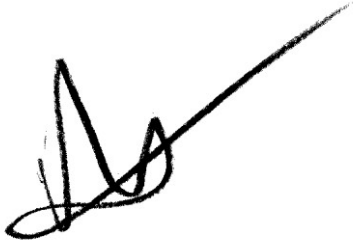
Rev #	Date	Author	Change	Version
001	11-Oct-15	IV	Start of documentation	0.90
002	31-Dec-16	MK	Updating to new software	0.92
003	20- Apr-2017	MK	Finalizing	1.00
004	01-May-2017	MK	Updating to latest files	1.00
005	02-Aug-2017	MK	First update after release	1.0.0.3

On behalf of Authority



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AUXILLIARY POWER UNIT

The CRJ700 and CRJ900 are both equipped with an Allied Signal RE 220 (RJ) auxiliary power unit (APU). The APU is technically a gas-turbine and it is used to provide electrical power and even more important compressed air.

The APU is basically comprised of three stages: a compressor followed by a combustion chamber and a turbine. The APU is started by an electrical motor which rotates the APUs main shaft until it gained enough speed so that fuel can be injected into the combustion chamber. The fuel burns and hence tries to expand which accelerates the air even further. The turbine on the other hand drives a generator – so the turbine converts the accelerated airflow into electrical power. As you can see the basic principle of an APU and an aircraft engine are technical the same. The major difference is that the APU is not used to produce thrust therefore APUs are also much smaller than aircraft engines.

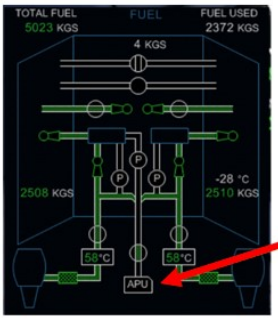
Apart from electrical power, bleed air is also drawn from the APU to supply the packs or also the engine starters (the aircrafts engines are usually started with pneumatic air).

Thus, it is mainly use during aircraft preparation and engine start. Nevertheless, it may also be used as a backup once an engine failed / was switched off.

The air-inlet-flap of the APU is used to control airflow into the APU. The flaps position is controlled automatically by the built-in electronics.

PWR FUEL:
As soon as the PWR FUEL pushbutton is pressed, the APU fuel shutoff valve is opened and the APU fuel pump energized.
Whilte preparing the APU to start, the APU IN BITE message is displayed and the APU RPM and EGT appear on the EICAS.
As soon as the DOOR OPEN message appears, the APU may be started.
When pressed again the APU is shut down and deenergized.

The upper part of the EICAS also displays several APU related status messages:
APU IN BITE (white)
Indicates that PWR FUEL is selected on and the air inlet door is not in position
APU START (white)
Indicates the starter motor is engaged.



START / STOP:
As soon as the APU is ready to start (RPM & EGT & DOOR OPEN message displayed on EICAS) you can start the APU by pressing the START/STOP pushbutton. When started the white START light comes on and extinguishes again as soon as 60% RPM are passed. As soon as 99% RPM are established for at least 2 seconds, the green AVAIL light illuminates. When pressed again, the APU is shut down and the light extinguishes.

The EICAS fuel page also indicates the APU status:
- White: APU not running
- Cyan: APU ready to load
- Magenta: invalid data

AURAL/VISUAL INDICATING & RECORDING

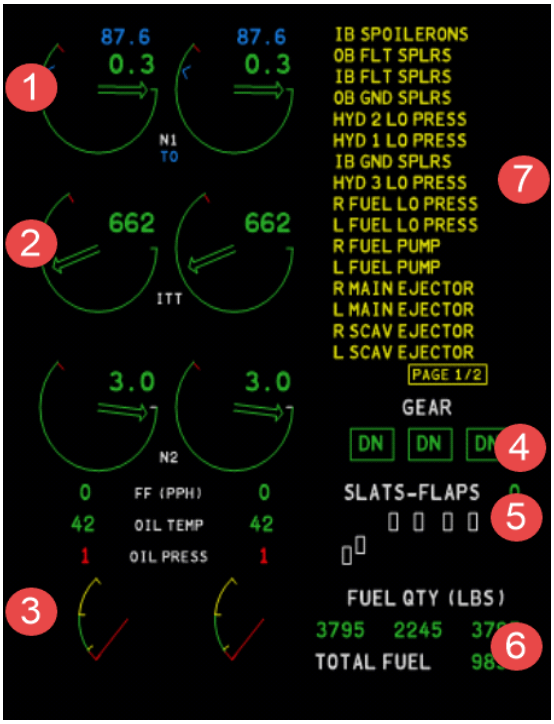
All aircraft systems do have sensors to detect abnormal settings or behaviour. All systems – including the engines – report this information to two central processing units: the data concentrator units (1 & 2). The interface to the pilots is the engine indication and crew alerting system (EICAS). Certain messages do also trigger audio signals or trigger the master warning or master caution light.

The EICAS is comprised of two units – called EICAS Display 1 & 2 (ED1 and ED2) – basically the left and the right EICAS display: The left EICAS is called ED1 and the right EICAS ED2.

Normally ED1 displays the primary page and ED2 displays the status page. The EICAS control panel on the lower pedestal enables the pilots to select if the primary, the secondary or a synoptic page is displayed on either ED. Please us the display reversion control panels to change whether the primary or secondary is displayed on ED1 or ED2 respectively. The EICAS source selector panel allows the pilot to select where all EICAS information is displayed. You may choose between ED1 or ED2 or both (default).

The EICAS primary page displays the following information:

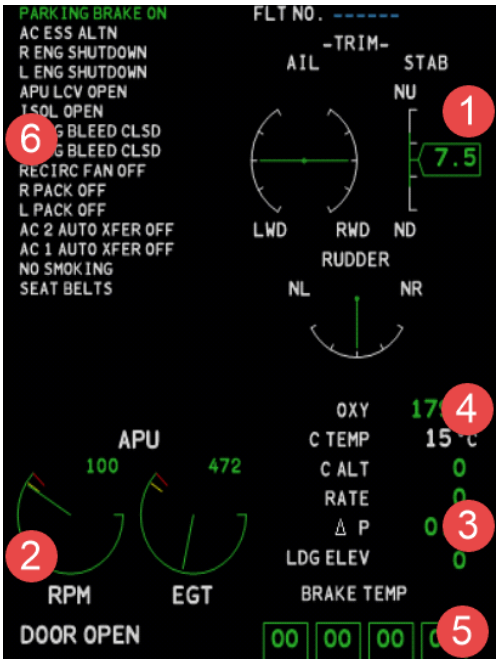
1. Engine compressor and turbine speeds (N_1 and N_2 rpm)
2. Engine temperature (ITT)
3. Fuel flow (FF)
   Oil pressure and temperature
   Engine vibration data
4. Landing gear position
5. Slat/flap position
6. Fuel tank quantities and total fuel
7. Crew alerting system (CAS) messages in the form of red warning and amber caution messages



The EICAS status page displays the following information:

1. Flight control trim indications
2. Auxiliary power unit (APU) indications such as APU RPM, exhaust gas temperature (EGT) and APU inlet door status
3. Pressurization data such as cabin altitude, cabin rate of change, cabin pressure differential, and landing field elevation
4. Oxygen system pressure
5. Brake system temperature readouts
6. Crew alerting system (CAS) messages in the form of green advisory and white status messages

- Aircraft systems synoptic pages (via the EICAS control panel)
  See next section for more details
- MENU page (via the EICAS control panel) allows reset of the fuel used indicator and displays the engine oil quantity
  See respective section of this chapter.



EICAS CONTROL PANEL

The EICAS Control Panel enables you to open the different aircraft system synoptic pages.
The panel itself is found on the upper pedestal. The following pushbuttons, respective system pages are available:

- PRI: Opens Primary Page (normally displayed on ED1) on secondary display (ED2)
- STAT: Displays Status Page. A second push removes all status messages / open further status messages if several pages of status messages exist.
- Synoptic Pages
  - ECS: Opens Environmental Control System page
  - HYD: Opens Hydraulic system page
  - ELEC: Opens Electrical system page
  - FUEL: Opens Fuel system page
  - F/CTL: Open Flight Controls system page
  - A/ICE: Opens Anti-Ice system page
  - DOORS: Opens Door system page
  - MENU: Opens the menu page
- SEL: Selector – used to activate a selected item. A change in colour will indicate selection
- CAS: Removes caution messages from primary display. Previously invisible messages get displayed
- UP: Controls cursor
- DN: Controls cursor
- STEP: Steps through pages of secondary page if available

DISPLAY REVERSION

In case EICAS display ED1 fails, ED2 will automatically switch to primary page. In case EICAS display ED2 fails, there is no automatic switch. With either display failed, the EICAS control panel is rendered inoperative. Please switch the EICAS selector on the SOURCE SELECTOR PANEL to the operative display (ED1 or ED2). This re-enables you to select and display the EICAS information on the selected display.

EICAS:
The EICAS fuel page also indicates the APU status:

- NORM: EICAS displays ED1 and ED2 are used and active
- ED1: EICAS control panel functions (i.e. system synoptics pages) may be used on ED1
- ED2: EICAS control panel functions (i.e. system synoptics pages) may be used on ED2

Furthermore, a revisionary panel is installed on either pilot's side panel. They offer three positions:

- PFD 1, respective PFD 2
  Switches the respective primary flight display (PFD1 = pilot, PFD 2 = co-pilot) to the adjacent MFD.
- NORM
  PFD and MFD in normal operation
- EICAS
  Shows the EICAS ED1 display on the MFD.

NORM

PFD 1

EICAS

AURAL WARNINGS / AUDIO SIGNALS

The following table shows the available aural warnings / audio signals.

Sound	Indication
Warbler	Stall
Windshear	Windshear
Whoop – Whoop	GPWS (excessive descent or closure rate)
Fire bell	Fire warnings
Clacker	Excessive stabilizer trim Movement VMO/MMO exceedance Airspeed too high for current flap setting
Cavalry Charge	Autopilot disconnect
Horn	Gear warning (not down)
Triple chime	Warning tone (indicates an aircraft system voice advisory)
C-chord	Altitude alert
Single chime	Caution tone (indicates an aircraft system voice advisory)

Faulty aural warnings may result from a defective DCU. There are two guarded pushbuttons on the co-pilots side panel – called the audio warning panel – to switch off the affected DCU. Open the guard and press the pushbutton to deactivate the DCU. Switching a DCU off triggers respective EICAS messages and the pushbutton will illuminate white.

MASTER WARNING LIGHT

There is a master warning light on either side – the pilot's and the co-pilot's side. In case a warning is triggered, both lights come on and stay flashing if the warning exists or the warning light is pushed by the pilot or co-pilot. The aural warning and flashing light stay off until the next warning is triggered.

In the following cases the aural warning may not be muted:

- Stall warbler
- Stabilizer trim clacker
- GPWS/TCAS (voices and aural)
- AP Disconnect cavalry charge
- Overspeed clacker
- Configuration warnings
- Flap clacker
- Gear Horn

MASTER CAUTION LIGHT

Positioned right next to the master warning light is the master caution light. It works the same way the master warning light does.

In the following two cases the master caution may not be muted:

- GPWS and TCAS voice alerts
- Altitude alert (C-chord) aural

CREW ALERTING SYSTEM (CAS)

All warning / caution messages are sorted by priority / urgency and order of occurrence. The CAS works with four categories of messages, with different colour codes and behaviour, indicated in the following table.

In case the triggering condition / fault is removed the message will disappear from the EICAS again. New messages are added on top according their priority / category.

If the number of message exceeds the available lines in the EICAS, the message “PAGE 1/2” appears in red. All further messages are available on the following page(s). Press the CAS button to access the messages on the second side.

When messages are excluded from view by pressing the CAS button a “MSGS” message appears in the EICAS reminding the crew of the excluded messages. Same goes for advisories and status messages on the STAT page.

Category	**Aural Warning**	**Master warning / master caution**	**Color code**	**Sort order**	**Displayed on ED1 / ED2**	**Removeable from EICAS?**
Warning	Triple chime Or voice	Master warning	Red	top	ED1	No
Caution	Single chime	Master caution	amber	Below warnings	ED1	Yes – CAS button
Advisory	No	No	Green	Top of ED2	ED2	No – unless condition is removed
Status	No	No	White	Below advisory	ED2	Yes – STAT button

To reduce information during flight phases with high stress level, the DCUs filter information:

<table>
<tr><th>Inhibit</th><th colspan="2">Inhibit is enabled when:</th><th>Inhibit is removed when:</th></tr>
<tr><td>Initial take-off</td><td colspan="2">• Left and right engine N_1 is greater than 79%,
• weight-on-wheels, and airspeed is less than 100 knots.</td><td>• Left and right engine N_1 is less than 67.6%, or
• Airplane is in the final take-off phase</td></tr>
<tr><td rowspan="5">Final take-off</td><td colspan="2">• Left and right engine N1 is greater than 79%, and
• airspeed transitions to greater than 100 knots.</td><td>• Left and right engine N1 is less than 67.6%, or
• Radio altitude is greater than 400 ft AGL, or
• 30 seconds after ground to air transition.</td></tr>
<tr><td>Aircraft System</td><td>Warning Message
(Inhibited during take-off)</td><td>Aural
(Inhibited during take-off)</td></tr>
<tr><td>Environmental Control System</td><td></td><td>CABIN ALT Cabin Pressure</td></tr>
<tr><td>Flight Controls</td><td></td><td>Overspeed Clacker</td></tr>
<tr><td>Landing Gear</td><td>• GEAR DISAGREE
• NOSE DOOR OPEN</td><td>• Gear Disagree
• Nose Door</td></tr>
<tr><td rowspan="8">Landing</td><td colspan="2">• Radio altitude transitions to less than 400 ft AGL, and
• landing gear down and locked.</td><td>• 30 seconds after air to ground transition or
• Radio altitude transitions from less than 400 ft to greater than 400 ft.</td></tr>
<tr><td>Aircraft System</td><td>Warning Message
(Inhibited during take-off)</td><td>Aural
(Inhibited during take-off)</td></tr>
<tr><td>Auxiliary Power Unit</td><td>APU OVERTEMP</td><td>APU</td></tr>
<tr><td>Doors</td><td>PASSENGER DOOR</td><td>Door</td></tr>
<tr><td>Environmental Control System</td><td>• CABIN ALT
• DIFF PRESS</td><td>• Cabin Pressure
• Cabin Pressure</td></tr>
<tr><td>Ice and Rain Protection</td><td>• ANTI-ICE DUCT
• L COWL A/I DUCT
• R COWL A/I DUCT
• WING OVHT</td><td>• Anti-Ice Duct
• Anti-Ice Duct
• Anti-Ice Duct
• Wing Overheat</td></tr>
<tr><td>Landing Gear</td><td>NOSE DOOR OPEN</td><td>Node Door</td></tr>
<tr><td>Power Plant</td><td>• L ENG OIL PRESS
• R ENG OIL PRESS</td><td>• Engine Oil
• Engine Oil</td></tr>
</table>

In a similar fashion the cautions are inhibited as well. There are several caution messages which are not inhibited though:

Airplane system	**Caution message (not inhibited)**
Automatic Flight Control System	YAW DAMPER
Auxiliary Power Unit	APU LCV CLSD
Fire Protection	FIRE SYS FAULT
Flight Controls	• GLD NOT ARMED • GLD UNSAFE • GND SPLR DEPLOY • IB (OB) FLT SPLRS • IB (OB) GND SPLRS • IB (OB) SPOILERONS • PITCH FEEL • RUD LIMITER • SLATS FAIL • SPOILERONS ROLL • STAB TRIM • STAB TRIM LIMIT • STALL FAIL
Flight Instruments	EFIS COMP MON
Hydraulic Power	HYD 1 (2) (3) LO PRESS
	• ICE • ICE DET FAIL • L (R) COWL A/I OPEN • L (R) WING A/I
Landing Gear	• A/SKID INBD (OUTBD) • IB (OB) BRAKE PRESS • PROX SYSTEM • WOW INPUT (OUTPUT)
Pneumatic	• ANTI-ICE DUCT • L (R) BLEED DUCT • L (R) COWL LOOP
Power Plant	• L (R) ENG FLAMEOUT • L (R) ENG SRG CLSD • L (R) FADEC • L (R) FADEC OVHT • L (R) REV INOP • L (R) REV UNLOCKED • L (R) REV UNSAFE

TAKE-OFF WARNING

A lot of aircraft do have take-off configuration warning. The actuals aircraft is checked according a pre-defined logic and in case a deviation is recognized, the crew is informed. The CRJ does this automatically as soon as the engines are accelerated beyond 70% N_1.

The following systems / conditions are checked:

Condition	Voice Message	EICAS Message
Autopilot engaged	Config autopilot	CONFIG AP
Flaps not in take-off position	Config flaps	CONFIG FLAPS
All spoilers not in take-off position (down)	Config spoilers	CONFIG SPLRS
Horizontal stabilizer outside take-off range (green band)	Config trim	CONFIG STAB
Parking brake set	Config Brakes	PARKING BRAKE SET
Rudder trim outside of take-off range (trim > ±1 degree)	Config trim	CONFIG RUDDER
Aileron trim outside of take-off range (trim > ±1 degree)	Config trim	CONFIG AILERON

If the aircraft detects a deviation it is considered unsafe for take-off. Aural and warning messages will indicate if such a condition is detected. Furthermore, both MASTER WARNING lights come on.

As soon as the triggering system is corrected, the warning is silenced.

LANDING CONFIG WARNING

Like the take-off configuration the landing configuration is automatically checked, too. A deviation will be indicated by the landing gear horn. Two minutes after lift-off (ground to air transition) the mechanism is armed and will sound if one of the following conditions exists:

- Radio altitude < 500 ft
- Both throttles at less than maximum landing setting
  OR
- Flaps > 30°

OR

- Both throttles at less than maximum landing setting
  OR
- Any one throttle is at IDLE with the landing gear warning horn muted

AND

- Airspeed < 170 kts
- Flaps > 30°
  OR
- Airspeed < 190 kts
- Flats / slats = 0

AND

- Radio altimeter OR throttle is not valid

OR

- Radio altitude is less than 1000 ft AGL
- vertical speed less than -400 ft/min

AND

- No windshear warning or a windshear warning with a windshear monitor failure

OR

- Radio altitude is less than 1000 ft AGL
- vertical speed OR GPWS not valid

The “Too low gear” aural warning is heard if:

- any landing gear is not down and locked
- radio altitude less than 500 ft AGL
- indicated airspeed at less than 190 knots.

MENU PAGE

The MENU page is divided into three sections: menu section, confirmation section and parameter readout. A cursor on the left side of the screen is controlled by the UP/DN buttons on the EICAS control panel (ECP). The SELECT button on the ECP is used to select a line item.

The menu list contains a single FUEL USED RESET line. When the line is selected, the ACCEPT/CANCEL selections in the confirmation section are used to accept or cancel the request to reset to zero the "Fuel Used" indication, on the FUEL synoptic page.

The parameter readouts section contains the engine OIL LEVEL indications.

FLIGHT DATA RECORDER

Real aircraft are equipped with flight data and voice recorders. The CRJ's flight data recorder saves different information for 25hrs of flight. The FDR automatically starts recording as soon as the BEACON light, STROBE light is switched ON or a take-off-like condition is detected via the wheels. In case the pilots want to mark a certain event, they can push the FDR event button for 2 seconds and a timestamp is saved.

The voice recorder saves the last 120 minutes of cockpit communication and passenger announcements as soon as the aircraft is powered up.

TEST:
Pressing and holding the TEST button for 5 seconds initiates a selftest procedure. The adjacent green light indicates a succesfull selftest.

ERASE:
Not simulated / not relevant as no Flight Data Recorder is simulated. Would normally erase the previous recording (on ground only)

FDR Event:
Not simulated / not relevant as no Flight Data Recorder is simulated. Pressing this button to 2 seconds records a time stamp on the FDR.

AUTOMATIC FLIGHT CONTROL SYSTEM

The automatic flight control system consists of several systems:

- Flight Director
- Autopilot
- Flight control computers
- Two yaw dampers
- Automatic elevator trim
- Servos / actuators

The flight director computes a flight path which needs to be followed to archive certain pre-set constraints (i.e. climb at a pre-defined speed to a pre-set altitude). The autopilot computes the required flight control's

deflections / trim adjustment to archive the commanded flight path. The flight control computers, FCCs, calculation are based on data from the inertial reference system and air data computers.

Further input sources are selections made on the flight control panel, flight management computer outputs and radio system outputs.

FLIGHT DIRECTOR

At this point we like to emphasize the difference between the flight director and the autopilot again. The flight director indicates the needed attitude to archive a pre-set flight path based on selected mode by means of two cross-hair bars or a v-shaped indication on the PFD's attitude direction indicator. The flight director does not control any actuator, flight controls, engine parameters or such to follow the flight path. It is solely for indication.

The autopilot on the other hand controls the flight control's servos and actuators to make the aircraft fly along the pre-set flight path in accordance with the programmed modes. Basically, the autopilot will do everything needed to follow the flight director.

Bear in mind that the CRJ has no auto throttle – during take-off, climb and go-around you get help from the FADEC and fixed throttle detents (see later chapters) but especially during descent and levelling off after descent you must monitor speed closely and adjust thrust as necessary.

The programmed / selected modes are split up in lateral and vertical modes and are presented on the PFD on top of the attitude direction indicator. The following section introduces and explains the available modes.

Click the FD pushbutton to activate and deactivate the flight director. Dave allows you to select different types of flight directors as this differs between companies.

