amber when above
windmill start envelope

Door Synoptic

The door synoptic indicates door closure status.

Toggle doors open/closed with shift+e then door number 1 through 4.

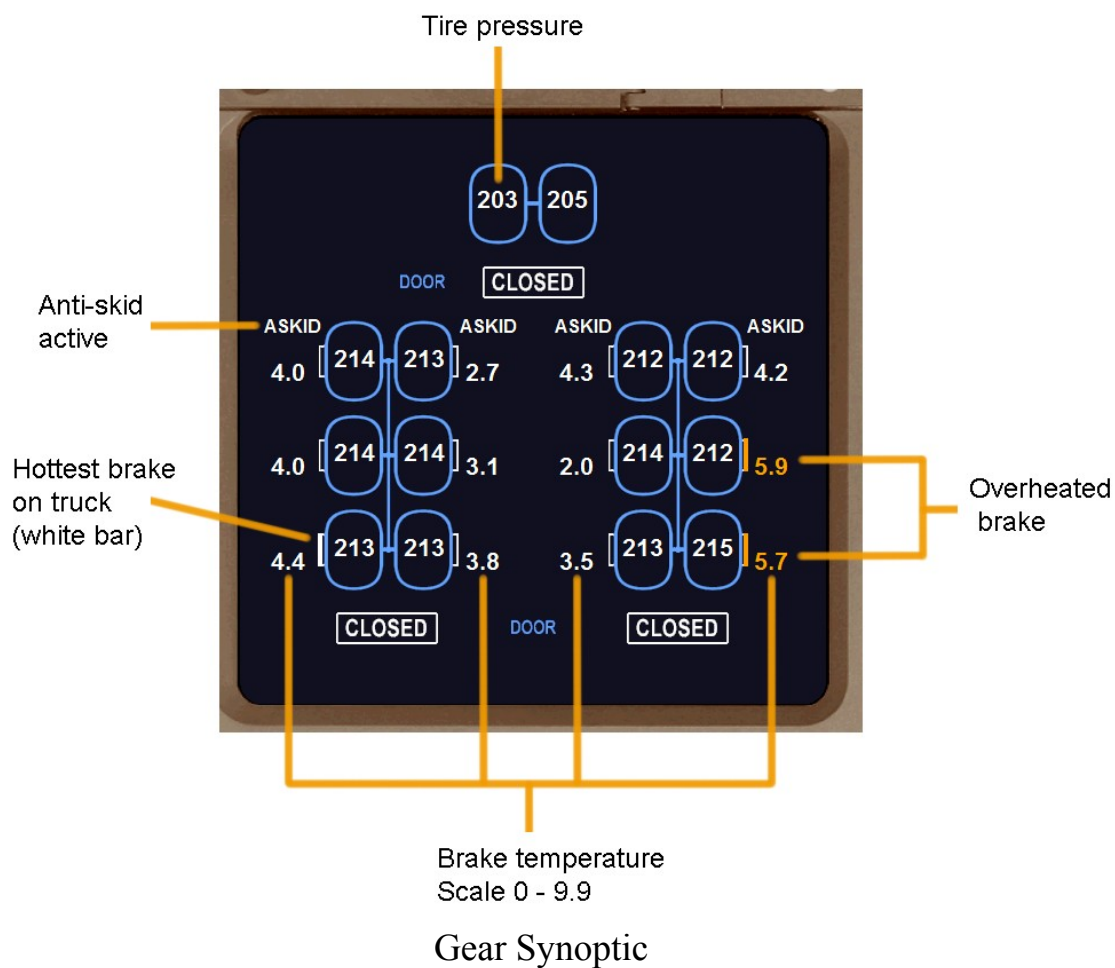


Gear Synoptic

The gear synoptic provides the following information:

- gear door status
- tire pressure
- brake temperature
- anti-skid status

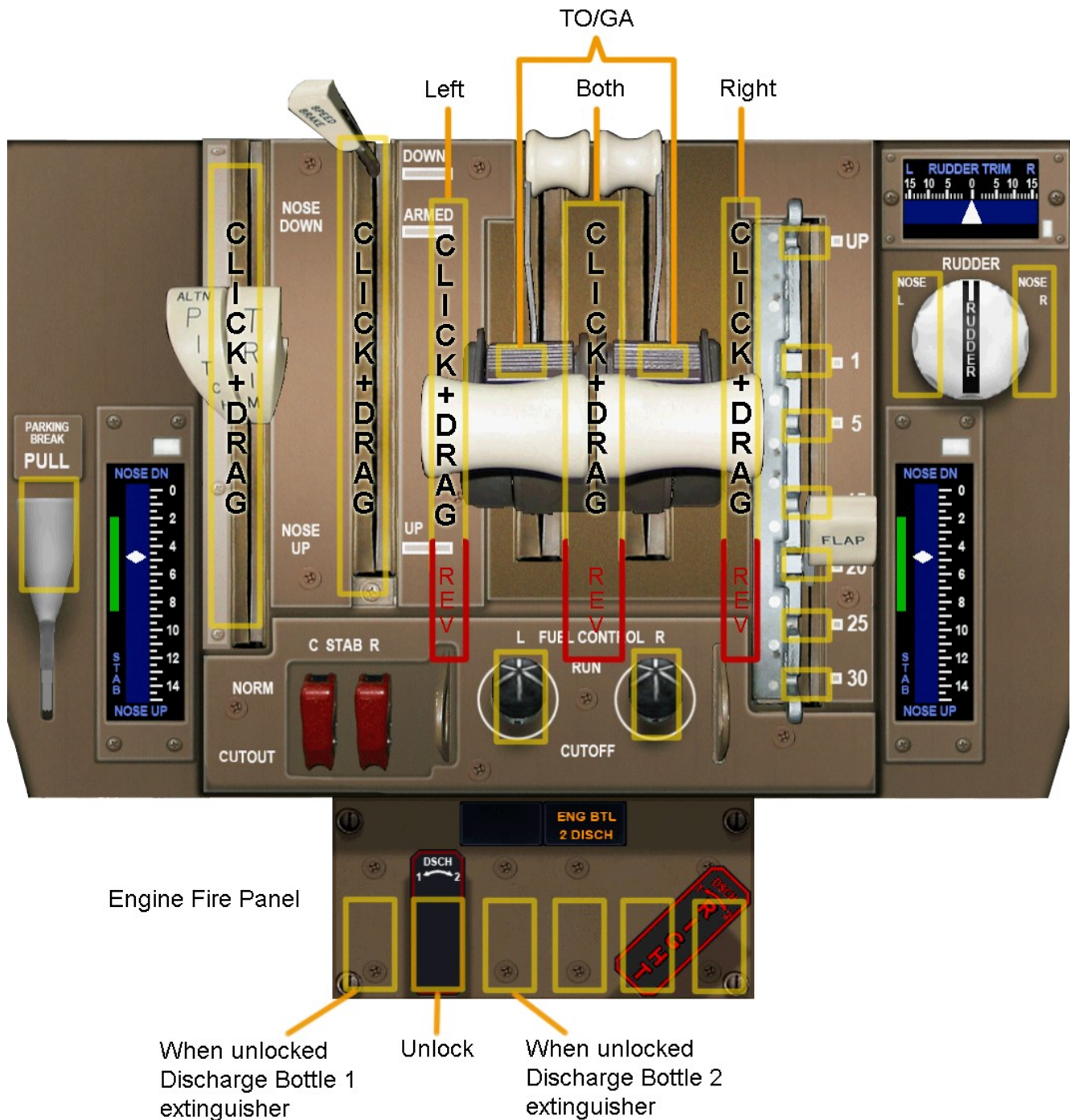
The gear synoptic is displayed on the MFD using the GEAR switch on the DSP.



13 Throttle Control Panel

The throttle control panel can be displayed by clicking on the throttle icon on the main panel or typing shift+6.

Throttle Panel Clickspots



14 EICAS Messages

Warning Messages

Warning messages display in red at the top of the EICAS message area. The master warning light illuminates when they occur. The messages pertain to airplane or operational situations that require immediate crew action. Most recent messages appear at the top of the list. Warning messages cannot be cancelled.

Message	Condition
OVERSPEED	Airspeed exceeds maximum speed. Flap placard speed or gear extension speed.
STALL	Aircraft is near or below stall speed.
CONFIG FLAPS	Flaps not set and aircraft is in takeoff or landing configuration
AUTOPILOT DISC	Autopilot disconnected. Lower and raise AP Disconnect switch to clear.
AIRSPEED LOW	Airspeed at or near buffet speed.
CONFIG GEAR	Aircraft in landing configuration and gear is not down.
CONFIG SPOILERS	Aircraft is in takeoff configuration with one or both throttles above 60% and speed brake lever is not in it's down position.
FIRE ENG L, R	Left and/or right Engine is on fire. Cutoff fuel flow. Discharge fire bottle. Simulate engine fires using the FSX Failures menu. Access it from the aircraft drop down menu.
FIRE APU	APU is on fire. Discharge APU fire bottle.

Caution Messages

Caution messages display in amber in the EICAS message area below warning messages. The master caution light illuminates when they occur. The messages pertain to airplane or operational situations that require immediate crew awareness and possible action. Most recent messages appear at the top of the list of caution messages. Caution messages can be cancelled using the DSP CANCEL/RECALL switch.