FLIGHT MODE ANNUNCIATOR – LATERAL MODES

Mode	**Commanded attitude**	**Annunciation**	**Select**	**Cancel**
Take-off mode	On ground: wings level After lift-off: heading hold Bank angle ≤ 5°		TOGA button on thrust lever	Synchronize FDs Select different lateral mode
Navigation mode	Capture and follow a track to a navigation source	Nav source „VOR1/2, LOC1/2 or FMS1/2“ illuminates in green	NAV button	
Heading select mode	Capture and hold selected heading	Green HDG message	Push HDG knob	Select different lateral mode
Back course mode	Capture and hold selected back course	Green B/C ½ message	Push B/C switch	Push B/C switch again or selecting another lateral mode
Roll mode	Holds the existing heading. Given the roll angle upon initiation was not over 5°	Green ROLL message	Roll mode is selected automatically if no other lateral mode is active	Selecting any other lateral mode
Half bank mode	Reduces maximum bank angle by 50%	White ½ BNK message	Push ½ BANK switch or climbing through 31,600ft	Pushing ½ BANK again
Lateral go-around mode	Heading Hold command, 5° bank limit, clears all other modes, turns on both flight directors and turns off the autopilot	Green GA message	Press of TOGA button on thrust lever	Selecting Synchronization or selecting another lateral mode
Approach mode	Commands to capture and track the selected navigation source. In case no valid navigation source is received, the mode arms but tracking won’t work. Automatically selects glideslope mode	Green message of the used navigation source: VOR ½, LOC ½, FMS ½.	Press APPR switch.	Press APPR switch again, selecting another lateral mode, changing nav source

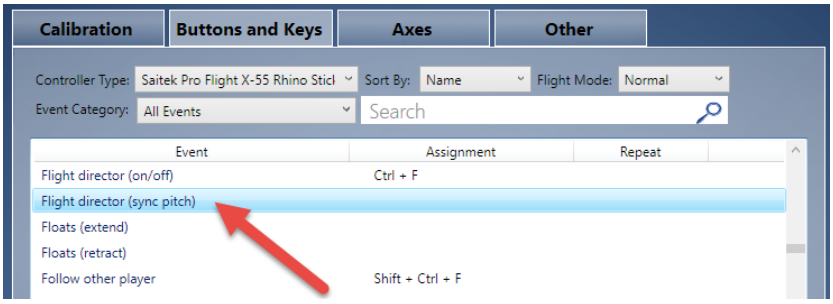
FLIGHT MODE ANNUNCIATOR – VERTICAL MODES

Mode	Commanded attitude	Annunciation	Select	Cancel
Vertical Take-off mode	Generates a fixed pitch-up command (pitch angle depends on take-off speed and difference between V2 and VR – loss of an engine reduces commanded pitch) clears all other modes, turns on both flight directors and turns off the autopilot	Green TO message	Press of TOGA button on thrust lever	Press TOGA switch again Engage autopilot Select synchronization Select another active mode
Pitch mode	Command to maintain pitch angle at activation. Reference value may be altered using the VS pitch wheel (1/2-degree change per click). When preselecting an altitude – altitude preselect mode must be activated before activating pitch mode	Green PTCH message	Pitch mode is automatically selected when the flight director is activated. Rotating the VS pitch wheel also activates the pitch mode (unless in glideslope capture or VS mode)	Selecting a vertical hold mode Selecting a vertical mode capture
Altitude Hold mode	Generates commands to capture and hold selected altitude. When the mode is selected, it sets the current altitude as reference.	Green ALT message	Press ALT switch	Press ALT switch again Selecting a vertical hold mode Vertical mode capture
Altitude preselect mode	Generates commands to capture and maintain a preselected altitude. The preselected value is displayed on the PFD. The capture point depends on the closure rate. In case the altitude is reselected during altitude capture (within 200ft of the preselected altitude), the flight director will ignore the new setting and capture the preselected altitude. As soon as altitude is captured, the flight director switches to altitude hold mode.	Annunciated by white ALTS message. Alt capture is indicated by green ALT CAP message.	It is automatically selected as soon as any vertical mode (except glideslope capture) is activated.	Cleared by glideslope capture or altitude capture and switching to altitude hold mode.
Speed mode (CLB, DES, IAS)	Commands pitch in order to capture and maintain and preselected airspeed. Speed is selected by turning the speed knob.	IAS CLB or IAS DES	Push the SPEED knob	Selecting another vertical capture mode Deactivate autopilot and flight director.

	As soon as the autopilot is activated or synchronization is activated the current airspeed is selected as the reference speed.			Capture of preselected altitude automatically deactivates speed mode.
Vertical speed mode	Generates commands to maintain and preselected vertical speed. The selected vertical speed is displayed on the PFD and may be selected in a range of ± 12,000 ft/min using the pitch wheel. As soon as the autopilot is engaged or synchronization selected, the reference vertical speed is set to the current vertical speed. In case a new altitude is preselected, the altitude must be preset before activating VS mode.	Green VS #.#↑ or VS #.#↓ The #.# shows the current vertical speed in thousands of feet/minute	Push the VS switch	Push VS switch again. Selecting a different vertical mode Capture of preselected altitude automatically deactivates vertical speed mode.
Glideslope mode	Generates commands to capture and follow a glideslope signal. Capture may be performed from above and below the glideslope.	Green GS message	Glideslope mode is activated automatically, when APR mode is active, the aircraft is flying towards (inbound) a navigation source with a valid glideslope signal.	Turning outbound or dialling in a different navigation source, deactivating APP mode clears glideslope mode.
Vertical go-around mode	Fixed pitch-up command. The commanded pitch angle depends on if both engines are running or one engine is inoperative. Activation automatically turns on both flight directors disengages both autopilots and clears all other modes. The resulting autopilot disengagement warning sound may be cancelled by pressing the TOGA switch again.	Green GA message	Press TOGA switch on thrust lever	Engaging the autopilot. Selecting synchronization. Selection / capturing or another active mode.

SYNCHRONIZATION

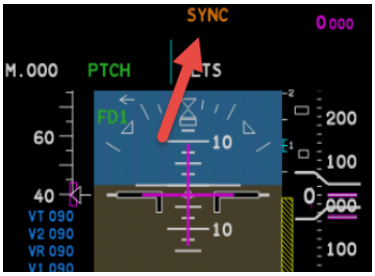
Synchronization enables you to synchronize the flight director bars with the current flight attitude.



The Sync switch on the yoke is not simulated (because it is hidden on the backside of the yoke), so you must use the standard key assignment "flight director synchronization". **Please note this standard key is NOT assigned in FS/P3D so you must assign a key to it before it can be used.** We used [control]-[shift]-[s].

It has no effect in case the autopilot is engaged and only certain lateral and vertical modes allow synchronization:

- Lateral
- Bank mode
- Vertical
- IAS mode
- MACH mode
- VS mode



Synchronization is annunciated by an amber SYNC indication on the PFD. The message disappears after 3 seconds.

ALTITUDE ALERT SYSTEM

The pilots are notified on the PFD in case they are reaching / leaving a preselected or selected altitude. The respective advisories are all displayed on the PFD but in two different places:

- The readouts and bugs change colours and state according the following rules:
- Approx. 1,000ft before reaching a preselected altitude an aural warning for approx. 1 second is sounded, and the readout and bugs flash in magenta for approx. 4 seconds
- Within 200ft of the (pre-)selected altitude the readout and bugs come steady to indicate altitude capture
- In case the aircraft deviates for more than 200ft from the selected altitude after capture, a 1 second tone will sound and the readout and altitude bugs will start to flash amber (and continue if the deviation occurs or the warning is cancelled by pressing the ALT switch or selecting a different altitude)
- In case the aircraft is 200ft below the selected altitude the flashing magenta bugs and readout will cancel
- If the aircraft deviates further (± 1,000ft) from the selected altitude a 1 second tone sounds
- As soon as the aircraft is again within 200ft of the selected altitude the readout and bugs will cease to flash

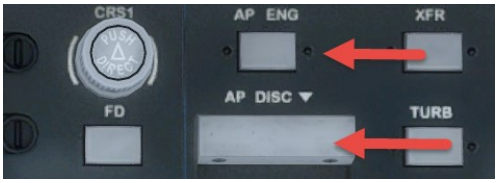
AUTOPILOT

The installed autopilot is a two-axes, digital, fail-passive autopilot. It commands input to the ailerons, elevators and rudder via the flight control computers, FCCs.

To activate the autopilot the following requirements need to be fulfilled:

- All flight control computers (FCC) are operative
- At least one channel of horizontal trim is available
- At least one yaw damper is engaged
- At least one IRS system is available
- At least one air data computer (ADC) is available
- No significant instability of the aircraft

When flying through turbulent weather autopilot's corrective signals might reduce passenger comfort. By selecting the turbulence mode, the intensity of signals is reduced to smooth aircraft motion. Turbulence mode is automatically cleared as soon as a localizer is captured. The autopilot is activated with the AP ENG pushbutton and can be deselected by the AP DISC push bar.



The autopilot can also be disengaged by any of the following controls.

1. Push AP/SP DISC switch on control when – this equals the autopilot disengage button / key assignment within FS.
2. Push the AP ENG switch on the flight control panel
3. Lower the AP DISC switch-bar on the right flight control panel
4. Operating the stabilizer trim
5. Pressing the TOGA switch on the thrust levers
6. Disengaging yaw damper by pressing the DISC pushbutton on the yaw damper panel

Disengagement of the autopilot is indicated by an aural warning (cavalry charge) and the AP indications on the PFDs turns red. After two repetitions of the cavalry charge the warning is cancelled automatically.

Automatic disengagement of the autopilot occurs:

- In case both yaw dampers are disengaged or fail
- In case a failure in the FCC monitoring circuit is detected (not simulated)
- In case a stall warning is triggered
- During a windshear and the subsequent clearance procedure.
  It automatically disconnects approx. 2 seconds after the windshear warning

In case the autopilot is disengaged automatically, the following warnings (aural and flashing red AP indication on the PFD) may be cancelled by pressing the AP/SP DISC switch or either TOGA switch.

COMMUNICATIONS

Some parts of the communication systems cannot be modelled and are not integrated in this package like the crew / passenger addressing system, boarding music system, external communication panels, attendant headsets or similar. So, the communication system basically consists of the

- Audio control panel
- Interphone panel on the centre pedestal
- Intercom control panel
- The radio tuning units

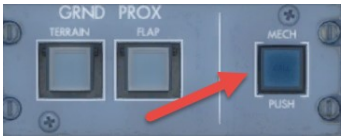
AUDIO CONTROL PANEL

The audio control panel is part of the audio integrating system. The audio integrating system provides display and control for all incoming and outgoing audio signals of the aircraft's navigation and communication system. Three audio control panels are the interface between the crew and the audio integrating system.

1. **Transmit Selector**: Selects the communication system, only one can be active.
2. **Receive pushbuttons**: Click to select and deselect.
3. **Voice/Both**: At voice only the voice transmissions are audible, at both voice and station indentification are audible.
4. **DME Ident selector**: Press to select
5. **ADF Ident selector**: Press to select
6. **NAV Ident selector**: Press to select
7. **MKR Ident selector**: Press to select

The other functions are not simulated.

INTERPHONE AND INTERCOM CONTROL PANEL



The interphone panel on the centre pedestal is part of the ground crew interphone. The ground crew interphone is used to establish communication between crew in- and outside of the aircraft (like during pushback, engine start, aircraft maintenance). Hence there are several panels in and outside the aircraft to establish communication. The interphone panel on the pedestal is the only one modelled and as the counterparts are missing as outside crew there is no function associated with the ground crew call button which is normally used to establish communication to an outside crew.

The intercom control panel is used for in-airplane-communication and it faces similar limitations like the interphone panel. It is not simulated, on the real plane, it offers four modes of communication:

- **PA**: Used to address passengers – turns green when activated / pushed
- **CHIME**: Sounds a chime in the cabin
- **CALL**: Sounds a chime in the cabin and enables intercom to the flight attendants – turns green when activated / pushed
- **EMER**: Used for emergency calls from the flight deck to the flight attendants – flashed in amber when activated / pushed

RADIO TUNING UNIT (RTU)

Two VHF (very high frequency) communication systems provide AM (amplitude modulation) voice communication with ground stations and other aircraft. They operate in a range from 118.000 to 136.975 MHz They are tuned by via the radio tuning units in normal operation and in case both RTUs fail a backup tuning unit provides tuning for communication system 1.

The radio tuning units, RTU, are associated with the side they are installed on. Hence the left RTU controls COM 1 and NAV 1 and the right RTU controls COM 2 and NAV 2.

1. **FREQUENCY READOUT**: The current active frequency is shown in green
2. **SELECT KEY**: Push once to directly tune the active frequency, push twice to open COM main page
3. **TUNING WINDOW**: The while box indicates the frequency that can be adjusted

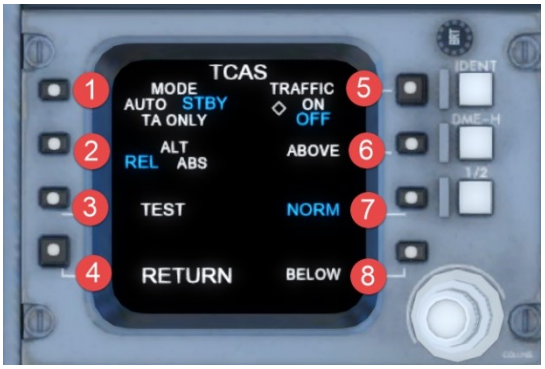
4. **PRE /RECALL:** PRE-indicates the frequency was changed, RECALL indicates the frequency was swapped with the active frequency
5. **PRE-SET FREQUENCY**: The Preset frequency (shown in white) can be swapped with the active frequency
6. **FREQUENCY SWAP**: Push to swap active with Preset
7. **ADJUST FREQUENCY**: in 25 kHz steps (COM) or 50 kHz steps (NAV)
8. **ADJUST FREQUENCY**: in 1 MHz steps
9. **IDENT**: Sends ATC Ident
10. **DME-H**: Locks frequency for DME measuring.
11. **1/2**: Swaps COM1/NAV1/ADF1 with COM2/NAV2/ADF2
12. **TCAS**: Push to open TCAS menu

COMS MENU

The COMS menu can be accessed by double clicking the COM select button (see #2 in previous image). It allows the toggling of Squelch.

TCAS MENU

The TCAS menu can be opened with the TCAS select button (see #12).



1. **MODE**: switch between Auto, Standby and Traffic Advisory Only
2. **ALT**: Toggles between relative (difference in altitude between aircraft and target) or absolute altitude display
3. **TEST**: Runs a test program
4. **RETURN**: back to main RTU menu
5. **TRAFFIC**: toggles display of traffic symbols on MDF
6. **ABOVE**: Shows traffic above altitude (can be selected with BELOW)
7. **NORM**: Standard display
8. **BELOW**: Shows traffic below altitude (can be selected with ABOVE)

BACKUP TUNING UNIT

The backup tuning unit provides a spare / backup in case both RTUs fail. Normally the backup tuning unit stays in standby mode the entire flight. As soon as it is switched on it takes control of COM1 and NAV 1.

1. **RTU INHIBIT**: Disables either RTU
2. **FREQUENCY DISPLAY**: Shows COM1 (upper) and NAV1) lower, TX is displayed to indicate transmission
3. **TUNING SELECTOR**: Toggles between tuning COM1 and NAV1
4. **FMS TUNE INHIBIT**: Stops FMS Autotune function
5. **ATC SEL**: To select the active transponder
6. **MODE SELECTOR**:
    a. OFF: Display off
    b. STB: Displays the frequency shown in RTU1
    c. ON: Frequency is controlled by the tuning knob
    d. SQ OFF: Squelch selected off
7. **TUNING KNOB:** To set frequency

ELECTRICAL

The CRJ's electrical system can be split into an alternating current, AC, subsystem and a direct current, DC, subsystem. The alternating current, AC system is supplied with power from the engine generators (integrated drive generators, IDGs), the auxiliary power unit's generator or the air driven generator, ADG (which is a backup in case both IDGs fail). The direct current, DC, system is supplied with power from two transformer rectifier units, TRUs, the main battery, or the APU battery. The TRUs convert alternating current to direct current. To reload both batteries, battery chargers are installed as well.

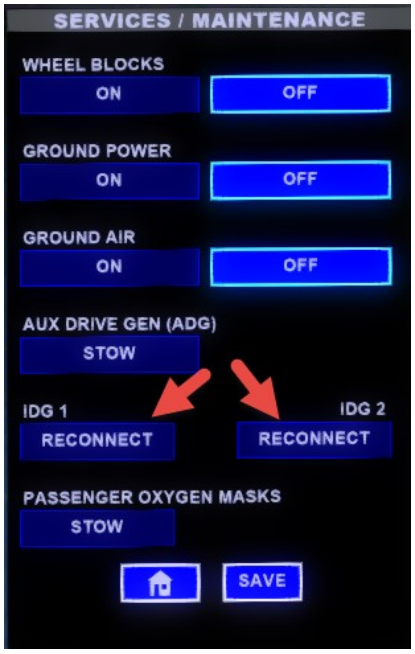
Both subsystems use computers to ensure the proper power distribution to the respective systems. The following table shows the available AC and DC busses.

AC busses	**DC busses**
• AC BUS 1 • AC BUS 2 • AC ESSENTIAL BUS • AC SERVICE BUS • ADG BUS	• DC BUS 1 • DC BUS 2 • DC ESSENTIAL BUS • DC SERVICE BUS • DC BATTERY BUS • DC EMERGENCY BUS • DC UTILITY BUS • MAIN BATTERY DIRECT BUS • APU BATTERY DIRECT BUS

Furthermore – when on ground – an external power receptacle is available which allows the CRJ to be supplied with ground power. The electrical power panel on the overhead panel is used to control the electrical systems. Error messages, warning or advisories are indicated on the EICAS.

ALTERNATING CURRENT, AC SYSTEM

During normal operation, the IDGs supply alternating current. The APU may be used as a backup in case both IDGs fail. In case even the APU fails, the CRJ is equipped with an Air Driven Generator, ADG, which is basically a propeller which is extended into the airstream. The ADG can provide enough power for the most important aircraft systems to be still able to fly the aircraft.



The IDGs are monitored regarding temperatures, oil pressure and supplied power. In case of exceedances the affected IDG can be disconnected automatically. Nevertheless, there is also a possibility by means of a switch light on the electrical power panel, to disconnect the IDG manually.

Please bear in mind that a disconnected IDG (no matter if disconnected automatically or manually) can only be reconnected on ground. Please open Dave, go to the “Services / Maintenance” page to reconnect the IDG. Disconnected IDGs are displayed in blue. Press on “Reconnect” and “Save” to reconnect.

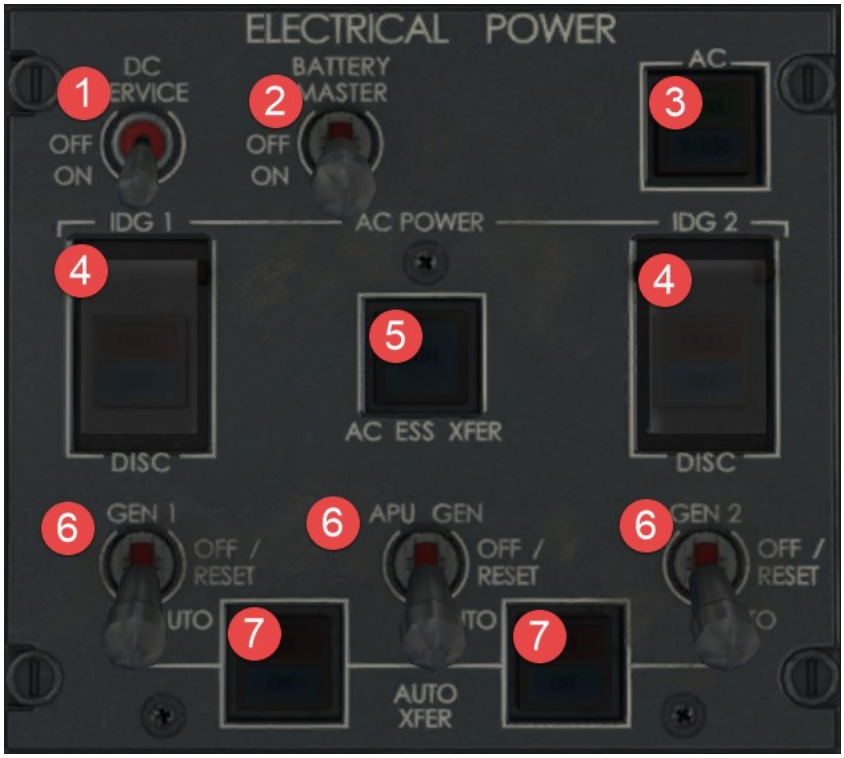
Before disconnecting you may try to reset the IDG by switching the generator switch on the electrical control panel to OFF/RESET and then back to ON.

The following table shows the power distribution in the AC system for normal operation:

AC BUS 1	**AC BUS 2**	**AC ESSENTIAL**
• Flight Recorder Power • TRU 1 • Main Battery Charger • Recirculating Fan 1 • Display Cooling Fan 2 • Lavatory Exhaust Fan • Baggage Compartment Heater • Slats and Flaps Channel 1 • Pitch Trim Channel 1 • Hydraulic Pumps 3B and 2B • Hydraulic System Fan • Left Windshield Heater • TAT Probe Heater • Right AOA Heater • Right Pitot Heater • Enhanced Ground Proximity • Warning System (EGPWS) • Engine Vibration Monitor • Avionics Cooling Fan 2 • ADG Heater	• TRU 2 • Essential TRU 2 • Recirculating Fan 2 • Galley Exhaust Fan • Galley Heater • Slats and Flaps Channel 2 • Pitch Trim Channel 2 • Hydraulic Pumps 3A and 1B • Right Windshield Heaters • Right Window Heater • Ice Detector 2 • Co-pilot Panel Integral Lights • Inertial Reference Unit Fan	• Essential TRU 1 • Display Cooling Fan 1 • Avionics Cooling Fan 1 • Crossflow Pump • Left Pitot Heater • Standby Pitot Heater • Left AOA Heater • Ice Detector 1 • Left Window Heater • Cabin Ceiling Lighting • CB Panel Integral Lights • Pilot Panel Integral Lights • Overhead Panel Integral Lights • Centre Panel Integral Lights • Traffic Alert and Collision Avoidance System (TCAS) • Engine Ignition A

AC SERVICE BUS	**ADG BUS**
• APU Charger • Logo Lights • Cabin Sidewall Lighting • Cabin Ceiling Lighting • Toilet • Water System	• Hydraulic Pump 3B • Pitch Trim 2 • Slats and Flaps #1 • Slats and Flaps #2

CONTROLS ON OVERHEAD PANEL



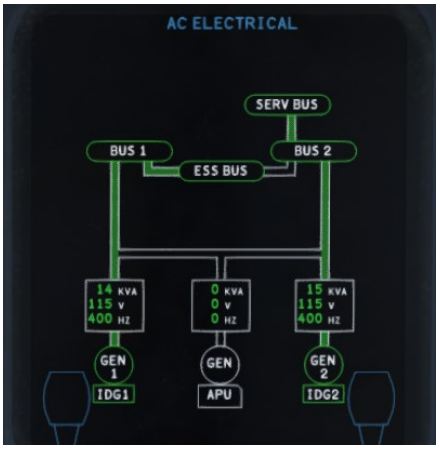
1. **DC SERVICE**: Connects the DC service bus to the APU battery direct bus
2. **BATTER MASTER**: Used to supply the battery bus with power from the APU or main direct busses. Always ON in flight!
3. **AC**: External Power toggle
   - AVAIL indicates connected source
   - IN USE indicates AC busses are connected to external power unit
4. **IDG1/2 DISCONNECT**: Open guard and press push button to disconnect IDG1 (reconnect on ground only!)
   - DISC (white) indicates IDG is disconnected
   - FAULT (amber) indicates low oil pressure or high temperature
5. **AC ESS XFER**: Switches essential bus feed from AC bus 1 to AC bus 2, switches automatic in case of IDG1 failure
   - ALTN (white) indicates essential bus is fed from AC bus 2
6. **GEN 1**: Used to switch generators between AUTO and OFF
7. **AUTO XFER**: Disables automatic transfer of respective IDG
   - OFF indicates autotransfer is deactivated
   - FAIL indicates a fault is preventing autotransfer

EICAS SYNOPTIC PAGE – HOW TO OPEN AC & DC ELECTRICAL SYNOPTIC PAGES

The AC and DC electrical synoptic page is opened via the EICAS control panel by pressing the ELEC key (1) once to open the AC electrical synoptic page and twice to open the DC electrical synoptic page.

EICAS SYNOPTIC PAGE – ELECTRICAL POWER SUPPLIED FROM ENGINES

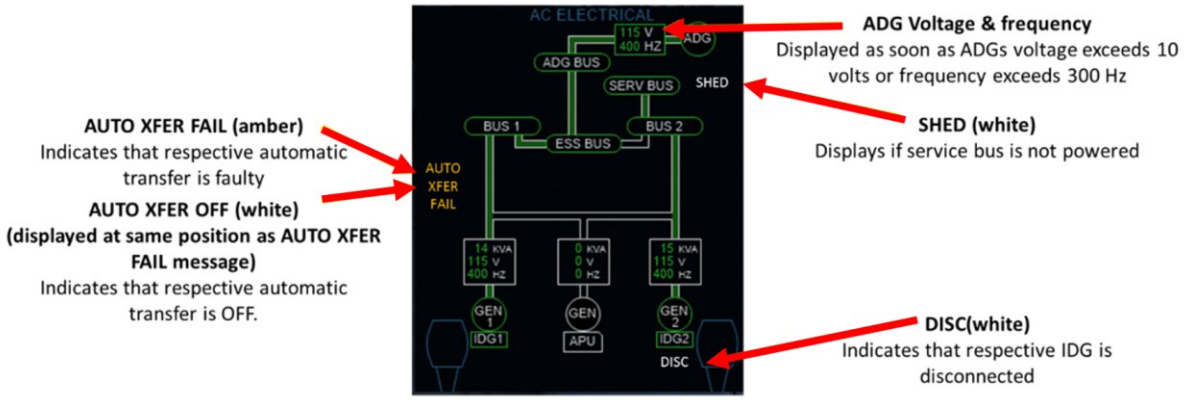
On the EICAS Electrical displays the green flow lines show energized busses, white lines show not energized busses.



EICAS DIGITAL READOUT	GREEN	AMBER	WHITE	HALF INTENSITY AMBER	AMBER DASHES
XXX kVA	Generator loaded	Generator overload	Generator not loaded	Insufficient data	Invalid data
XXX V	Voltage in range	-	Voltage not in range	Insufficient data	Invalid data
XXX HZ	Frequency in range	-	Frequency not in range	Insufficient data	Invalid data

EICAS OUTLINE	GREEN	AMBER	WHITE	HALF INTENSITY AMBER	HALF INTENSITY CYAN
BUS	Bus powered	Bus not powered or voltage low	-	Invalid data	-
GEN	Generator on	Generator off with engine / APU running	Both generator and engine / APU are off	Invalid data	-
IDG	Constant speed drive on	Low oil pressure or high oil temperature	Engine is off or IDG is disconnected	Invalid data	-
APU	-	-	Engine / APU off	Invalid data	Engine / APU running and ready to load

EICAS SYNOPTIC PAGE – ELECTRICAL POWER SUPPLIED FROM AIR DRIVEN GENERATOR



EICAS DIGITAL READOUT	GREEN	WHITE	AMBER DASHES
XXX V	Between 108 and 130 volts	Less than 108 or more than 130 volts	Invalid data
XXX HZ	Between 360 and 440 Hz	Less than 360 or more than 440 Hz	Invalid data

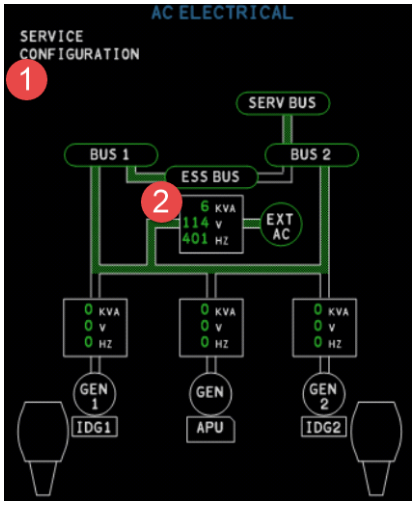
EICAS OUTLINE	GREEN	WHITE
ADG BUS	ADG outline green	ADG outline white
ADG	Voltage and frequency digital readouts green	Voltage or frequency digital readouts white

EICAS SYNOPTIC PAGE – ELECTRICAL POWER SUPPLIED FROM EXTERNAL POWER

Before you can connect an external power supply to your aircraft you need to set the parking brake and/or chocks and then activate the power cart via Dave. So please open Dave and proceed to the "Services / Maintenance" menu, then activate the chocks and ground power. Then press SAVE.

The green AVAIL light of the AC pushbutton on the overhead panel will illuminate as soon as the power supply is connected to the aircraft. Press pushbutton to accept power supply. Please note that engines and APU generators need to be off.

1. When External Power is available SERVICE CONFIGURATION will be displayed
2. When External Power is connected to the busses the Generator load, Voltage and Frequency will be displayed



EICAS MESSAGES

For certain occurrences, messages are triggered on the EICAS ED1 and ED2 display.

- **IDG 1/2** CAUTION (amber): Low oil pressure or high temperature
- **GEN 1/2** CAUTION (amber): Generator(s) off
- **GEN 1/2** CAUTION (amber): Generator load over 40 kVA
- **APU GEN OFF** CAUTION (amber): APU generator ready but off
- **APU GEN OVLD** CAUTION (amber): APU generator load over 40 kVA
- **IDG 1/2 DISC** (white): IDG(s) disconnected
- **EMER PWR ONLY** WARNING (red): ADG deployed
- **AC BUS 1/2** CAUTION (amber) : Bus not powered
- **AC ESS BUS** CAUTION (amber) : AC essential bus voltage under 90 Volts
- **AC 1/2 AUTOXFER** CAUTION (amber) : Automatic bustransfer failed
- **AC 1/2 AUTOXFER OFF** (white): Automatic bustransfer deactivated
- **AC ESS ALTN** (white): Essential bus fed from AC bus 2
- **ADG FAIL** (white): Generator control unit failed
- **ADG AUTO FAIL** (white): ADG deployment control unit failed

DIRECT CURRENT, DC SYSTEM

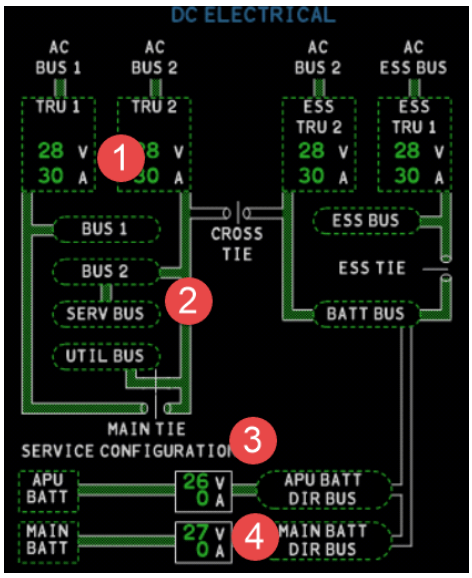
Direct power is supplied by four transformer rectifier units, TRUs and two batteries.
The following table shows normal power distribution from the AC to the DC system:

INPUT BUS	TRU	OUTPUT BUS
AC BUS 1	TRU 1	DC BUS 1
AC BUS 2	TRU 2	DC BUS 2 / DC UTILITY BUS
	ESSENTIAL TRU 2	DC BATTERY BUS
AC ESSENTIAL BUS	ESSENTIAL TRU 1	DC ESSENTIAL

ESS TRU 2 is normally supplied AC power from AC BUS 2. If AC BUS 2 is not available, ESS TRU 2 will be automatically supplied from the AC ESS BUS, via the ESS TRU 2 XFR switch.

Battery	location	Output voltage	Capacity
APU	Aft equipment compartment	24V DC	43 Ah (ampere hours)
MAIN	Nose avionics compartment	24V DC	17 Ah (ampere hours)

1. **TRU VOLTAGE / TRU LOAD**
2. **FLOW LINES**: Green indicates bus energized, white indicates bus not energized
3. **SERVICE CONFIGURATION**: Indicates DC service is selected ON
4. **BATTERY VOLTAGE / BATTERY LOAD**



EICAS DIGITAL READOUT	GREEN	WHITE	AMBER DASHES
XX V (TRU)	Between 22 and 29 volts	Less than 22 volts or more than 29 volts	Invalid data
XX V (BAT)	Between 18 and 32 volts	Less than 18 volts or more than 32 volts	Invalid data
XX A (TRU)	Between 3.7 and 120.7 amps	Less than 3.7 amps or more than 120.7 amps	Invalid data
XX A (BAT)	Between 1.7 or not less than 12 volts	Less than 1.7 amps and less than 12 volts	Invalid data

EICAS OUTLINE	GREEN	AMBER	WHITE	AMBER DASHES
II BUS	Bus powered	Bus not powered	-	Invalid data
DIR BUS	Not less than 18 volts	Less than 18 volts	-	Invalid data
TRU	Not less than 3.7 amps and not less than 18 volts	-	Less than 3.7 amps and less than 18 volts	Invalid data
BATT	Not less than 18 volts	Less than 18 volts	-	Invalid data

EICAS MESSAGES

For certain occurrences, messages are triggered on the EICAS ED1 and ED2 display.

- **APU / MAIN BATT OFF** CAUTION (amber): APU or main battery is not available
- **DC BUS 1/2** CAUTION (amber): DC bus not powered and AC bus 1 or 2 online
- **DC EMER BUS** CAUTION (amber): Emergency bus not powered
- **DC ESS BUS** CAUTION (amber): Essential bus not powered in flight / Essential bus not powered and AC or APU generator on line on ground
- **DC SERV BUS** CAUTION (amber): Service bus not powered AND either DC bus 2 OR DC SERVICE is selected AND APU voltage > 18 volts
- **BATTERY BUS** CAUTION (amber): Battery bus not powered
- **DC CROSS / DC MAIN / DC ESS TIE CLSD** (white): Respective bus tie closed
- **ESS TRU 2 XFR** (white): Displayed when essential TRU 2 is powered by AC essential bus
- **APU BAT / MAIN BAT CHGR** (white): Battery not charging or overheating
- **TRU 1/2 FAIL** (white): TRU 1/2 voltage < 18 volt with AC BUS 1/2 online
  OR main is closed with TRU 1/2 load < 3.7 amps
- **ESS TRU 1/2 FAIL** (white): Essential TRU 1/2 voltage < 18 volt with AC BUS 1/2 online
  OR main is closed with essential TRU 1/2 load < 3.7 amps

DC BUS 1		
Flight Recorder Control	ACS Control 2 Channel A	Brake Pressure Application
EICAS Primary Display	Lavatory Smoke Detector	PSEU Channel A
EICAS Secondary Display	SSCU 1 Channel A	Nose Wheel Steering
Left Lamp Driver Unit	Pitch Feel 1	Anti-Skid
EICAS Dimming	Radio Altimeter 1	Left Cabin Reading Lights
Data Loader	Hydraulic Pump 2 and 3B	Cockpit Dome Light
Left IAPS	Control	Taxi Lights
Boarding Music	Hydraulic System Fan Control	Nose Landing Lights
Passenger Door Actuator	Hydraulic System 2 Indication	Cockpit Floor Lights
ACPC Control 1	Anti-Ice Control Channel A	Rear Anti-Collision Lights
Baggage Compartment Control	Left T2 Heater	Wing Inspection Lights
Fan Monitor	Pilot Windshield Wiper	Maintenance Lights
Cabin Pressure Control 1	Left Windshield Heater Control	GPS 1
Cockpit Temperature Sensors	ADS Heater Control 2	DME 1
Aft Cabin Temperature Sensors	Right Static Heaters	Weather Radar

DC BUS 2		
Right IAPS	SSCU 1 Channel B	Right Window Heater Control
Right AFCS	Aileron and Rudder Trim	PSEU Channel B
Right IAPS Fan	Clock 2	Nose Wheel Steering
Observer Audio	Radio Altimeter 2	Brake Pressure Indication
VHF Communication 2	Air Data Computer 2	Anti-Skid
RTU 2	Primary Flight Director 2	Chart Holder Lights
Service Bus Feed	Multifunctional Display 2	Copilot Map Light
ACPC Control 2	EFIS Control Panel 2	Wing Anti-Collision Lights
Left ACS Pressure Sensors	Attitude Heading 2	ADF 2
Cabin Pressure Control 2	Right Fuel Pump and Control	Transponder 2
Galley Heater Control	Hydraulic System 1 Indication	VHF Navigation 2
Fwd Cabin Temperature Sensors	Hydraulic Pump 1 and 3A	DME 2
ACS Control 1 Channel B	Control	AHRS Fan 2
Right ACS Manual	Right T2 Heater	GPS 2
	Copilot Windshield Wiper	
	Right Windshield Heater Control	
	Right EFIS CRT Dimming	
EMERGENCY BUS	SERVICE BUS	UTILITY BUS
APU Battery Direct Bus Feed	Service Lights	Right Cabin Reading Lights
FIREX	Boarding Lights	
Engine and APU Fuel SOVs	Navigation Lights	
Hydraulic SOVs	Toilet Lights	
	Galley Area Lights	
	Beacon Lights	
	Water System	

ESSENTIAL BUS		
EICAS DCU 1	Stall Protection Right Channel	Anti-Ice Control Channel B
RTU 1	Left EFIS CRT Dimming	Instrument Flood Lights
Pilot Audio	EFIS Control Panel 1	Emergency Lights
Cockpit Voice Recorder	Air Data Computer 1	ADF 1
Door Indication 1 and 2	Primary Flight Director 1	Transponder 1
ACS Control 2 Channel B	Multifunctional Display 1	VHF Navigation 1
Left ACS Manual	Crossflow Pump Control	Attitude Heading 1
Display Fan Control	Fuel System Control	AHRS Fan 1
Right ACS Pressure Sensors	Left Static Heater	Bleed Air SOVs
Flap and Slat Control Channel 1	ADS Heater Control 1	Thrust Reversers
SSCU 2	ADS Standby Heater Control	Right Engine Oil Pressure
Pitch Feel 2 Rudder Travel Limit	Left Window Heater Control	Left T2 Heater

BATTERY BUS		
EICAS DCU 1 and 2	ACPC Control 3	Gravity Fuel Crossflow
EICAS Primary Display	ADG Deployment	Fuel Transfer SOVs
EICAS Secondary Display	ACS Control 1 Channel A	APU Fuel Pump
EICAS Control Panel	Ram Air SOV	Hydraulic System 3 Indication
Right Lamp Driver Unit	Manual Cabin Pressure Control	Cowl Anti-Ice Valves
EICAS Dimming	Passenger Oxygen Deployment	Wing Anti-ice Isolation Valve
Left AFCS	Crew Oxygen Monitor	PSEU Channel A and B
MDC	Cargo Smoke Detection	Weight-On-Wheels
Left IAPS Fan	Fire Detection	Passenger Signs
APU Control	MLG Bay Overheat Detection	Wing Landing Lights
APU ECU Primary	Flap and Slat Control Channel 2	Map Lights
VHF Communication 1	Aileron and Rudder Trim	Cabin Utility Lights
Emergency Tuning	Indication	Overhead Panel Lights
Pilot, Copilot and Observer Audio	Stall Protection Stick Pusher	EICAS and RTU Dimming
Cabin Interphone	Stall Protection Left Channel	Left Engine Oil Pressure
Passenger Address	Standby Instrument	Engine Starting
Emergency Bus Feed	Clock 1	FADEC
IDG Disconnect	Left Fuel Pump and Control	Engine Ignition B
Generator Control Units	Fuel System Control	
	Right T2 Heater	
MAIN BATTERY DIRECT BUS	**APU BATTERY DIRECT BUS**	
Main Battery Power Sensors	APU ECU Secondary	Service Bus Feed
Main Battery Control	APU Door Actuator	Emergency Bus Feed
External AC Power	APU Battery Power Sensors	Refuel/Defuel Control
DCPC 2	APU Battery Control	Emergency Refuel
Main Battery Charger Output	DCPC 1	Engine Oil Indication
Clocks	External AC Power	Engine Oil Replenishment
Cockpit Dome Lights		

ENVIRONMENTAL CONTROL SYSTEM

The environmental control system controls mainly the cabin temperature and cabin pressure of the aircraft. Even though this sounds very simple several different systems are needed to perform these tasks:

- Air condition units / Packs
- Cabin pressurization system
- Recirculation fans

AIR CONDITIONING SYSTEM / PACKS

With increasing altitude, the surrounding air gets thinner and colder as well. Above 12,000ft breathing is barely possible and the air temperature is below freezing point. With aircraft cruising at high altitudes processing the outside air before letting it enter the cabin is necessary. The air conditioning systems, also called packages, or packs perform this task by mixing and filtering cabin air and outside air. Hot bleed air from the engines is used to heat the air from outside before mixing it with the air from the cabin. Bleed air and outside air are not missed though. In case the engines are not running, bleed air from the auxiliary power unit, APU, may be used as well.

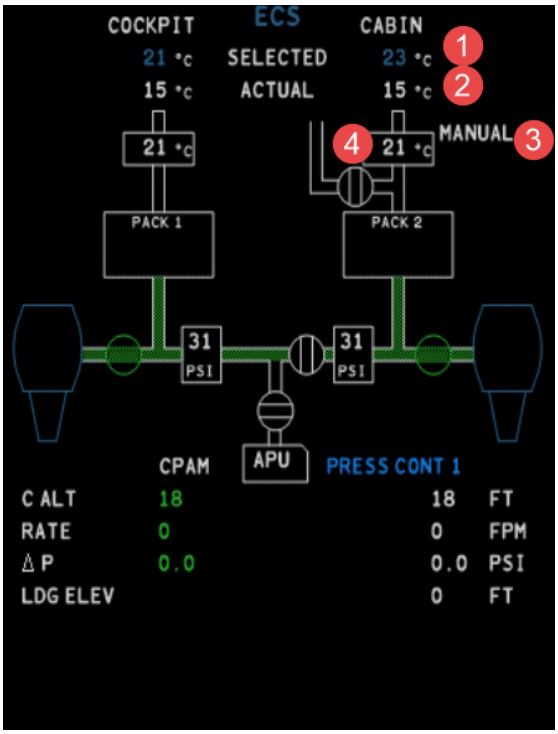
The CRJ is equipped with two packs. The left pack normally supplies the flight deck and the right pack supplies the cabin.

1. **LEFT (L) / RIGHT (R) PACK**: controls the operation of the conditioning packs.
2. **RECIRCULATION FANS**: controls the recirculation fans
3. **RAM AIR** (guarded): Used when both packs failed to let ambient air into the left (cockpit) air condition duct
4. **MANUAL MODE VALVE CONTROL**: Directly controls the valve positions for air condition in manual mode (cockpit/cabin)
5. **MANUAL MODE CONTROL**: Selects manual temparature control (cockpit/cabin)
6. **AUTOMATIC MODE TEMPERATURE CONTROL**: Used to set desired temparature (cockpit/cabin)
7. **AFT CARGO BAY AIR CONDITIONING**: Activates air conditioning in aft cargo bay. Should be set to COND after take-off

In case both packs fail and outside air needs to be ventilated into the cabin, you must descend to a suitable altitude (12,000ft or lower) and activate the RAM air ventilation by pressing the guarded RAM air pushbutton. OPEN illuminates in white after pressing / activating RAM air ventilation.

To ensure that the air cycles through the cabin, recirculation fans – which are installed in the mixing manifolds – support cycling. To activate the recirculation fans, move the RECIRC FAN switch to ON.