Message	Condition
SINK RATE	Sink rate is excessive in relation to altitude above the ground.
TOO LOW TERRAIN	Terrain impact is possible. Pull up.
ELEC AC BUS L+R	Loss of AC power on left and or right buses. Check generator switches and status.
FUEL LOW CENTER	Center tank fuel quantity is low and center tank pump(s) are on. Turn off center tank pumps..
FUEL PRESS ENG L+R	Fuel pressure to left and/or right engine is low. Check pumps and fuel level.
FUEL QTY LOW	Main tank fuel quantity is low.
NO AUTOLAND	Autoland capability is not available.
HYD PRESS SYS L+C+R	Hydraulic system pressure is low in left and/or right, and /or center.
ENG SHUTDOWN L+R	Left and/or right engine is shutdown.
ENG OIL PRESS L+R	Left and/or right engine oil pressure is low.
AUTOTHROTTLE DISC	Autothrottle is disconnected. Toggle autothrottle arm switches to clear.
NAV ADRIU INERTIAL	Navigational computer is off. Check switch.
LANDING ALTITUDE	Landing altitude is not set. Set landing altitude manually from pressurization panel or check flight-plan is loaded.
OUTFLOW VALVE FWD	Forward pressurization outflow valve is in manual mode.
OUTFLOW VALVE AFT	Aft pressurization outflow valve is in manual mode.
SPEEDBRAKES EXT	Speed brakes are extended
ALTITUDE ALERT	Altitude is more than 200 feet beyond MCP set altitude.
HYD QTY SYS L+C+R	Hydraulic reservoir quantity is low in left and/or center and/or right system.

Advisory Messages

Advisory messages display in amber in the EICAS message area below caution messages. They pertain to airplane or operational situations that require crew awareness. Most recent messages appear at the top of the list of advisory messages. Advisory messages can be cancelled using the DSP CANCEL/RECALL switch.

Message	Condition
FUEL IN CENTER	There is fuel in the center tank and the center tank pumps are off. Turn on pumps.
FUEL PUMP L FWD	Left forward fuel pump pressure is low. Check pump and fuel level.
FUEL PUMP L AFT	Left aft fuel pump pressure is low. Check pump and fuel level.
FUEL PUMP R FWD	Right forward fuel pump pressure is low. Check pump and fuel level.
FUEL PUMP R AFT	Right aft fuel pump pressure is low. Check pump and fuel level.
FUEL PUMP L CTR	Left center fuel pump pressure is low. Check pump and fuel level.
FUEL PUMP R CTR	Right center fuel pump pressure is low. Check pump and fuel level.
FUEL IMBALANCE	Main tank fuel imbalance exceeds 3000 pounds. Use pumps and crossfeed valves to balance fuel.
ENG AUTOSTART OFF	Engine autostart is off. Check switch.
RAT UNLOCKED	RAM air turbine is unlocked.
BRAKE SOURCE	Insufficient hydraulic pressure to operate brakes.
BRAKE TEMP	One or more brakes are overheated.
EQUIP COOL OVRD	Equipment cooling fans on continuous operation. Check switches.
JETTISON COMPLETE	Fuel jettison is complete. Turn off ARM switch.
JETTISON NOZZLE L+R	Fuel jettison nozzle valve not in commanded state. Turn off valves.
BOTTLE 1 DISCH ENG	Engine fire bottle 1 discharged.
BOTTLE 2 DISCH ENG	Engine fire bottle 2 discharged.
BOTTLE DISCH APU	APU fire bottle discharged.
MAIN BATTERY DISCH	Main battery is discharging. Check electrical generators.
BLEED OFF APU	APU bleed air valve closed. Check switch.
BLEED OFF ENG L	Left engine bleed air valve closed. Check switch.
BLEED OFF ENG R	Right engine bleed air valve closed. Check switch.
BLEED ISLN CLSD L	Left bleed isolation valve is not in auto mode. Check switch.
BLEED ISLN CLSD C	Right bleed isolation valve is not in auto mode. Check switch.
BLEED ISLN CLSD R	Center bleed isolation valve is not in auto mode. Check switch.

Advisory Messages Continued.