1. **SELECTED TEMPERATURE** (cyan): Indicates the selected temperature
2. **ACTUAL TEMPERATURE** (white): Indicates sensed temperature
3. **MANUAL** (white): Indicates manual mode is selected.
4. **SUPPLY DUCT TEMPERATURE** (white): Displays sensed temperature in the supply duct



ECAM MESSAGES

- **HI TEMP** (amber): High temperature detected
- **AUTOFAIL** (amber): Failure or pack in automatic mode is detected
- **L/R PACK AUTOFAIL** CAUTION (amber): Pack failed in automatic mode and is NOT switched to manual mode
- **L/R PACK TEMP** CAUTION (amber): Temperature is > 85 °C
- **L/R PACK** CAUTION (amber): Pack failed independent of mode (manual / automatic)
- **L/R PACK FAULT** STATUS (white): Indicates a fault in the pack
- **L/R PACK OFF** STATUS (white): Indicates pack is switched off
- **CKPT /CABIN TEMP MAN** STATUS (white): Indicates that manual mode is selected
- **RAM AIR** STATUS (white): Indicates ram air valve is open.
- **AFT CARGO OVHT** CAUTION (amber): Temperatures over 40° sensed
- **AFT CARGO SOV** STATUS (white): Air-inlet shut-off valve failed to open.

AVIONICS COOLING SYSTEM

All electrical systems heat up during use. Same goes for all the avionic in the cockpit. Given the restricted space, cooling is necessary to prevent the avionic from overheating. Two display (DSPLY) fans supply cold air to the displays – only one of them is running during normal operation: on ground fan 2 and in flight fan 1.

Furthermore, two AVIONIC fans extract the heated air from behind the avionics. On ground fan 2 is powered and in flight fan 1 is powered.

1. **DISPLAY FANS CONTROLS**
   - **GND ALT:** Select fan 1 during ground operations
   - **NORM:** Fans in exhaust duct operate in automatic mode to exhaust hot air from display and avionics compartments. Fan 1 used in flight, fan 2 used for ground operations

- **FLT ALT**: Select fan 2 during flight
- **STDB:** Selects conditioned air shut-off valve open

2. **AVIONICS FANS CONTROLS**
   - **GND ALT**: Selects fan 1 during ground operations
   - **NORM**: Fans operate in automatic mode: fan 1 supplies air in flight and fan 2 supplies air during ground operations
   - **FLT ALT**: Selects fan 2 during flight

ECAM MESSAGES

- **OVBD COO**L CAUTION (amber): Displayed when overboard exhaust shut-off valve is not closed AND passengers and service doors are closed. Unable to pressurize in this state.
- **DISPLAY COOL** CAUTION (amber): Displays when low airflow in cockpit cooling duct is detected.

CABIN PRESSURIZATION SYSTEM

Cabin pressure is regulated by controlling the flow of outflowing valve by adjusting the outflow valve's position. To limit differential pressure when on ground a ground valve is installed to prevent excessive differential pressure when on ground.

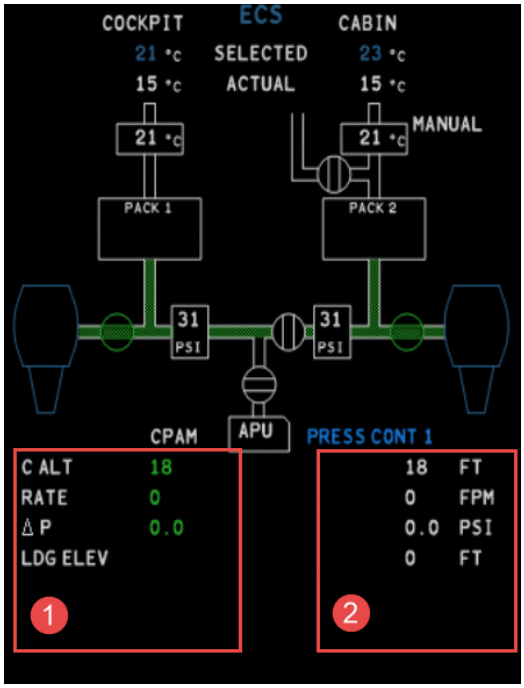
1. LDG LEVEL: Used to set destination airport altitude, selected value displayed on EICAS
2. MAN ALT: Controls for pressurization in manual mode:
   - UP: Opens outflow valve, increase cabin altitude
   - HOLD: All manual selections disabled
   - DN: Closes outflow valve, decreases cabin altitude
3. EMER DEPRESS (guarded): Depressurizes airplane in case of emergency, outflow valve is fully opened, cabin altitude is dumped to 14.500ft
4. PRESS CONTROL: Selects between automatic and manual control
   - MAN (white) light indicates manual mode is selected
   - FAULT (amber) light indicates a fault of both pressure controllers
   - OFF (no light) indicates automatic mode
5. MAN RATE: Adjusts altitude adjustment
   - UP RANGE: +150 to +4.000 fpm
   - DN RANGE: -100 to -2.500 fpm

ECAM MESSAGES

- **CABIN ALT** WARNING (red): Cabin altitude exceeds 10.000ft
- **DIFF PRES** WARNING (red): Differential pressure exceeds 8.6 PSI
- **AUTO PRESS** CAUTION (amber): Automatic pressurization control is unserviceable
- **CABIN ALT** CAUTION (amber): Cabin altitude between 8.500 and 10.000ft
- **EMER DEPRESS** CAUTION (amber): Emergency decompression activated

- **ALT LIMITER** CAUTION (amber): Altitude limitation function unserviceable
- **OVDB COOL** CAUTION (AMBER): Ground valve open in flight
- **AUTO PRESS 1/2 FAIL** STATUS (white): Cabin pressure control unserviceable
- **AUTO PRS 1/2 FAIL** STATUS (white): Active channel is lost in manual mode
- **CABIN PRESS MAN** STATUS (white): Landing elevation set above 8.000ft
- **CPAM FAIL** STATUS (white): Ground valve has closed on ground
- **OUTFLOW VLV OPEN** STATUS (white): Outflow valve in fully open position

1. **MONITORED DATA**
2. **ACTIVE DATA**



Item	Description	Green font	White font	Amber font	Red font	Amber dashes
C ALT	Cabin altitude in 100ft increments	Monitored data	Active data	> 8.500ft	> 10.000ft	Invalid data
RATE	Rate of climb of cabin altitude	Monitored data	Active data	-	-	Invalid data
DELTA P	Differential pressure between ambient and cabin pressure	Monitored data	Active data	-	> 8.6PSI	Invalid data
LDG ELEV	Selected landing field elevation in 20ft increments. Displayed in cyan					Invalid data, elevations above 15.000ft and below -2.000ft

Two cabin pressure controllers are available to regulate cabin pressure. Only one cabin pressure controller is active at a time – the other one is on standby but automatically updates the status of the cabin pressurization system. The pressure controller will automatically adjust the outflow valves position to maintain a differential pressure of 8.3 PSI.

The following table shows typical cabin altitude in relation to the aircrafts altitude.

Aircraft altitude (feet)	**Cabin altitude (feet)**
10‘000	-200
15’000	600
20’000	1’500
25’000	2’700
30’000	4’200
35’000	6’000
41’000	8’000

PRESSURIZATION MODES – AUTOMATIC MODES

Mode	**Trigger**	**Behaviour**
Ground mode	A/C on ground	Outflow valve & ground valve → full open
Pre-pressure mode (Packs ON)	Thrust levers advanced to take-off	Cabin climb rate = 300 ft./min, limited at a diff. pressure of 150 ft./min
Pre-pressure mode (Packs OFF)	Thrust levers advanced to take-off	Outflow valve and ground valve closed
Take-off abort mode	Thrust-levers retarded to idle	Cabin ascends for 20 seconds at approx. 500 ft./Min, then outflow valve full open
Climb mode		Fixed schedule cabin alt. vs. aircraft alt. Climb rates 500 to 800ft/min dependant on the aircrafts rate of climb
Flight abort mode	Aircraft maintained altitude 6’000ft above take-off field elevation for 10 minutes and has initiated descend of 1’000ft/min	System assumes landing elevation regardless of pre-selected landing elevation
Descent mode	descent	Cabin rate of descent approx. 300 to 700 ft/min to either landing field elevation or maximum differential. In case the landing field elevation is higher than 8’000ft, cabin altitude will be maintained at maximum differential, until the airplane descends, then the cabin altitude will rate up to the pre-selected landing elevation.
Landing mode	The cabin altitude is driven below field elevation or the airplane is unpressurized	When the cabin is below field elevation, then the cabin is rated up at approximately 600 ft/min for 30 seconds, then the outflow valve is driven full open
Touch and Go mode	Landing mode activated and thrust levers are advanced	System will switch to pre-pressure mode

PRESSURIZATION MODES – MANUAL MODES

Caution: In manual mode, you must manually select HOLD mode as soon as the required altitude is reached

Mode	**Trigger**	**Behaviour**
UP		Cabin ascends at selected rate of 150 (±150) to 3,000 (±500) fpm
DN		Cabin descends at selected rate -100 (±100) to -2,500 (±500) fpm
HOLD		Disables all previous MAN ALT selections

SAFETY VALVES

Two safety valves prevent the differential pressure exceeding its maximum.

- Maximum positive differential pressure limit 8.6 PSI (tolerance ±0.1PSI)
- Maximum negative differential pressure limit -0.5 PSI

GROUND VALVE

On ground the ground valve is normally open if passenger and/or service doors are open. The valve limits differential pressure drop due to discharging air from the avionics cooling. As soon as the passenger and service doors are closed and locked, or the pre-pressurization mode is initiated, the valve is driven to the CLOSED position.

In case the ground valve fails to open on ground an OVBD COOL FAIL status message appears on the EICAS status page.

CABIN ALTITUDE LIMIT

To prevent an increase of cabin altitude after passing 14’500 ft. (±500 feet) with the aircraft, the outflow valve closes automatically.

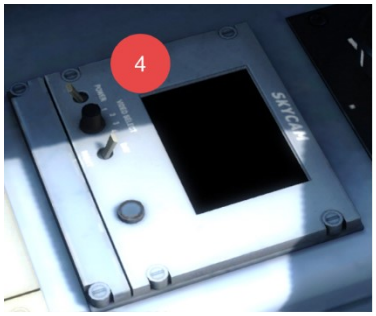
EMERGENCY DEPRESSURIZATION

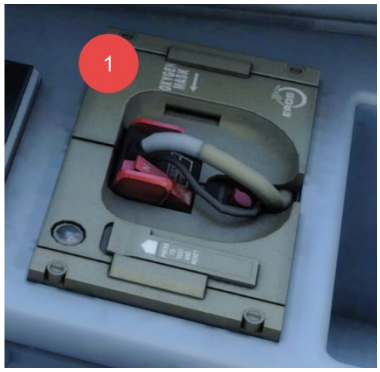
As soon as the EMER DEPRESS pushbutton is pressed, the outflow valve is driven open. In case the aircraft cruises at a higher altitude, the altitude limiter will limit cabin al to 15’000ft.

EMERGENCY EQUIPMENT

As most parts of the emergency equipment are hardware, there is not much to simulate within FS. You'll find four parts of the emergency equipment which are represented but without further function:

1. The oxygen masks on the pilots and co-pilots side, click to hear test the flow of oxygen
2. The PASS OXY switch on the overhead panel: Activates the oxygen supply for the passengers – not simulated obviously
3. The Emergency Locator Transmitter, ELT, switch.
   It is located on the overhead panel as well. It has two positions: ARM/RESET which is the usual position and ON. The ELT normally activates automatically as soon as a crash is detected. Nevertheless, this detection may be overridden by setting the switch to ON. The ELT sends a location signal as soon as activated to ease search and rescue crews finding the aircraft.
4. Skycam: After 9/11 authorities and manufacturers developed concepts to prevent other people than the flight crew from entering the cockpit in flight. Hence a reinforced and bulletproof cockpit door was developed which is supposed to stay locked throughout the flight. As the need to leave and enter the cockpit can't be prevented, a camera system was installed so pilots can check certain spots in the cabin via cameras and a display unit in the cockpit. This unit is represented In the CRJ's cockpit even though only static pictures are called when cycling through the Skycam-views.





FIRE PROTECTION

The following aircraft components are protected by the fire detection and protection system:

- Engines
- Auxiliary power unit, APU
- Forward and aft cargo compartment
- Main wheel well
- Lavatories

Fire detection is indicated by aural and visual warnings as well as EICAS warnings.

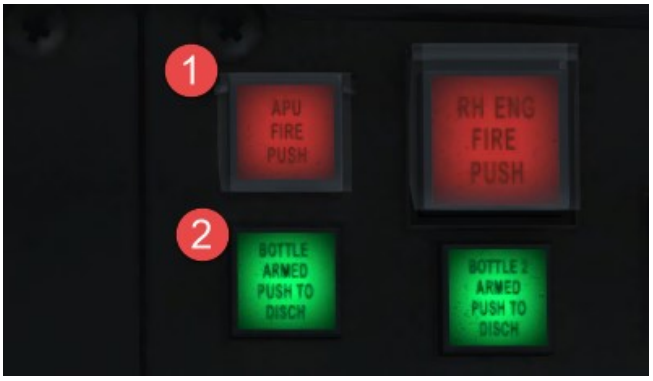
The engines, APU, forward and aft cargo compartment are monitored by the same fire detection and extinguishing system (called FIDEEX).

Fire loops, installed in the engines and the APU, indicate a fire and trigger the respective fire warning. To extinguish a fire, the engines are equipped with two FIREX bottles. Each bottle contains two squibs of halon which is injected with 600 PSI into the engine when triggered by the pilot. There is another bottle with just one squib for extinguishing APU fires.

ENGINE FIRE CONTROLS & MESSAGES

On the pilot's side, only the left engine fire controls are available, the right hand of the glare shield there are controls for both engines (shown here)

1. **LH/RH FIRE PUSH**: Red light indicates a fire was detected. Press to isolate the engine from the fuel transfer, hydraulic, bleed air systems. This results in an engine shut down.
2. **BOTTLE 1/2 DISCHARGE**: Press to discharge, green light indicates the squib is armed and bottle is charged.



ECAM MESSAGE

- **L/R ENG FIRE** WARNING (red): Engine fire detected
- **L/R ENG SQB** CAUTION (amber): Appears when either or both bottles have fired or have failed
- **L/R FIRE FAIL** CAUTION (amber): Indicates a failure in either fire detection system
- **ENG BTL1/2** CAUTION (amber): Indicates respective bottle was discharged
- **L/R ENG SQB** STATUS (white): Appears when either or both bottles have fired or have failed

L or R ENG FIRE warning (red)
Appears when a fire in the respective engine is detected

L or R ENG SQB caution (amber)
Appears when left or right squibs of **both bottles** are fired or failed.

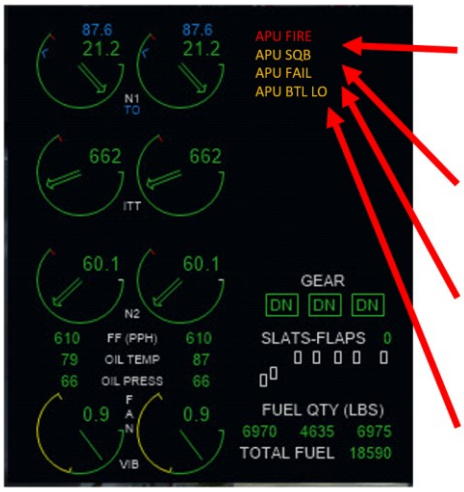
L or R FIRE FAIL caution (amber)
Indicates a failure of the respective fire detection system

ENG BTL 1 or 2 LO caution (amber)
Appears when the respective bottle was discharged

ENGINE FIRE EXTINGUISHING						
EVENT (Left engine fire procedure is described; the right engine fire procedure is similar)		**RESULT**	**GLARESHIELD INDICATIONS**			
			LH ENG FIRE PUSH	BOTTLE 1 ARMED PUSH TO DISCH	BOTTLE 2 ARMED PUSH TO DISCH	MASTER WARNING
1	Fire condition occurs in the left engine fire zone	Fire bell sounds MASTER WARNING LH FIRE PUSH switch lights come on	ON	OUT	OUT	ON
2	MASTER WARNING switch light is pressed in.	Fire bell is silenced MASTER WARNING switch out System is reset	ON	OUT	OUT	OUT
3	Left thrust lever is set to the SHUTOFF position	LH ENG FIRE PUSH switch light remains on	ON	OUT	OUT	OUT
4	LH ENG FIRE PUSH switch light is pressed in	BOTTLE 1 ARMED PUSH TO DISCH switch light comes on BOTTLE 2 ARMED PUSH TO DISCH switch light comes on Left squibs of bottles 1 and 2 armed Left engine fuel SOV closes Left bleed air SOV closes Left hydraulic SOV closes	ON	ON	ON	OUT
5	BOTTLE 1 ARMED PUSH TO DISCH switch light is pressed in	Left squib on bottle 1 fires FIREX agent from bottle 1 discharges into left power plant nacelle	ON	ON	ON	OUT
6	Bottle 1 fully discharges	The pressure switch on bottle 1 opens as pressure drops below the set point ENG BTL 1 LO is displayed on the EICAS	ON	OUT	ON	OUT
7	Fire condition in left engine persists	LH ENG FIRE PUSH switch light remains on	ON	OUT	ON	OUT
8	BOTTLE 2 ARMED PUSH TO DISCH switch light is pressed in	Left squib on bottle 2 fires FIREX agent from bottle 2 discharges into left engine nacelle	ON	OUT	ON	OUT
9	Bottle 2 fully discharges	The pressure switch on bottle 2 opens as pressure drops below the set point ENG BTL 2 LO is displayed on EICAS	OUT	OUT	OUT	OUT

APU FIRE CONTROLS & MESSAGES

- **APU FIRE** WARNING (red): Appears when APU fire is detected
- **APU SQB** CAUTION (amber): Appears when APU squib was fired or failed
- **APU FIRE FAIL** CAUTION (amber): Indicates a failure of the APU fire detection system
- **APU BTL LO** CAUTION (amber): indicates APU bottle was discharged



APU FIRE warning (red)
Appears when a fire in the APU is detected

APU SQB caution (amber)
Appears when the APU squib (just one available) was fired or failed.

APU FIRE FAIL caution (amber)
Indicates a failure of the APU fire detection system

APU BTL LO caution (amber)
Appears when the APU bottle was discharged

CARGO COMPARTMENT FIRE CONTROLS & MESSAGES

FWD and AFT CARGO SMOKE PUSH:
A red light indicates that smoke is detected in either the forward or aft cargo compartment.

Pressing the pushbutton isolates the respective compartment from air conditioning and disconnects the heater and arms the respective squibs and charges the bottles.

BOTTLE ARMED PUSH TO DISCH:
Press pushbutton to discharge one FIREX bottle. The green light indicates that the respective squib is armed and the bottle is charged

ECAM MESSAGES

- **SMOKE AFT / FWD** WARNING (red): Smoke in aft/forward cargo area detected
- **AFT / FWD CARGO SQB 1/2** CAUTION (amber): Respective squib was fired or failed
- **AFT / FWD CARGO DET** CAUTION (amber): Failure of fire detection system
- **APU BTL LO CAUTION** (amber): One or both bottles discharged

FIRE SYSTEM TEST

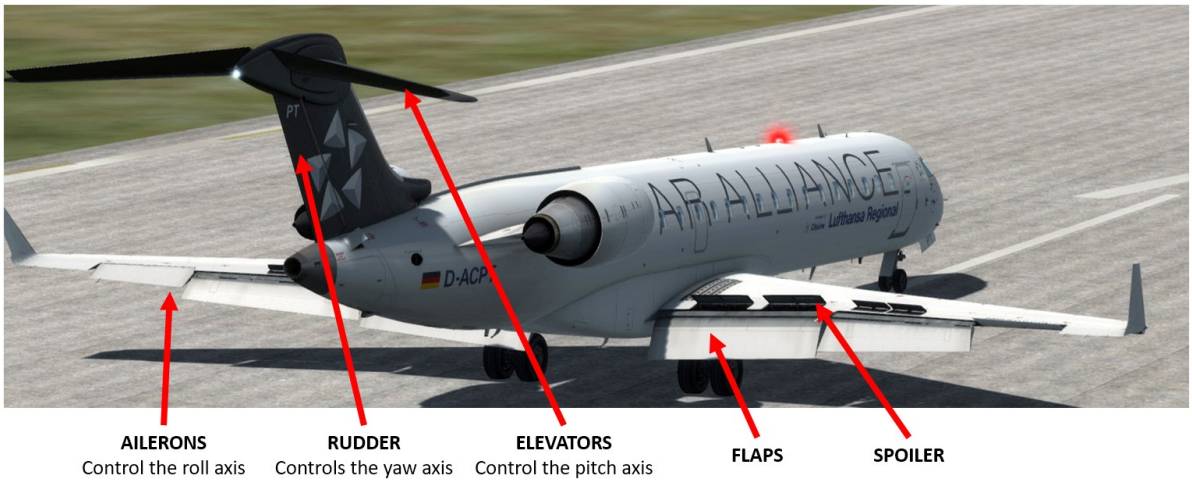
Pressing and releasing the FIRE DETECTION test button will initiate a test sequence. The engine fire controls will light up and FIRE SYS OK will show on EICAM to indicate a successful test.

MAIN LANDING GEAR OVERHEAT DETECTION

1. **MLG BAY OVHT**: Tests the landing gear overheat detection system. Will show **MLG OVHT FAIL** CAUTION (red) in EICAM and will light MASTER WARNING light
2. **MLG OVHT FAIL**: Used to simulate a failure in the landing gear bay overheat detection. Will show **MLG OVHT FAIL** WARNING (amber) in EICAM and will light MASTER CAUTION light

FLIGHT CONTROLS

The flight controls enable the aircraft to be moved on all three axes. They are divided into primary and secondary flight controls.



Axis	**Primary flight control**		**Secondary flight control**	
	Input device	**Control surface**	**Input device**	**Control surface**
Pitch	Steering column	Elevator	Pitch trim	Horizontal stabilizer
Roll	Steering column	Aileron assisted by spoilers	Aileron trim	Ailerons
Yaw	Rudder pedals	Rudder assisted by yaw damper	Rudder trim	Rudder
N/A			Flap lever	Slats / Flaps
N/A			Spoiler lever	Spoiler

The basic principle stays the same for all flight control systems – any deflection of the steering column or rudder pedals is transported through the aircraft by cables, pulleys, rods to an actuator which controls the actual deflection of an associated control surface.

This chapter is divided into several sections:

- Ailerons
- Rudder
- Elevator
- Horizontal Stabilizer Trim
- Flaps and Slats
- Spoilers
- Stall Protection System

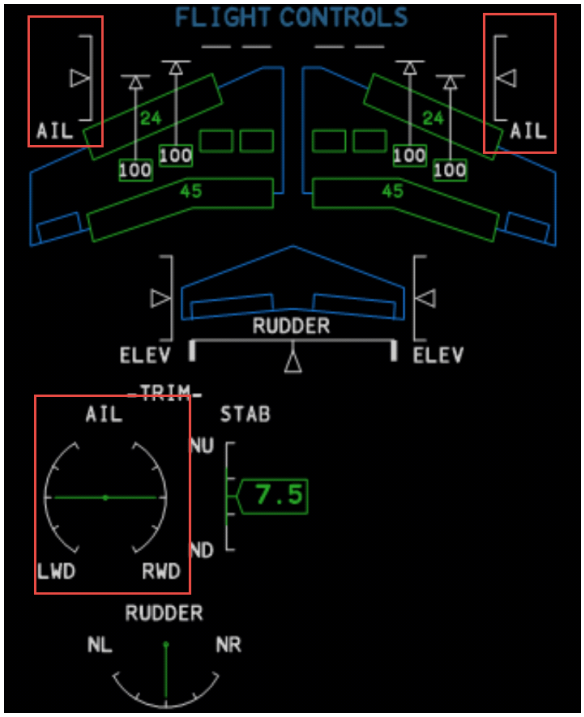
Before diving into the different sections and details on flight controls, we'd like to introduce some features which are visible in the virtual cockpit but not further simulated. These are failure related and hence not further simulated.

The real CRJ offers two handles to disconnect the yokes in case either one is jammed. As flightsim does not simulate jammed controls, these handles may be moved and the animation is visible but it has no influence on controlling the CRJ. The associated failure messages are not simulated as well.

AILERONS

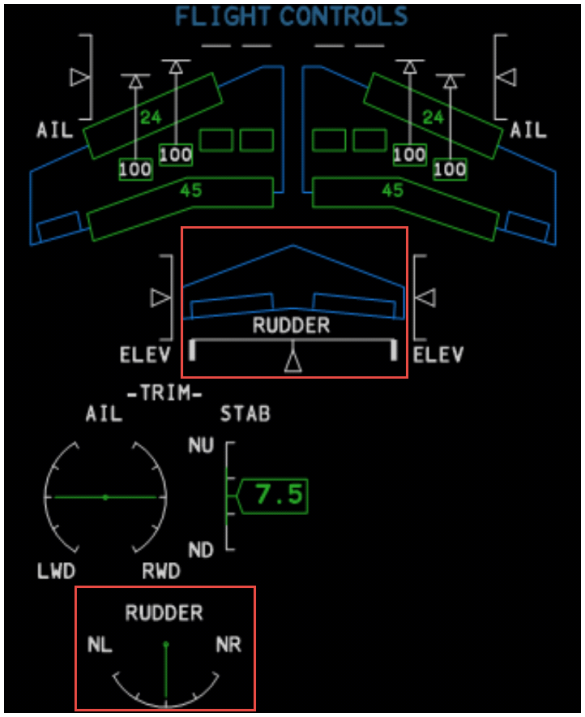
The CRJ is equipped with two ailerons, one mounted on each wing near each wingtip. By turning the steering column to the left the left aileron will move up, the right aileron will move down. For steep turns the spoiler on the wing which is moving downwards will deflect to assist the turn. The left ailerons are supplied by hydraulic system 1 and 3, while the right aileron is supplied by hydraulic system 2 and 3. The movement up and down is 25.1°.

The current position of the flight controls and aileron trim can be checked on the Flight Control synoptic page.

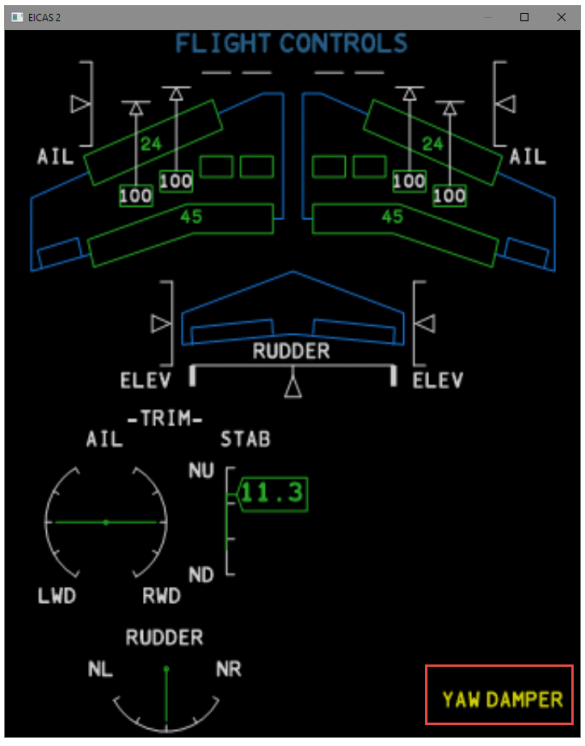


RUDDER

Yaw axis is controlled by the rudder mounted to the empennage. The rudder is controlled via the pedals. Two yaw dampers add to the aircrafts directional stability and keep the aircraft coordinated during turns. The input signal from the rudder pedals is transferred to the actuators, which deflect the rudder. To minimize side slip during high speeds, the rudder deflection angle is automatically adjusted over speed (from 33° to 4°).

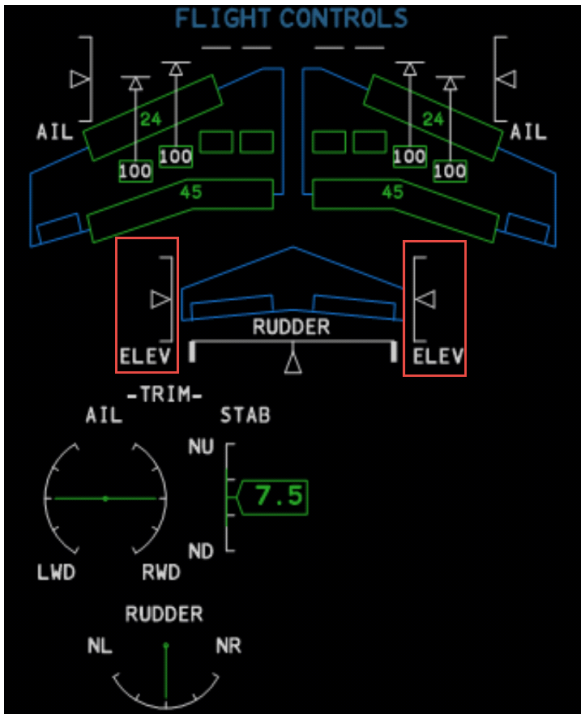


A yaw damper system can reduce reduce the rolling and yawing oscillations known as the Dutch roll.



ELEVATOR

The CRJ's elevators are mounted to the empennage and controlled by either pilot's yoke. The elevators have 18.4° up movement and 23.6° down movement.



HORIZONTAL STABILIZER TRIM

The horizontal trim works a little bit different than the other systems; when adjusting the trim, the entire stabilizer is moved by two motors and a jack screw. Pitch trim is limited to +2° up and -13° down.

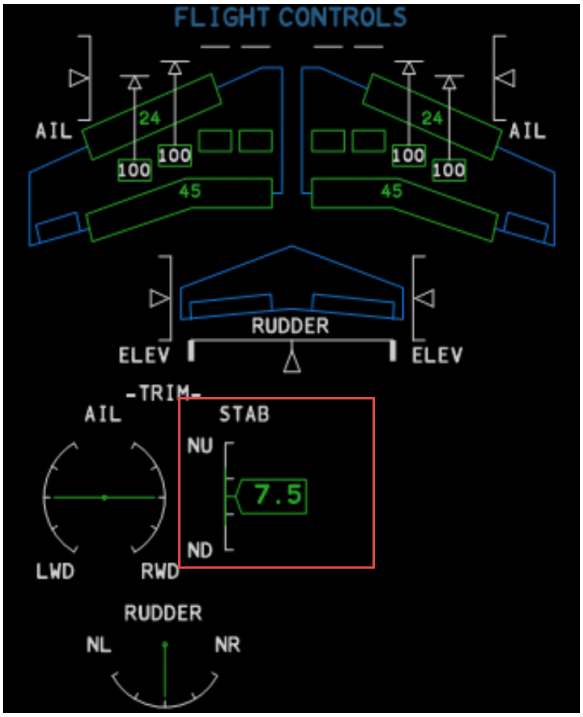
There are four elevator trim modes:

- **Manual trim**: The stabilizer is moved according the input from the trim switches. The adjustment of the stabilizer is adjusted over speed.
- **Autopilot trim**: With the autopilot activated it trims automatically as soon as it detects that loads are building up on the control surfaces
- **AUTO trim**: With flaps moving between 0 and 20° AUTO trim helps to reduce pitch input resulting from moving flaps.
- **Mach trim**: Helps to compensate the aircrafts tendency of putting the nose down with increasing Mach numbers

1. Stabilator trim channel engage
2. Mach trim engages
   Amber light indicates Mach trim is unserviceable
3. Trim switches (of course the default trim key commands from FS can also be used.

The trim position is shown on the Flight Control display and is colour coded:

- Green: Take-off configuration
- White: NOT in Take-off configuration



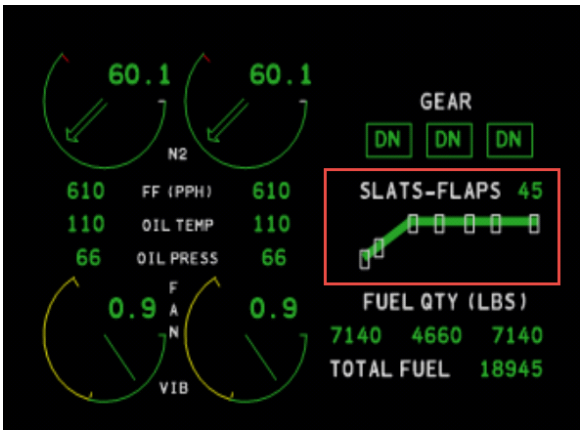
FLAPS AND SLATS

The slats and flaps enable the aircraft to fly at lower speeds without stalling. On the other hand flaps and slats increase drag and hence fuel flow. Thus, the flaps and slats are moveable to extend and retract them as needed. The CRJ offers the following positions:

Position	Slats	Flaps
0	Fully retracted	Fully retracted
1	20°	Fully retracted
8	20°	8°
20	8°	20°
30	25° (fully extended)	20°
45	25° (fully extended)	45° (fully extended)

The Slat/flap Position Indicator is shown in degrees on the engine display and is colour coded:

- Green: Normal operation
- White: Flaps disagree
- Amber dashes: Invalid data

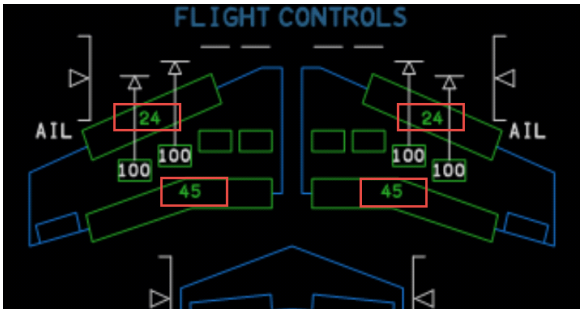


The Slat/flaps Position Bar displays slat/flaps deployment with the white markers as detents:

- Green: Normal operation
- White: Flaps disagree
- Amber dashes: Invalid or missing data

The Slat/flap Position Indicator is also shown in degrees on the Flight Control display.

- Green: Normal operation
- White: Flaps/slats disagree
- Amber dashes: Invalid or missing data



Flaps lever controls the extension of slats and flaps, of course the standard FSX controls can also be used. Please note the Emergency Flaps extension is not simulated.

SPOILERS

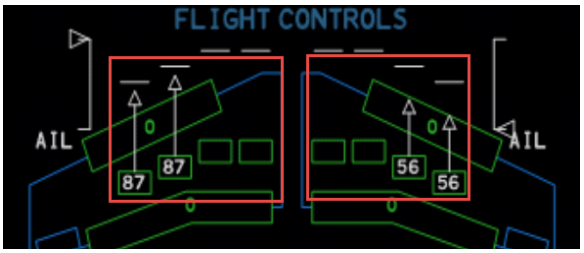
To speedup descends, assist in turns and prevent bouncing during landing / touchdown the CRJ is equipped with spoilers. As already indicated they may be used for different purposes. Accordingly, the spoilers itself are divided into multifunctional (2 per wing) and ground spoilers (2 per wing)

To extend the spoilers to speed up a descent or to bleed off speed simply pull the spoiler lever back as required. The multifunctional spoilers will deploy according the setting of the spoiler lever.

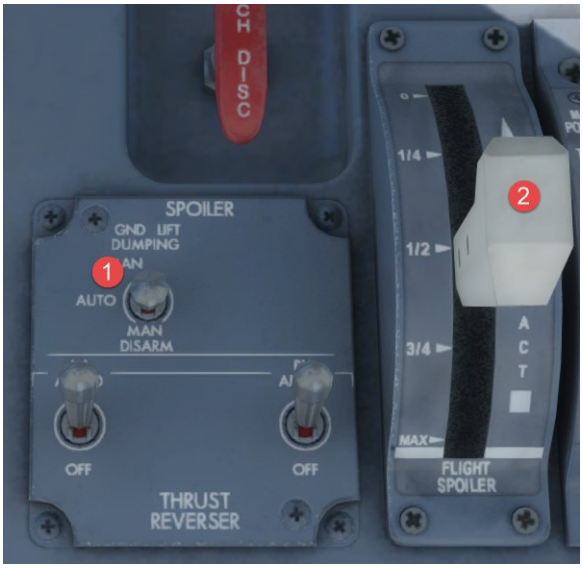
Assistance during steep turns is performed automatically by the multifunction spoilers as well.

If the GND LIFT DUMPING switch is not moved to the MAN DISARM position all spoilers will extend as soon as the aircraft sensed a touchdown or an aborted take-off.

Spoiler positions is shown on the Flight Control display. The outer two indicated multi-functions spoilers, the inner two ground spoilers (only deply on ground).



1. GND LIFT DUMPING: Three-position switch to select ground lift dumping mode that prevents the aircraft from bouncing back into the air on landing:
    a. **AUTO**: Spoiler armed to deploy on touchdown.
    b. **MAN ARM**: Manually arm spoilers for deployement (backup mode for AUTO)
    c. **MAN DISARM**: Disable automatic deployment.
2. Flight Spoiler Control Lever



STALL PROTECTION SYSTEM

As previously mentioned a stall needs to be prevented any time. Accordingly, all aircraft are equipped with at least a stall warning. The CRJ is equipped with a stall warning and a stick pusher – both together are called the stall protection system. The angle of attack (AoA) is monitored throughout all flight phases and as soon as the AoA reaches a critical value the stall computer warns the crew by:

- Activating the stick shaker
- Activates the engines auto-ignition system (to prevent flameout)
- Disengages the autopilot

In case the angle of attack continues to approach the stall point, the stick pusher is activated. The stick pusher moves the steering column forward to command a nose down attitude to gain speed and prevent the stall.

The STALL PTCT PUSHER switch engages and disengages the stick pusher system.

The STALL pushbutton (guarded) flashes red when the aircraft is approaching stall conditions. When pushed on the ground it will initiate the stall test sequence:

- Auti-ignition activated
- Pilot Stick shakers activated for 3 seconds
- Co-Pilot Stick shakers activated for 3 seconds
- After 7 seconds stick pusher is activated
- Stall light flashes
- Press AP/DISC to verify the stick pusher disengages and stall warning are off.

FLIGHT INSTRUMENTS

The flight instruments comprise the electronic flight instrument systems, standby instruments and clocks. The instruments receive data from the aircraft's sensors via the air data system, radio altimeter and inertial reference system. All this information is processed to provide the pilots with the following parameters:

- Barometric and radio Altitude
- Vertical speed
- True and indicated airspeed as well as Mach number
- Airspeed trend
- Overspeed warning
- Airplane attitude
- Heading information
- Navigation information
- Temperature

The electronic flight instruments consist of:

- Two primary flight displays, PFDs (one for each pilot)
- Two multi-function flight displays, MFDs (one for each pilot)

The integrated standby instrument (ISI) provides a backup with the following information:

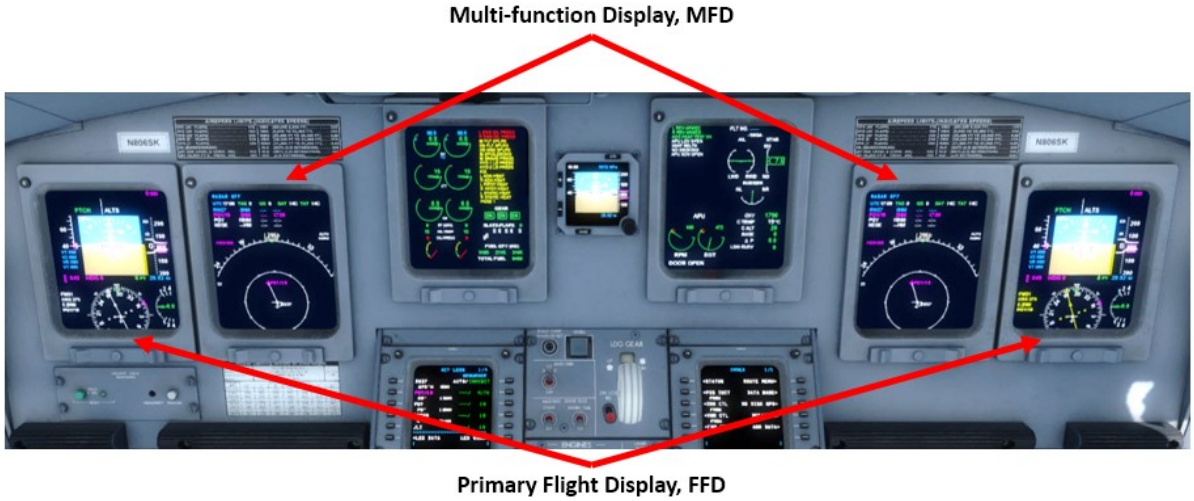
- Aircraft attitude
- Altitude
- Airspeed information

An independent standby compass (Whiskey compass) provides heading information in relation to magnetic north. The sources of information are:

- Air data system
    - Speed
    - Altitude
    - Temperature data
- Radio altimeter
    - Accurate measurement of height above terrain at low altitudes
- Inertial reference system
    - Aircraft attitude
    - Heading
    - Aircraft position
    - Angular rate
    - Linear acceleration
- Electronic clock
    - Time

ELECTRONIC FLIGHT INSTRUMENT SYSTEM (EFIS)

Each pilot has a primary flight display, PFD and a multi-functional display, MFD. All 4 units are technically identical and interchangeable. The PFD's primary function is to show aircraft attitude, airspeed, altitude, flight director commands and flight mode annunciations. The MFD's primary function on the other hand is to provide navigational information, like heading, bearings.

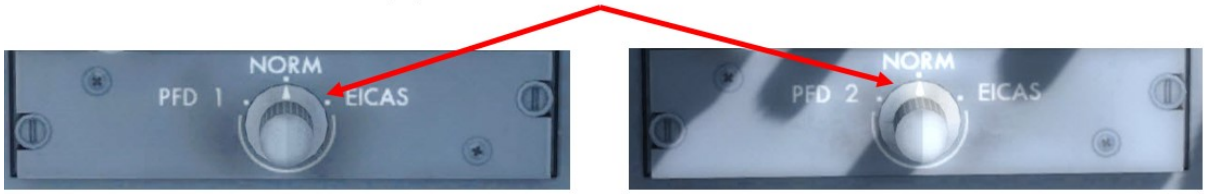


DISPLAY REVERSION

Display reversion is needed in case one PFD fails. It allows to display the PFDs information or EICAS pages on the MFD. The MFD information cannot be displayed on the PFD though.

Display Selector
Used to display EICAS information on the pilot's/copilot's PD or MFD.

- EICAS – EICAS information are displayed on the MFD according selection on EICAS control panel
- PFD – Power is removed from the PFD and all information is displayed on the MFD



DISPLAY CONTROL

On either pilot's side display control panel is installed. It allows selecting of the following:

- MFD format selection
- Bearing point selection
- Navigation source selection
- Cross side navigation data and course display (depends on selected format)

The following formats are available by turning the FORMAT knob:

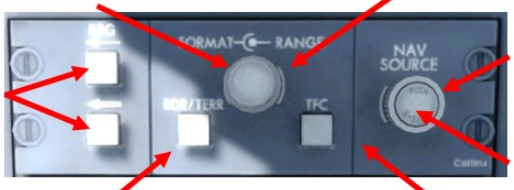
- HSI compass
- Navaid selector map
- TCAS
- FMS present position map
- FMS plan map
- Weather radar

In case one display control panels fails (this situation is not simulated) the DISPL CONT selector allows the remaining display control panel to manage all four PFDs and MFDs.

FORMAT – Outer selector
Selects MFD display format. Possible modes: HSI compass, navaid sector, present position map (PPSN), plan map, TCAS and weather radar

RANGE – Inner selector
Selects display range on MFD. Possible selections: 5, 10, 20 and 40 nm.

BRG
Selectors for bearing pointers. Click to cycle through possible waypoints



NAV SOURCE
Used to select navigation source. In clockwise direction: FMS 1, VOR/LOC 1, OFF, VOR/LOC 2, FMS 2.

PUSH X-SIDE
Pushbutton to swap the navigational sources from opposite side's MFD.

RDR / TERR
Selects either a radar mode or terrain to be displayed on the MFD.

TFC
Directly activates TCAS display on the MFD

DISPL CONT

Used to revert pilot or copilot display control panel.