Message	Condition
HYD PRESS PRI L	Primary left engine hydraulic pump pressure is low or pump is off. Check switch, reservoir level.
HYD PRESS PRI C1	Primary center 1 hydraulic pump pressure is low or pump is off. Check switch, reservoir level, ac power status.
HYD PRESS PRI C2	Primary center 2 hydraulic pump pressure is low or pump is off. Check switch, reservoir level, ac power status.
HYD PRESS PRI R	Primary right engine hydraulic pump pressure is low or pump is off. Check switch, reservoir level.
HYD PRESS DEM L	Demand left hydraulic pump pressure is low or pump is off. Check switch, reservoir level, ac power status.
HYD PRESS DEM C1	Demand center 1 hydraulic pump pressure is low or pump is off. Check switch, reservoir level, air duct pressure and isolation valves.
HYD PRESS DEM C2	Demand center 2 hydraulic pump pressure is low or pump is off. Check switch, reservoir level, air duct pressure and isolation valves.
HYD PRESS DEM R	Demand right hydraulic pump pressure is low or pump is off. Check switch, reservoir level, ac power status.
PACK L	Left air conditioning pack output pressure is low. Check switch, duct pressure. Normally closes during engine start.
PACK R	Right air conditioning pack output pressure is low. Check switch, duct pressure. Normally closes during engine start.
TRIM AIR L	Trim air left output pressure is low. Check switch, duct pressure.
TRIM AIR R	Trim air right output pressure is low. Check switch, duct pressure.
ELEC GEN OFF APU	APU is running and generator is off. Check switch.
ELEC GEN OFF L	Left engine generator is off.
ELEC GEN OFF R	Right engine generator is off.
ELEC BUS ISLN L	Left electrical bus isolation breaker is off. Check switch.
ELEC BUS ISLN R	Right electrical bus isolation breaker is off. Check switch.
ELEC BACKUP L	Left engine backup generator is off.
ELEC BACKUP R	Right engine backup generator is off.
ELEC BACKUP SYS	Both engine backup generators are off.
ELEC BATTERY OFF	Main battery is off. Check switch.
DOORS	One or more doors are not closed. Check door synoptic.
WINDOW HEAT	One or more window heaters are off. Check switches.
PASS OXYGEN ON	Passenger oxygen is on.

Memo Messages

Memo messages display in white at the bottom of the EICAS message area. They are intended to remind the crew of normal operation conditions. Most recent messages appear at the top of the list of memo messages. Memo messages cannot be cancelled.

Message	Condition
PARKING BRAKE SET	Parking brake is set.
AUTOBRAKE RTO	Autobrake is in rejected takeoff state.
AUTOBRAKE DISARM	Autobrake is disarmed.
AUTOBRAKE 1	Autobrake set to level braking.
AUTOBRAKE 2	Autobrake set to level braking.
AUTOBRAKE 3	Autobrake set to level braking.
AUTOBRAKE 4	Autobrake set to level braking.
AUTOBRAKE MAX	Autobrake set to maximum braking.
APU GEN ON	APU is running and generator is on.
APU RUNNING	APU is running.
APU COOLDOWN	APU is in COOLDOWN period prior to shutdown.
SEAT BELTS ON	
NO SMOKING ON	
PASS SIGNS ON	Seatbelts and no smoking signs are on.
ENG CONT IGN L+R	Left and/or right continuous ignition switch is on.
RECIRC FANS OFF	
SPEEDBRAKE ARMED	

15 Autopilot Key Support

A subset of the available autopilot key strokes are supported as shown in the following table. Invoking unsupported key strokes will cause unpredictable results and should be avoided.

Event	Keyboard	Supported
Altitude bug (select)	Ctrl + Shift + Z	
Autopilot (decrease max bank)		
Autopilot (increase max bank)		
Autopilot Mach hold (on/off)	Ctrl + M	●
Autopilot N1 hold (on/off)		
Autopilot NAV 1 hold (on/off)	Ctrl + N	●
Autopilot airspeed hold (on/off)	Ctrl + R	●
Autopilot altitude hold (on/off)	Ctrl + Z	
Autopilot approach mode (on/off)	Ctrl + A	
Autopilot attitude hold (on/off)	Ctrl + T	
Autopilot back course mode (on/off)	Ctrl + B	
Autopilot heading bug (decrement)		
Autopilot heading bug (increment)		
Autopilot heading hold (on/off)	Ctrl + H	
Autopilot localizer hold (on/off)	Ctrl + O	
Autopilot master (on/off)	Z	●
Autopilot pitch ref (down)		
Autopilot pitch ref (up)		
Autopilot vertical speed hold (on/off)		
Autopilot wing leveler (on/off)	Ctrl + V	
Autothrottle (arm)	Shift + R	●
Autothrottle engage (TOGA)	Ctrl + Shift + G	●
Flight director (on/off)	Ctrl + F	●
Flight director (sync pitch)		
Heading bug (select)	Ctrl + Shift + H	
Nav 1/GPS (toggle)		
Pitch reference (select)		
VSI bug (select)		
Yaw damper (on/off)	Ctrl + D	●