- NORM – each display control panel controls the associated displays
- 1 – pilots control panel controls all four displays (DCP 1 caution appears on PFD)
- 2 – copilots control panel controls all four displays (DCP 2 caution appears on PFD)

AIR DATA SYSTEM

The air data system collects information from several sensors of the aircraft (like pitot probes, static ports) to forward this information directly as well as computing new information from the gathered information to supply further aircraft systems with.

We'd like to pro provide just some basic information on the air data system as the atmosphere and hence all parameters which are measurable in real-world are simulated in FS and furthermore faults or failures are not simulated within this system.

PITOT STATIC SYSTEM

The pitot static system collects dynamic pressure, static pressure and ambient temperature from the pitot tube, static port and total air temperature probe (TAT probe). It supplies the air data system, integrated standby instruments and cabin pressure control panel.

Please note that the TAT probes readings are inaccurate when the aircraft is on ground. The TAT probe is heated to protect it from icing and this leads to inaccurate readings when on ground. During flight the influence of the heating is neglectable.

AIR DATA

The air data system supplies the following information:

- Corrected pressure altitude (static pressure errors are corrected)
- Vertical speed
- Calibrated and indicated airspeed (CAS / IAS)
- Mach number
- True airspeed
- Static air temperature (SAT)
- Total air temperature (TAT)
- Temperature variations from standard atmosphere (ISA deviation)

Furthermore, the air data system computes and controls the following values and parameters:

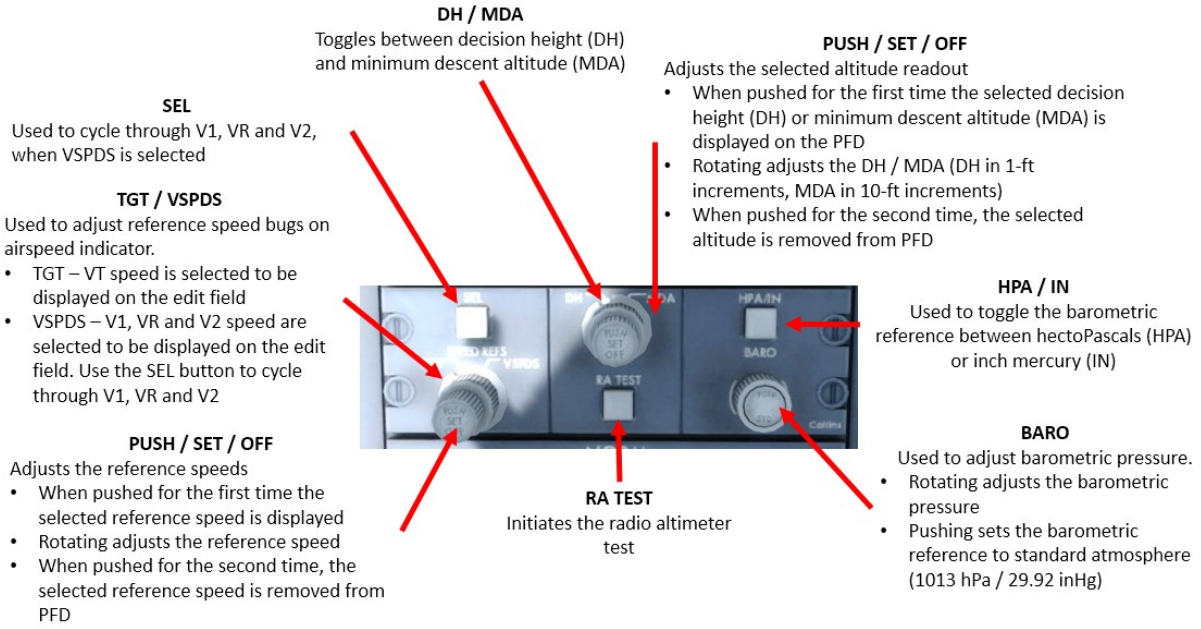
- Preselected altitude
- Airspeed trend vector
- Maximum allowable speed (V_{MO})
- Maximum allowable Mach number (M_{MO})
- Baro corrected value
- Vertical speed references

AIR DATA REFERENCE (ARP) PANELS

The air data reference panels – located on either pilot's side – enable the pilots to enter airspeed reference pointers and barometric correction for altitude.

The air data reference panels maybe divided into three sections:

- ***The speed reference section***
  This section enables the pilot to enter several reference speeds (V_1, V_2, V_R and V_T). Both PFDs show the same values.
- ***The altitude reference section***
  Enables the pilot to select minimum descent altitude, MDA, and decision height, DH, value. Furthermore the radio altimeter self-test is initiated from this section of the ARP panel.
- ***The barometric reference section***
  Each PFD may have different barometric pressure settings. The last selected value is saved and restored after the next power-on. This section allows to:
  - Select the barometric pressure for barometric altitude correction
  - Switch between hPa or inHg
  - Set standard barometric pressure when climbing through transition altitude



Mach Readout (white)
Indicates current airspeed in Mach. Displayed when Mach is above .45 and removed when Mach below .40

Airspeed indicator
See following picture for more details

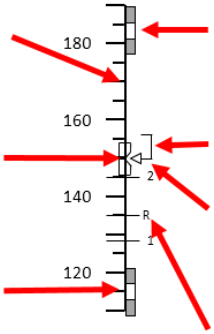
IAS / Mach Reference (magenta)
Indicates reference airspeed as selected on the FCP

Speed reference (cyan)
Indicates reference speed as selected by the pilot on the air data reference panel

Indicated airspeed tape (white)
Moving tape to indicate current airspeed.
Range is from 40 to 400 knots.
Marks at 5 kts increments.
Digits at 20kts increment

IAS bug (magenta)
Indicates selected airspeed on FCP

Low Speed Cue
(red / black checkerboard)
Indicates stick shaker speed and lower – must be avoided during flight.



Overspeed Cue
(red / black checkerboard)
Indicates overspeed range. Reaches from Vmo to Mmo. If actual airspeeds exceeds Vmo by more than 3 kts, the overspeed clacker (aural warning) sounds

Trend vector (magenta)
Indicates predicted airspeed in 10 seconds

Indicated airspeed pointer (white)
Indicates current airspeed

Speed reference bugs (cyan)
Indicate V1, VR, V2 and VT – are removed 7 seconds after exceedance (except target speed)

- V1 - maximum takeoff abortion speed
- VR – rotate airspeed
- V2 – take-off safety speed
- VT – Target speed

Preselected Altitude Readout (magenta)
Indicates preselected altitude in feet (100-ft increments).

Metric Preselected Altitude Readout (magenta)
Indicates preselected altitude in meters. Displayed when metric altimeter is selected on.

Altitude indicator
See following picture for more details

Barometric Pressure Setting Readout (cyan)
Indicates selected baromentric pressure in selected unit (hPa or inHg).

Metric Altitude Readout (white)
Indicates airplane altitude in meters. Displayed when metric altimeter is selected on.

METRIC ALT

- ON – barometric altitude is displayed in meters as well
- OFF – barometric altitude is displayed in feet only

Coarse Tape

- Small rectangles in 500-ft increments
- Large rectangles in 1,000-ft increments

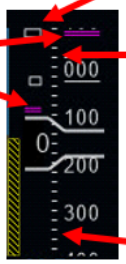
Preselected Bug (magenta)
Lines at coarse and fine tape indicate preselected altitude

Barometric Altitude Tape (white)
Moving tape with fixed window, that indicates barometric altitude from -1,000 to +50,000ft.

Altitude Readout
Indicates airplane barometric altitude in feet

Fine Tape

- Marks in 20-ft increments
- Marks in 100-ft increments



Minimum Descent Altitude (MDA) Readout (cyan)
Indicates Minimum Descent Altitude, MDA, as set on the air data reference panel

Minimum Descent Altitude Pointer (cyan)
Indicates MDA as set on the air data reference panel. Disappears when out of range and flashes during MDA alert.

Minimum Descent Altitude (MDA) Alert (cyan)
Moving tape with fixed window, that indicates barometric altitude from -1,000 to +50,000ft.

Negative Altitude Flag (yellow)
Appears at barometric altitudes below 0 feet

Vertical Speed Readout (green)
Indicates current vertical speed from 0 to 15,000 fpm

- From 0 to 9,950 fpm in 100-fpm increments
- Above 9,950 fpm in 1000-fpm increments and decimal point disappears

Vertical Speed Scale (white)
Non-linear scale of vertical speed. Range ± 4,000ft

- Small ticks = ± 250 fpm
- Large ticks = ± 500 fpm
- Digits at ± 1,000, ± 2,000 and ± 4,000 fpm

Vertical Speed Pointer (green)
Indicates vertical speed in feet per minute fpm

ALTITUDE ALERTS

The altitude alerts notifies the crew that preselected altitudes are going to be captured or a deviation from a preselected altitude occurs.
Three types of altitude alerts may occur:

- Acquisition mode
- Cross side tracking
- Deviation mode

Mode	Short Description	Aural warning	Visual warning	How to cancel
Acquisition mode	Present altitude is within ±1,000ft or preselected altitude.	C-chord	Preselected altitude flashes. Flashing stops when ±200ft within preselected altitude	Press altitude knob on flight control panel
Cross side tracking	In case a difference between the preselected altitudes from ADC 1 and 2 is detected	None	Altitude digits change from magenta to cyan	NIL
Deviation mode	Altitude deviates more than ±200ft from preselected altitude. OR Altitude capture is active and aircraft deviates from preselected altitude by more than ±100ft	C-Chord	Preselected altitude and bug change from magenta to amber and start flashing.	

LOW SPEED CUE

The low speed cure displays the speed margin to stick shaker during normal low speed manoeuvers and approaches to stall. The top of the low speed cue corresponds to stick shaker speed.

AIR DATA REVERSION

During normal operation, each air data computer supplies one pilot's side with data. In case one air data computer fails or provides unreliable data, the pilots may switch to the remaining air data computer, which supplies both pilots' instruments then.

As failure of an air data computer is not simulated, this function has no relevance in FS even though switching the selector and the respective message is implemented.

AIR DATA
Used to switch air data computers
- NORM – each air data computer suplies to the same side display
- 1 – air data computer 1 supplies data to both sides (ADC 1 caution appears on PFD)
- 2 – air data computer 2 supplies data to both sides (ADC 2 caution appears on PFD)

RADIO ALTIMETER SYSTEM

Two radio altimeter systems provide an accurate measurement of the aircrafts altitude over ground within -20 to 2,500ft AGL. The following systems receive data from the radio altimeter:

- PFDs
- Spoiler and stabilizer control units (SSCU)
- Enhanced ground proximity system (EGPWS)
- Traffic alert and collision avoidance system (TCAS)

The PFDs specifically receive the following information from the radio altimeter system:

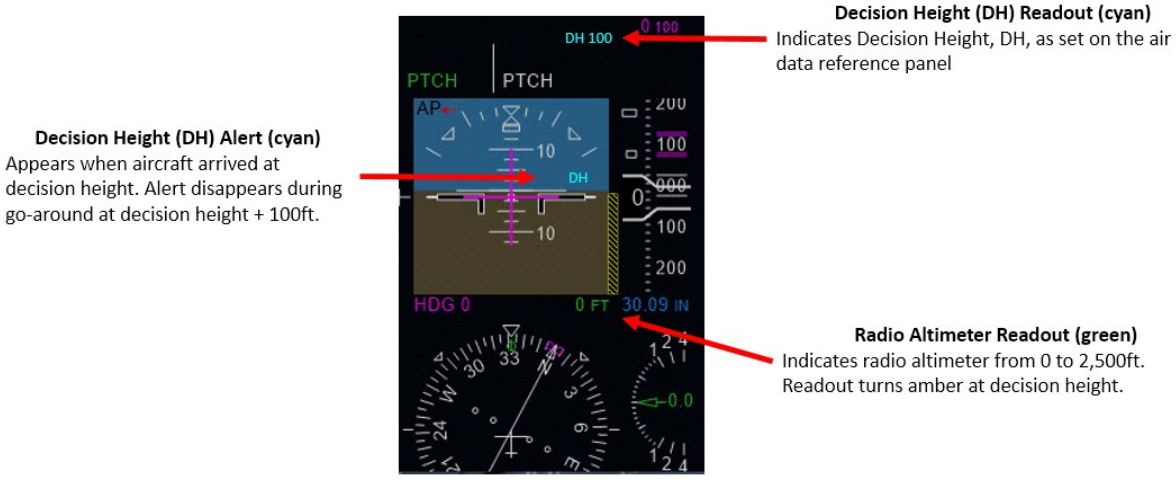
- Radio altitude readout
  Shown as a digital readout as soon as the aircraft descends through 2,500ft.
  A moving tape / analogue scale is added as soon as the aircraft descends through 1,225ft.
- Decision height readout
  Decision height is selected on the air data reference panel
- Decision height alerts and radio altimeter fail flags
- In case a failure of the radio altimeter is detected, a fail flag is indicated.

A test button on the air data reference panel allows initiating a self-test of the radio altimeter system.

DH / MDA
Toggles between decision height (DH) and minimum descent altitude (MDA)

RA TEST
Initiates the radio altimeter test

PUSH / SET / OFF
Adjusts the selected altitude readout
- When pushed for the first time the selected decision height (DH) or minimum descent altitude (MDA) is displayed on the PFD
- Rotating adjusts the DH / MDA (DH in 1-ft increments, MDA in 10-ft increments)
- When pushed for the second time, the selected altitude is removed from PFD



INERTIAL REFERENCE SYSTEM

Back in the 1960's the first inertial reference systems replaced the navigator for trans-oceanic flights. The first IRS systems used gyros oriented in all three axes. The gyros enable to detect and compute motion the IRS experiences. Now add a reference / starting point and this enables you to compute the track of an aircraft.

Until today IRS systems were developed further and in conjunction with a GPS system this enables very accurate computing of the aircrafts position and the flown track as well as attitude changes.

The inertial reference system provides several information to other aircraft systems:

- Attitude
- Heading
- Angular rate
- Linear acceleration
- Present position

The following systems are supplied with those information:

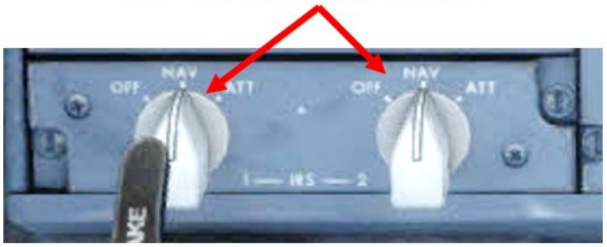
- Flight Control Computers
- Flight Management Computers
- TCAS
- EGPWS
- Fuel system
- Stall protection system
- Flight data recorder
- EFIS
    - Attitude Director Indicator, ADI
    - Horizontal Situation Indicator, HIS

The IRS normally operates in navigation, NAV, mode. The other available mode, attitude, ATT, mode is used, when a failure of the unit is detected. As failures of the IRS are not simulated, this mode is not simulated.

1 – IRS -2

Used to select IRS mode.

- OFF – power removed from IRS
- NAV – IRS operates in navigation mode
- ATT – IRS operates in attitude mode

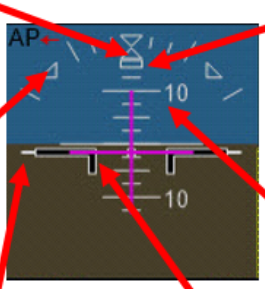


Roll Pointer (white)
Indicates roll angle. Pointer rotates along fixed scale

Slip / Skid Indicator
Indicates lateral displacement from center of roll (airplane slips / skids)

Roll Scale (white)
Fixed scale to indicate roll attitude.

- Small marks at 10° and 20°
- Large marks at 30° and 60°
- Small triangle at 45°



Pitch Tape (white)
Moving tape to indicate pitch attitude

- Small marks at 2,5° increments
- Medium marks at 5° increments
- Large marks and numbers at 10° increments
- Red chevrons are displayed during extreme pitch attitudes to direct back to neutral pitch

Horizon Line (white)
Indicates roll and pitch attitude relative to aircraft symbol.

Airplane symbol (black)
Indicates aircrafts position relative to horizon index

Lubber Line (magenta)
Fixed reference for reading current airplane heading. Fixed index marks are located around the compass rose every 45°.

Selected Heading Bug (magenta)
Indicates the selected heading as set on the FCP.
In case bug is off scale, a dashed line is displayed from the center of compass to selected heading

Compass rose (white)
Rotating card indicates current magnetic heading under lubber line.

- Small marks at 5° increments
- Larger marks at 10° increments
- Digits and cardinal points at 30° increments

Airplane symbol (white)
Indicates center of compass rose

DISPLAY REVERSION

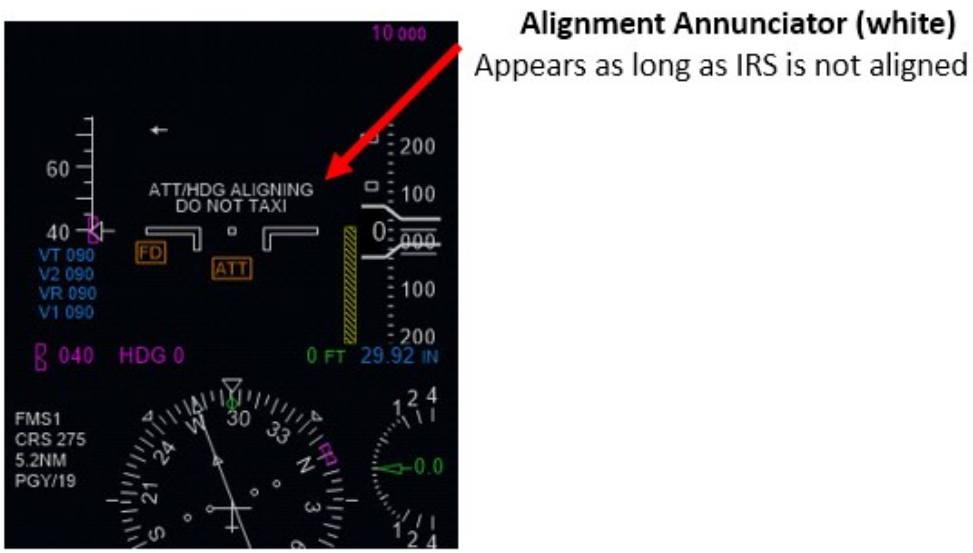
Normally each Inertial Reference System supplies data to the respective PFD / MFD. The ATT HDG knob on the source selector panel allows to switch between normal configurations (each IRS supplies the same side displays) or select the specific IRS 1 or 2. The selection is indicated by a yellow single source flag on the PFD.

INITIALIZATION AND ALIGNMENT

Initialization of the IRS systems takes approximately 7 minutes. To complete the process the present position needs to be entered in the POS INIT page of the flight management system. During initialization, an initialization alignment message is flashing on the PFD.

Dave allows you to modify initialization time. You may choose between

- Realistic – initialization takes 6 to 17 minutes
- Fast - initialization takes 3 minutes
- Instant – as soon as the switches are set to NAV and position initialization on the FMS is done, the IRS is aligned



STANDBY INSTRUMENTS AND CLOCKS

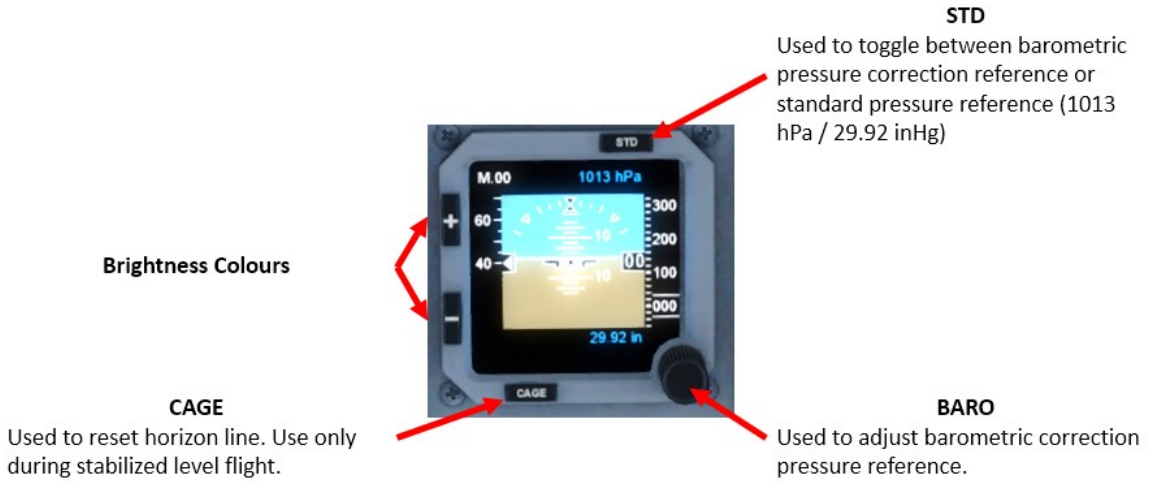
The integrated standby instrument is located between the EICAS displays on the center instrument panel. The standby compass sits under the overhead panel on the center window post. Each pilot has a clock on his side panel.

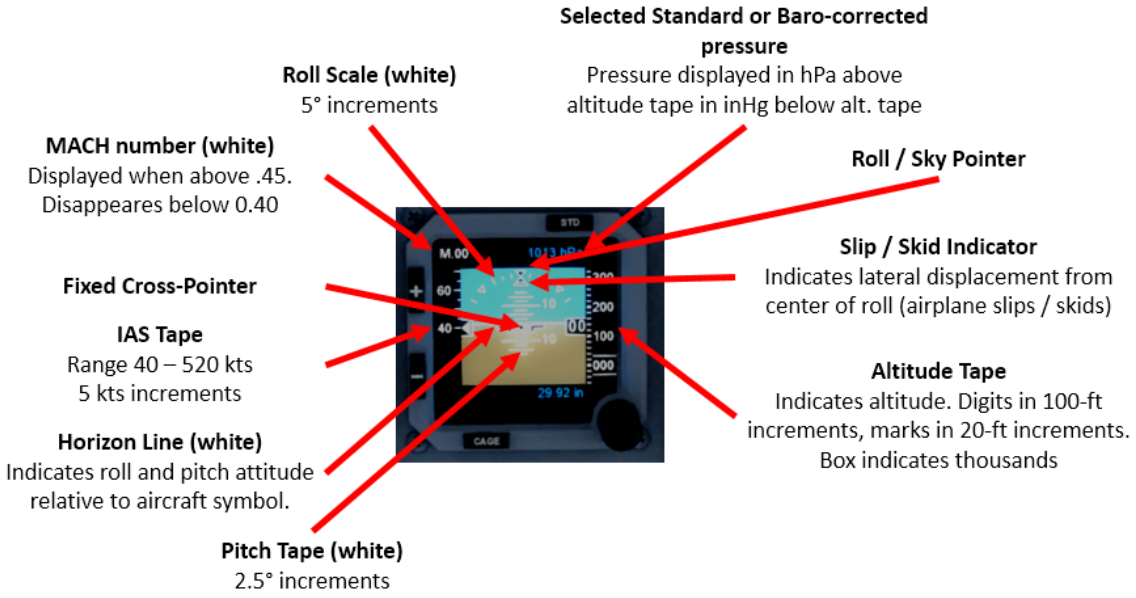
INTEGRATED STANDBY INSTRUMENT

The integrated standby instrument, ISI, is supplied with electrical power from the battery bus to ensure operation even under emergency conditions. They provide attitude, altitude and airspeed information. Air data input is coming from the alternate pitot probe and static ports.

The ISI is capable to display the following information:

- Attitude
- ILS deviation
- Corrected altitude
- V_{MO} display
- Airspeed
- Static source error correction (SSEC)
- Mach number
- Barometric pressure
- Slip-skid indication





STANDBY COMPASS

The standby compass is a self-contained dry compass with damping to reduce overshooting. It is independent from all other aircraft systems. A miniature aircraft symbol indicates the aircrafts heading in relation to magnetic north.

The compass correction card, sitting above the compass rose, shows the correction values to subtract or add to the indicated heading for compensation of metallic or magnetic materials in the aircraft, influencing the compass rose.

Compass Correction card
Used to record compass instrument errors at the headings indicated. The correction card is filled out during maintenance check.

Magnetic Compass
Indicates heading of airplane in relation to magnetic north

CLOCKS

A digital clock is installed on either pilots' side panel. The clock is normally synchronized with a time signal from the GPS, which happens automatically during aircraft start-up. In case the GPS sync is interrupted, the clock switches to internal (INT) mode.

The clock features the following modes

- Display date (GPS or UTC)
- Display current time (GPS, internal UTC or local)
- Chronometer (CHR) function
- Elapsed Timer (ET)

Time / Date Display
Displays time (GPS, INT or LT mode)
- Time is displayed in hours, minutes and seconds (HH:MM:SS)
- Date is displayed in Day / Month / Year

ET SEL
Swaps to elapsed time function in case chronometer is active.
During manual clock adjust used to decrease data by one digit

ET RST
Used to reset elapsed time when on ground.
During manual clock adjust used to increase data by one digit

Mode
Used to select mode of operation (DT, GPS, INT, LT) and also in conjunction with ET SEL and ET RST to adjust time manually.

CHR
Used to start, stop and reset the chronometer.

Mode annunciator
Indicates the active mode.
- DT – date
- GPS – GPS synchronization active
- INT – internal time (GPS disabled)
- LT – Local Time

ET /CHR Display
Displays elapsed time or chronometer

FUEL SYSTEM

The fuel system is comprised of the following subsystems:

- Fuel tanks / storage
  The CRJ has three tanks: two wing and one center tank
- Fuel management (transfer/crossflow) & distribution
- Fuel quantity gauging

FUEL TANKS / STORAGE

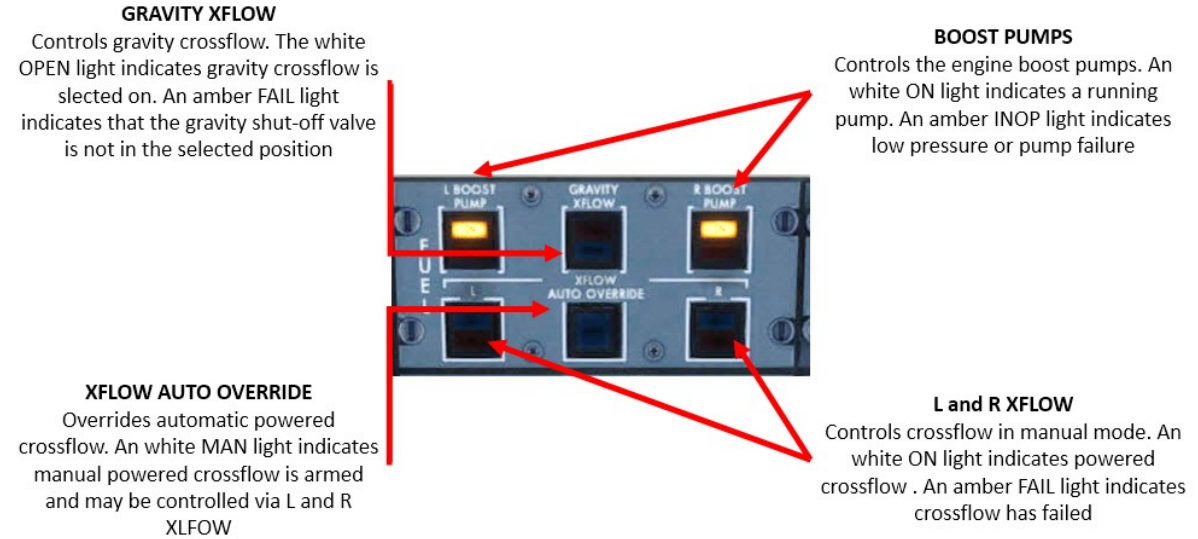
Fuel is stored in both wing and the center tank. The wing tanks are emptied first. With decreasing fuel in the wing tanks, fuel is transferred from the center tank into the wing tanks, in case the center tank is filled.

Tank	Useable fuel	Unusable fuel	Total fuel
Left wing tank	7’493 lbs / 3’399 kg	62 lbs / 28 kg	7’554 lbs / 3’427 kg
Center tank	4’610 lbs / 2’091 kg	32 lbs / 14 kg	4’642 lbs / 2’106 kg
Right wing tank	7’493 lbs / 3’399 kg	62 lbs / 28 kg	7’554 lbs / 3’427 kg
Total			19’750 lbs / 8’960 kg

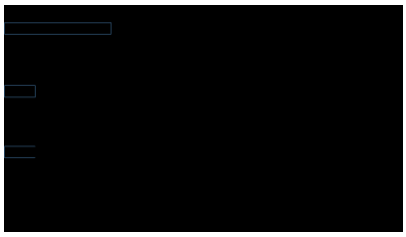
FUEL MANAGEMENT (TRANSFER/CROSSFLOW) & DISTRIBUTION

Fuel transfer from the center to the wing tanks is done automatically. The monitoring computer stars transfer as soon as the wing tank’s quantity drops below 93% and ends transfer either when the center tank is empty or the wing tank reaches 97%. Fuel crossflow between the wing tanks may be performed powered or by gravity. Fuel crossflow is used to equalize imbalances between the wing tanks to maintain lateral stability.

A pump in the center tank provides powered crossflow either in automatic or in manual mode. In automatic mode, a computer monitors imbalanced and starts equalizing on its own. This mode may be overridden by the crew and crossflow controlled manually.



The following graphic shows how valve positions are displayed on the Fuel EICAS Synoptic page.



Scavenge Ejectors
- White – engine not running
- Green – normal operation
- Amber – low pressure and engine running
- Half-intensity magenta – invalid data

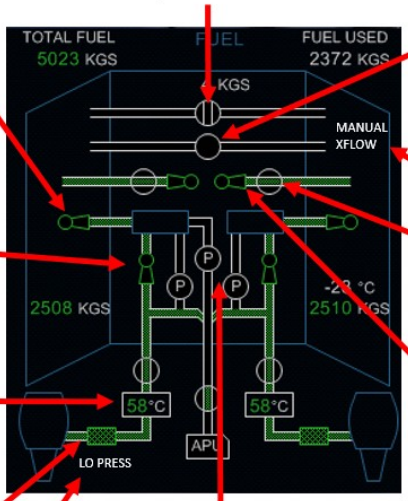
Main Ejectors
- White – engine not running
- Green – normal operation
- Amber – low pressure and engine running
- Half-intensity magenta – invalid data

Fuel Feed Temperatures
- Green: ≥ 5°C
- Amber: < 5°C
- Amber dashes – invalid data

Fuel Filters
- Green – normal flow
- Amber – fuel pressure drop in filter
- Half-intensity magenta – invalid data

LOW PRESS (amber)
Indicates a low pressure condition

Gravity Crossflow Valve



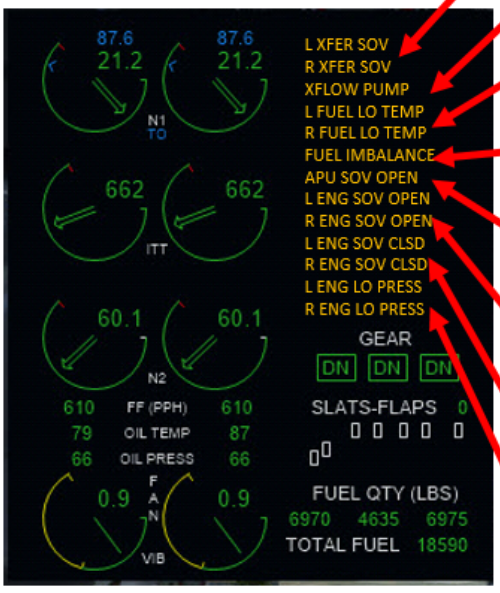
APU and Boost Pumps
- White – Pump is off
- Green – pump is operating
- Amber – pump has failed
- Half-intensity magenta – invalid data

Powered Crossflow Pump
- White – Pump is off
- Green – pump is operating, arrow indicates flow direction
- Amber – pump failed
- Half-intensity magenta – invalid data

MANUAL XFLOW (white)
Appears when manual crossflow is selected

Transfer Shut-Off Valve

Transfer Ejectors
- White – center tank is empty or transfer shut-off valve is closed or engine not running
- Green – normal operation with fuel in center tank
- Amber – low pressure and engine running
- Half-intensity magenta – invalid data



L and R XFER SOV caution (amber)
Appears when respective transfer shut-off has failed

XFLOW PUMP caution (amber)
Appears when crossflow pump has failed

L and R FUEL LO TEMP caution (amber)
Appears when fuel temperature is less than 4.3°C

FUEL IMBALANCE caution (amber)
Appears when a fuel balance bigger than 800 lbs is detected

APU SOV OPEN caution (amber)
Indicates APU shut-off valve is open and APU ready to load and an APU fire is detected

L or R ENG SOV OPEN caution (amber)
Indicates engine fuel shut-off valve is open and an engine fire is deteced

L or R ENG SOV CLSD caution (amber)
Indicates engine fuel shut-off valve is closed and no engine fire is deteced

L or R ENG LO PRESS caution (amber)
Indicates low fuel pressure condition

GRAV XFLOW OPEN status (white)
Appears when gravity crossflow shut-off valve is open

L or R AUTO XFLOW status (white)
Appears when automatic powered crossflow is operating on respective side

L or R XFLOW ON status (white)
Appears when crossflow shut-off valve is manually selected open

MAN XFLOW ON status (white)
Appears when manual crossflow is selected

L or R FUEL PUMP ON status (white)
Appears when respective boost pump is operating

L or R ENG SOV CLSD status (white)
Appears when respective engine fuel shut-off valve is closed and an engine fire is detected

APU SOV CLSD status (white)
Appears when APU shut-off valve is closed and an APU fire is detected

APU SOV OPEN status (white)
Appears when APU shut-off valve is open and no APU fire is detected

The engines are supplied with fuel from the so-called side collective tanks. These two tanks are structural part of the central tank but are separate tanks though. To prevent fuel starvation during manoeuvring, the collective tanks are continuously filled up by the monitoring computer system. Boost pumps support fuel feed to the engines in case of a pressure drop in the fuel line. The boost pumps are normally on standby but as soon as a pressure drop is sensed, the boost pumps are activated. During engine start the boost pumps are activated as well, independent of the pressure in the fuel line.

The APU is supplied from the left collective tank. The APU fuel pump ensures sufficient pressure on the fuel line to the APU. Activating the APU also activates the APU fuel pump.

FUEL QUANTITY GAUGING

Several probes in the wing center and collective tanks determine the amount of fuel in the respective tank, fuel temperature and fuel density. These signals are processed by a computer system to correct errors due to wing deflection, or density changes. The resulting fuel quantities, temperature and amount of used fuel are displayed on the EICAS.

Total Fuel

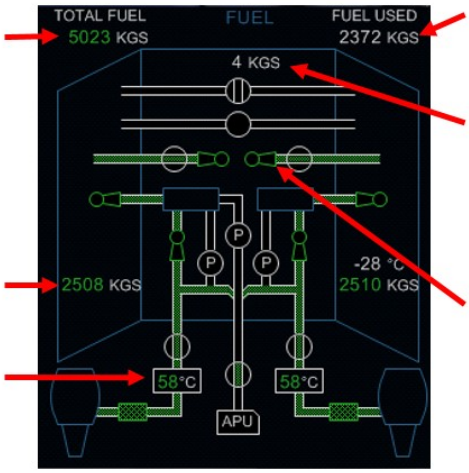
Displays fuel in 5kg increments

- Green – total fuel quantity > 408 kg
- Amber – total fuel quantity < 408 kg

Left and Right Tank Fuel Quantity

Displays fuel in respective tank in 5kg increment

- Green – fuel imbalance in limits, tank quantity > 204kg and total fuel quantity > 408kg
- Amber – fuel imbalance exceeds limits, or tank quantity < 204kg or total fuel quantity < 408kg



FUEL USED (white)

Displays amount of used fuel in 5kg increments. Reset through MENU page

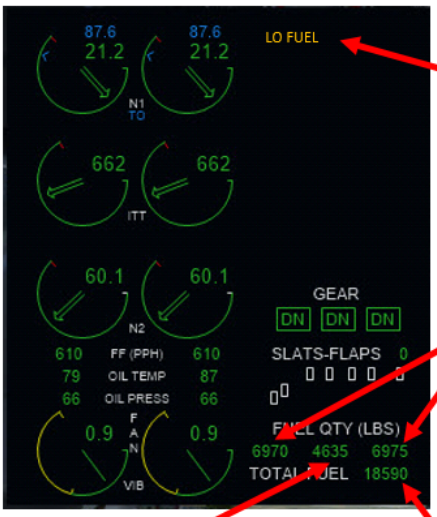
Center Fuel Tank Quantity

Displays fuel quantity in center tank in 5kg increments

- Green – fuel quantity > 5kg
- White – fuel quantity < 5kg

Bulk Fuel Temperature

- Green – temperature of fuel in right wing tank is -40°C or greater
- Amber – temperature of fuel in right wing tank is less than -40°C



LO FUEL caution (amber)

Appears when

- Fuel quantity in either tank is < 272kg
- Total fuel quantity is < 544kg
- Quantity in both collector tanks is low

Left and Right Tank Fuel Quantity

Displays fuel in respective tank in 5kg increment

- Green – fuel imbalance in limits, tank quantity > 204kg and total fuel quantity > 408kg
- Amber – fuel imbalance exceeds limits, or tank quantity < 204kg or total fuel quantity < 408kg

Center Fuel Tank Quantity

Displays fuel quantity in center tank in 5kg increments

- Green – fuel quantity > 5kg
- White – fuel quantity < 5kg

Total Fuel

Displays fuel in 5kg increments

- Green – total fuel quantity > 408 kg
- Amber – total fuel quantity < 408 kg

HYDRAULIC POWER

The CRJ has three hydraulic systems. Systems 1 and 2 are identical. All three systems operate on a nominal pressure of 3,000 PSI. Each system has two pumps. A main pump (A) for normal power and a backup pump (B). System 1 and 2's main pumps are engine driven pumps (EDP). The backup-pumps are AC-motor pumps (ACMP). Pump 1A is driven by the left engine, while pump 2A is driven by the right engine.

System 3 has two AC motor pumps. Pump A runs continuously whereas pump B is only running when high flows of hydraulic are required. In case supply of AC fails, pump 3B may be supplied by the ADG.

Except pump 3A all pumps have three operation-Modes:

- ON
- AUTO
- OFF

In AUTO mode, the pumps will start running automatically under the following conditions:

- AC BUS 2 must be powered for pump 2B operation
- AC BUS 1 must be powered for pump 1B operation
- Flaps are out if the 0° position

AC Motor Pump 1 and 2
Controls operation of AC motor pumps 1B and 2B. There are three operational modes:
- ON – pump operates at 3.000PSI output
- OFF – pump is deactivated
- AUTO – Pump operates when flaps are greater than 0 degrees

AC Motor Pump 3A
Controls operation mode of AC motor pump 3A. In case the ADG is extended this pump is operating independant of the selected mode.
- ON – pump operates at 3.000PSI output
- OFF – pump is deactivated

AC Motor Pump 3B
Controls operation mode of AC motor pump 3B. In case the ADG is extended this pump is operating independant of the selected mode.
- ON – pump operates at 3.000PSI output
- OFF – pump is deactivated
- AUTO – Pump operates when flaps are greater than 0 degrees and either IDG 1 or 2 is operating

In case of an engine fire the engine-driven pump of the affected engine needs to be shut off with the engine being shut off. Hence a shut-off valve is installed for pumps 1A and 2A to shut them off as well as son as the fire handle for the engine is pulled. Closing this shut-off valve can also be done manually.

L and R HYD SOV
Guarded pusbuttons which allow manually closing the hydraulic shut-off valves.
A white CLOSED light indicates which shut-off valve is selected closed.

The following table shows which aircraft system is supplied by which hydraulic system.

System 1		**System 3**		**System 2**	
Engine driven pump (1A)	AC motor pump (1B)	AC motor pump (3A)	AC motor pump (3B)	Engine driven pump (2A)	AC motor pump (2B)
Rudder		Rudder		Rudder	
Left and right elevator		Left and right elevators		Left and right elevator	
Left aileron		Left and right aileron		Right aileron	
Left and right outboard spoilerons		Main and nose landing gear		Left and right MLG and NLG assist actuators	
Left and right outboard spoilers		Left and right inboard brakes		Left and right outboard brakes	
Left and right outboard ground spoilers		Left and right inboard ground spoilers		Left and right inboard spoilerons	
Left thrust reversers		Nosewheel steering		Left and right inboard spoilers	
				Right thrust reversers	

Further information on valve positions, pressures and hydraulic fluid quantities may be obtained on the Hydraulic (HYD) EICAS Synoptic page.

Hydraulic systems 1 & 2:

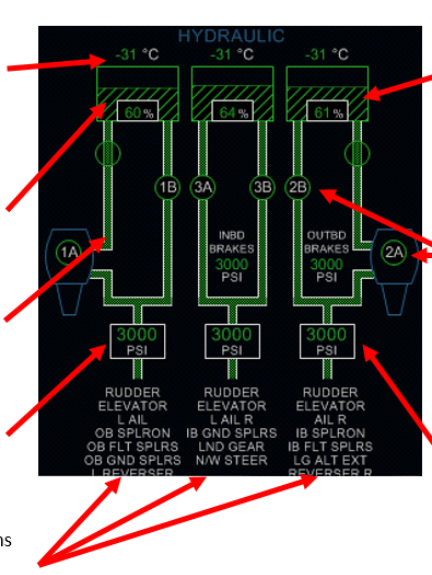
Hydraulic Temperature
Displays fluid temperature in 1°C increments
- Green – temperature < 96°C (205°F)
- Amber – temperature ≥ 96°C (205°F)
- Amber dashes – invalid data

Reservoir Output Line
- Green – sufficient quantity ≥ 5%
- Amber – insufficient quantity < 5%

Engine Driven Pump Input Line
- Green – SOV open
- Amber – SOV not closed with an engine fire

Pump Output and Pressure Manifold Line
- Green – pressure > 1,800 PSI
- Amber – low pressure < 1,800 PSI

System Distribution table
Displays status of associated aircraft systems
- White – adequate pressure > 1,800 PSI
- Amber – inadequate pressure < 1,800 PSI
- Half-intensity magenta – invalid data



Hydraulic quantity
Displays fluid quantity (in 5% increments). Normal quantity is 45 to 85 percent.
- White – quantity < 45% or > 85%
- Green – quantity ≥ 45% or ≤ 85%
- Amber dashes – invalid data

Pump
Displays pump status
- White – pump off
- Green – normal operation of pump
- Amber – low pressure of pump
- Half-intensity magenta – invalid data

Hydraulic Pressure
Indicates hydraulic pressure in 100 PSI increments. Normal operating pressure is between 2,800 and 3,200 PSI.
- White – pressure > 3,200 PSI
- Green – pressure > 1,800 PSI and ≤ 3,200 PSI
- Amber – pressure ≤ 1,800 PSI
- Amber dashes – invalid data

Hydraulic systems 3:

Hydraulic Temperature

Displays fluid temperature in 1°C increments

- Green – temperature < 96°C (205°F)
- Amber – temperature ≥ 96°C (205°F)
- Amber dashes – invalid data

Reservoir Output Line

- Green – sufficient quantity ≥ 5%
- Amber – insufficient quantity < 5%

Pump

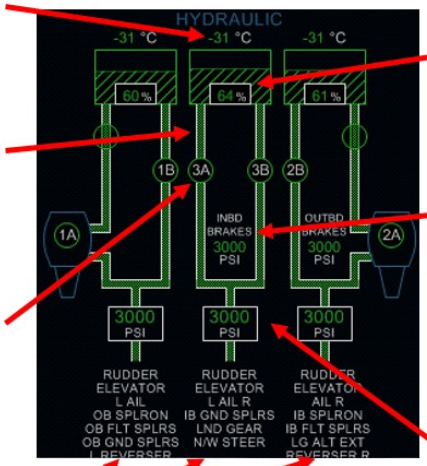
Displays pump status

- White – pump off
- Green – normal operation of pump
- Amber – low pressure of pump
- Half-intensity magenta – invalid data

System Distribution table

Displays status of associated aircraft systems

- White – adequate pressure > 1,800 PSI
- Amber – inadequate pressure < 1,800 PSI
- Half-intensity magenta – invalid data



Hydraulic quantity

Displays fluid quantity (in 5% increments). Normal quantity is 45 to 85 percent.

- White – quantity < 45% or > 85%
- Green – quantity ≥ 45% or ≤ 85%
- Amber dashes – invalid data

Pump Output and Pressure Manifold Lines

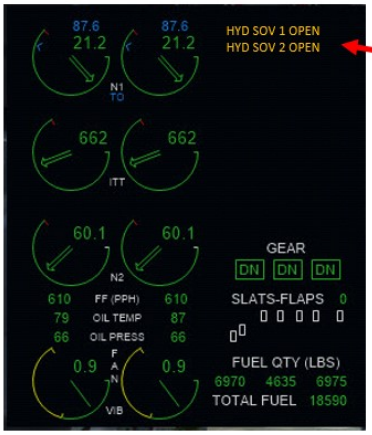
- Green – pressure > 1,800 PSI
- Amber – low pressure < 1,800 PSI

Hydraulic Pressure

Indicates hydraulic pressure in 100 PSI increments. Normal operating pressure is between 2,800 and 3,200 PSI.

- White – pressure > 3,200 PSI
- Green – pressure > 1,800 PSI and ≤ 3,200 PSI
- Amber – pressure ≤ 1,800 PSI
- Amber dashes – invalid data

Just a few cautions and status messages may be triggered by the hydraulic system.



HYD SOV 1 or 2 OPEN caution (amber)

Appears when the respective shut-off valve is open and the associated engine on fire

HYD SOV 1 or 2 CLOSED status (white)

Indicates that respective hydraulic shut-off valve is selected closed.

ICE & RAIN PROTECTION

The aircraft does not need much protecting from rain if no icing conditions persist (definition is coming up in a second), hence windshield wipers are the only system for rain protection.

Icing conditions are defined as follows: TAT of 10°C and less and visible moisture like fog, clouds, any form of precipitation, except the SAT is -40°C (-40°F) or below.

Icing may affect the functionality of certain aircraft systems, alter the aerodynamic of the aircraft's wings and if sucked into the engine lead to engine trouble. Hence several systems need to be protected from icing:

- The wings leading edges
- Air data sensors like pitot tubes, angle of attack sensors, static ports, etc. pp)
- The engine intakes / cowls
- The cockpit windows

There are two approaches to heat the mentioned systems / areas: either by extracting bleed air from the aircraft engines or by means of an electrical heating.

Apparently extracting bleed air from the engines reduces the available amount of thrust. Accordingly, the engines RPM must be increased a little to compensate the extracted air for heating. Therefore, you'll experience an increase of N_1, when activating the anti-ice systems. The more systems are supplied with bleed air the bigger the increase of N_1 is going to get.

The following systems are heated with bleed air:

- Wing anti-ice
- Engine intake cowl anti-ice

Whereas the following systems are electrically:

- Windshields and side windows
- Air data probes and sensors

An ice detection system assists the crew by warning of possible ice accumulation. The ice detection system is operational as soon as AC power is available. In case either detector senses icing conditions an amber caution "ICE" is indicated on the EICAS if either the wing- or cowl-anti-ice system is still off. Failures of the anti-ice systems as well as bleed air leakages are not simulated.

The following sections introduce the controls for each sub-system, the indications on the Anti-Ice EICAS Synoptic Page as well as possible EICAS messages.

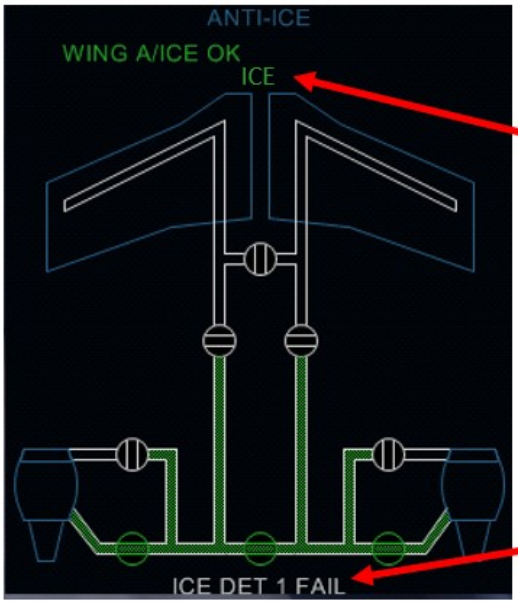
ICE DETECTION SYSTEM

DET / TEST

Pushbutton to initiate test sequence. An amber ICE light illuminates during the test sequence and when the ice detection system detected some ice and anti-ice is not activated.

Pressing and holding the pushbutton for approximately 5 seconds, starts the test sequence:

- Master caution light flashes
- ICE caution message appears on the EICAS
- ADS HEAT TEST OK message appears on EICAS status page
- ICE light on anti-ice panel / pushbutton illuminates
- All messages and lights disappear / extinguish when pushbutton is released and test ends



ICE, ICE 1 or ICE 2 (amber/green)

Appeares when icing conditions are dected.

- Green – icing conditions detected and anti-ice is activated
- Amber – icing conditions detected and anti-ice is not activated

ICE DET 1 or 2 FAIL (amber)

Appears when respective ice detector failed

ICE caution (amber)

Appears when icing conditions are detected and anti-ice is not activated or failed

ICE DET FAIL caution (amber)

Appears when both ice-detector systems fail

ICE status (white)

Appears when icing conditions are detected and wing and cowl anti-ice are selected on.

ICE DET 1 or 2 FAIL status (white)

Appears when respective ice detector system failed and the remaining system is active and operational

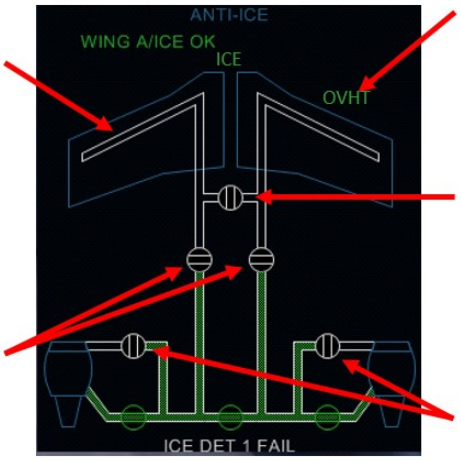
WING AND COWL ANTI-ICE SYSTEM

WING
Controls operation of wing anti-ice:
ON – system is activated
OFF – system is deactivated

COWL LH and RH
Controls operation of cowl anti-ice on left-hand and right-hand engine:
ON – system is activated
OFF – system is deactivated

WING A/I CROSS BLEED
Controls the bleed air sources
- FROM LEFT – wing cross bleed valve opens and right wing anti-ice valve closes
- NORMAL - – wing cross bleed valve closes
- FROM RIGHT – wing cross bleed valve opens and left wing anti-ice valve closes

Anti-Ice Flow Lines
- Green – system is selected on and operating normally
- Amber – valve failed to close or low temperature detected even though anti-ice system is activated
- Red – overheat condition detected



OVHT (red)
Indicates an overheat condition in the respective anti-ice system

Wing Cross-Bleed valve
Position indicator

Wing Anti-Ice Valve
Position Indicator

Engine Cowl Anti-Ice Shut-Off Valve
Position Idicator

COWL status (white)
Indicates that both cowl anti-ice valves (left & right) are open when selected on

L or R COWL A/I ON status (white)
Indicates that the left or the right cowl anti-ice valve is open

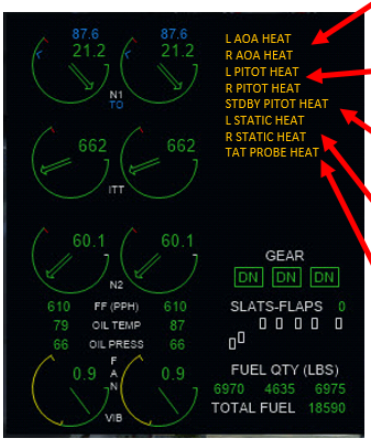
WING/COWL A/I ON status (white)
Indicates that both wing and cowl anti-ice systems are on and operating normally

L or R COWL A/I DUCT status (white)
Indicates low pressure (less than 3.12 psig) or high pressure (greather than 53.1 psig) is detected in respective cowl duct

AIR DATA ANTI-ICE SYSTEM

PROBES LH and RH
Used to control the air data anti-ice systems while on ground. In flight the heaters are controlled automatically independent of the switch position.

- OFF – air data anti-ice system switched OFF (on ground only)
- ON – air data anti-ice system switched ON (on ground only)



L or R AOA HEAT caution (amber)
Appears when left or right angle of attack heater is off or failed

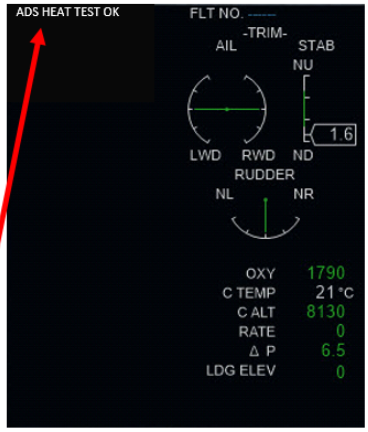
L or R PITOT HEAT caution (amber)
Appears when left or right pitot heater is off or failed

STDBY PITOT HEAT caution (amber)
Appears when standby pitot heater is off or failed

L or R STATIC HEAT caution (amber)
Appears when static port heater is off or failed

TAT PROBE HEAT caution (amber)
Appears when temperature probe heater failed and AC bus 1 is powered

ADS HEAT TEST OK status (white)
Illuminates when ice detection system ended succesfully



WINDSHIELD AND SIDE WINDOW ANTI-ICE SYSTEM

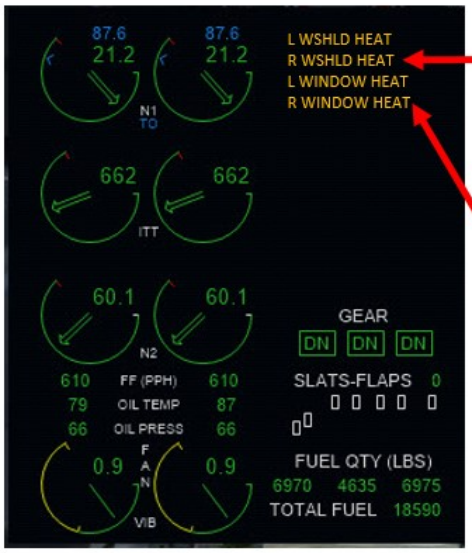
WSHLD LH and RH

Used to control windshield and side windows anti-ice systems.

- LOW – this mode is used for de-misting and de-fogging the windshield and side windows
- HI – this mode is used for de-icing the windshield. The side windows stay in LOW mode
- OFF / RESET – deactivates the anti-ice system

TEST

Press and hold to initiate test sequence. Caution message appears during the test.



L or R WINDOW HEAT caution (amber)

Appears when an overheat or no heat condition is detected

L or R WINDOW HEAT caution (amber)

Appears when an overheat or no heat condition of the side window heater is detected

WINDSHIELD WIPER SYSTEM

WIPER

Used to control windshield wipers:

- OFF / PARK – stops wipers and moves them to park position
- INT – wiper operate every 5 seconds
- SLOW – wipers operate at 80 cycles per minute
- FAST – wipers operate at 125 cycles per minute

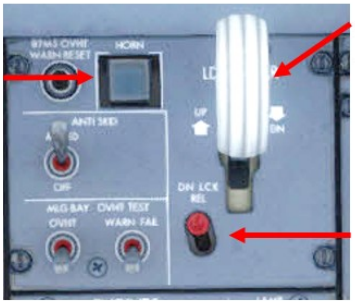
LANDING GEAR

The CRJ is equipped with two main landing gear assemblies mounted in either wing-root, and a forward, steerable, fuselage mounted nose gear assembly. Each assembly is equipped with two wheels and a braking system.

Gear extraction and retraction is triggered electrically by the landing gear selector whereas the extension and retracting is actuated hydraulically (by hydraulic system 3).

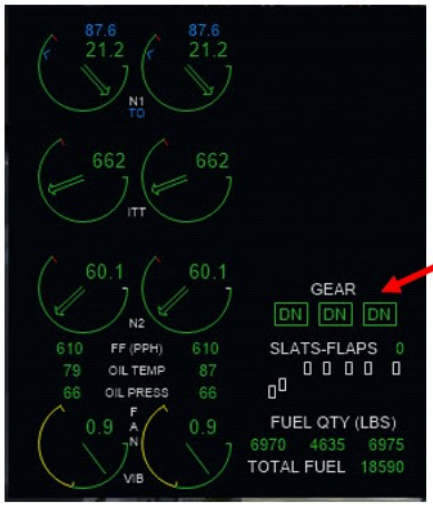
In case the normal extension mechanism fails an alternate gear extension mechanism is available: just pull the landing gear manual release handle to unlock the gear uplocks. Due to gravity, the gear will partially extend. A combination of valves in the hydraulic system is activated to divert pressure from the No. 2 system to complete the gear extension and lock the gear in the down position.

HORN
Press button to mute landing gear horn. A white MUTE light comes on when horn is muted.



GEAR LEVER
Used to retract and extend the landing gear
- UP – retracts the landing gear
- DN – extends the landing gear

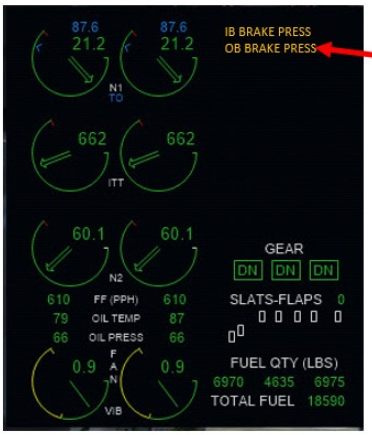
DN LOCK REL
Used to manually release the landing gear lever down lock



Landing Gear Position Indicator
- UP (white) – landing gear is up and locked
- DN (green) – landing gear is down and locked
- (amber) – landing gear is in transit
- (red) – landing gear is not in safe position
- --- (amber dashes) – landing gear position is unknown

BRAKE SYSTEM

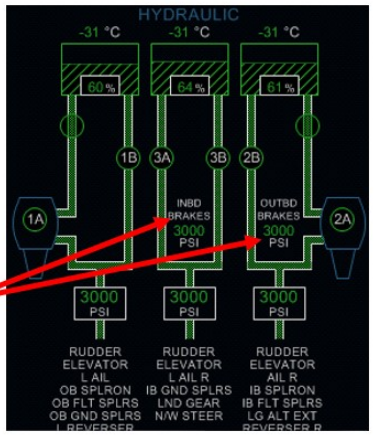
Each wheel of the gear assembly is equipped with self-adjusting multi-disc brakes. The inboard brakes are actuated by hydraulic system no. 3. Brake pressure is applied by pressing the rudder pedals. To enable this feature within your flightsim make sure that the toe brake axis is assigned to your rudder pedals brake axis or whichever axis you prefer.



IB or OB BRAKE PRESS caution (amber)
Appears when brake pressure of the respective system is below 1,800 PSI and DC bus 2 is powered

Brake Pressure Readout
Displays brake pressure of inboard (INBD) and outboard (OUTBD) braking system in 100 PSI increments.

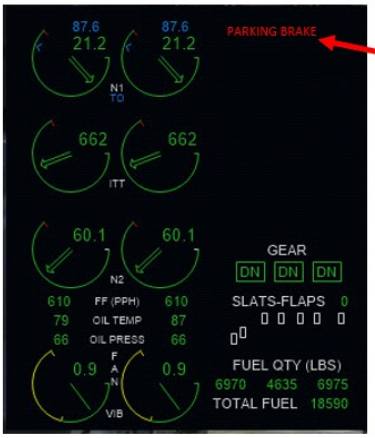
- Green: pressure between 1,800 and 3,200 PSI
- White: pressure greater 3,200 PSI
- Amber: pressure is less than 1,800 PSI
- Amber dashed – invalid data



PARKING BRAKE

To activate the parking brake fully press the brake/rudder pedals, pull the parking brake lever and twist it 90° in either direction. The inboard brake control valves and the parking shutoff valve prevent a pressure drop in the system due to leakages when the parking brake is set.

PARKING BRAKE
Used to activate and deactivate the parking brake. Click the handle, press your flights key assignment (mostly Ctrl + „.“) or your joystik button assignment to activate and deactivate



PARKING BRAKE warning (red)
Appears when parking brake is activated and airplane is configured for take-off or in the air

PARKING BRAKE ON status (white)
Appears under following conditions:

- Parking brake set
- Aircraft on ground
- Engines not in take-off power
- Inboard brake pressure > 800 PSI

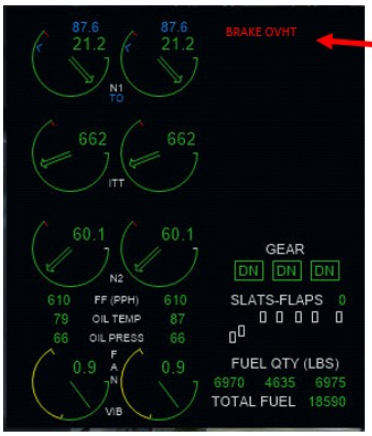
BRAKE TEMPERATURE MONITORING SYSTEM

The main wheel brakes temperature is monitored and indicated on the EICAS as long as the gear and flap/slats position are indicated on the EICAS. In case an overheat condition is detected and no longer persists, the warning may be reset by the BTMS overheat warning reset switch.

Each brakes temperature is indicated as a colour-coded numerical value:

Colour-code	**Numerical values**	**Temperature range**
Green	01 – 06	≤ 220°C
White	07 – 14	≥ 221°C and ≤ 492°C
Red	≥ 14	≥ 493°C

BTMS OVHT WARN RESET
Used to reset the Brake Temperature Monitoring System, BTMS.



BRAKE OVHT warning (red)
Appears when an overheat condition is detected on one of the brakes

Brake Temperature Readout
Indicates brake temperature

- Green: 06 and less (≤ 220°C)
- White: 07 to 14 (between 221 and 492°C)
- Red: >14 overheat condition (≥ 493°C)

ANTI-SKID

The anti-skid-system controls the hydraulic pressure applied to the wheel brakes and performs the following functions:

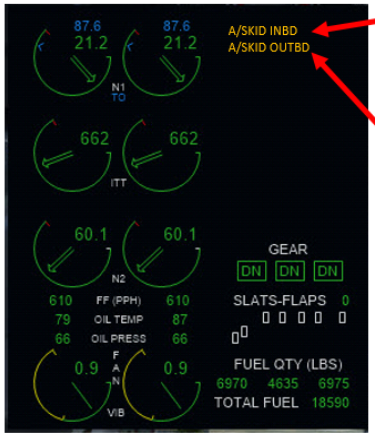
- Prevent skidding
- Protection during touchdown – even though the brake pedals may be pressed / applied, a landing with locked wheels is prevented
- Recovering of a wheel from deep skid

The anti-skid-system comprises four-wheel speed transducers and two dual anti-skid control valves.

It may only be activated when both main gears are locked in the down position and the parking brake is not activated. The anti-skid switch needs to be switched to the ARM position and the system becomes operation automatically as soon as passing 35 knots on ground (weight-on-wheels signal is present).

As soon as the aircraft is in the air (and there is no weight-on-wheels signal) brake pressure is dumped to prevent a landing with locked wheels.

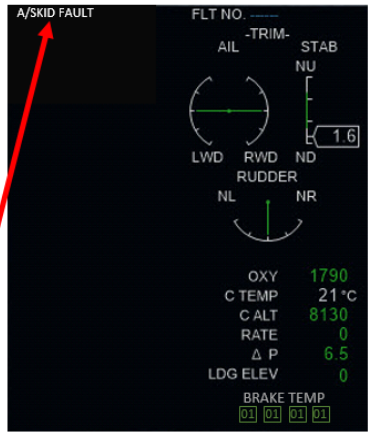
ANTI SKID
Used to arm the anti-skid system. The system automatically is armed as soon as the wheel spin-up (>35 kts) is detected.



A/SKID INBD caution (amber)
Appears under the following conditions:
- Inboard anti-skid failed OR
- Parking brake shut-off valve failed / closed OR
- Loss of ASCU output

A/SKID OUTBD caution (amber)
Appears under the following conditions:
- Outboard anti-skid failed OR
- Loss of ASCU output

A/SKID FAULT status (white)
Appears under the following conditions
- Loss of redundancy of ASCU OR
- Loss of weight-on-wheels input OR
- Spin down fail OR
- Loss of internal communication



NOSE WHEEL STEERING SYSTEM

Unlike in most other aircraft the CRJ's nosewheel steering needs to be activated manually by selecting the N/W STRG switch to the ARMED position. Then you can turn the nosewheel up to 80° either side of center with the steering tiller mounted on the pilot's side panel. Deflection controlled by the rudder pedals is limited to 8° either side of center.

As soon as the aircraft is in the air (no weight-on-wheel signal detected) the systems commands straight ahead. In case the steering tiller is deflected more than 2° while in air (i.e. before touchdown) the STEERING INOP caution message will appear on the EICAS

.

Nose Wheel Steering Switch

Used to control nosewheel steering:

- OFF – nosewheel is in free castoring mode
- ARMED – nosewheel steering is activated

Tiller

Steering tiller for nosewheel steering – may be assigned to an joystick axis in Dave or controlled via rudder pedals or flights key / axis assignments

LIGHTING

This chapter is divided into the following sections:

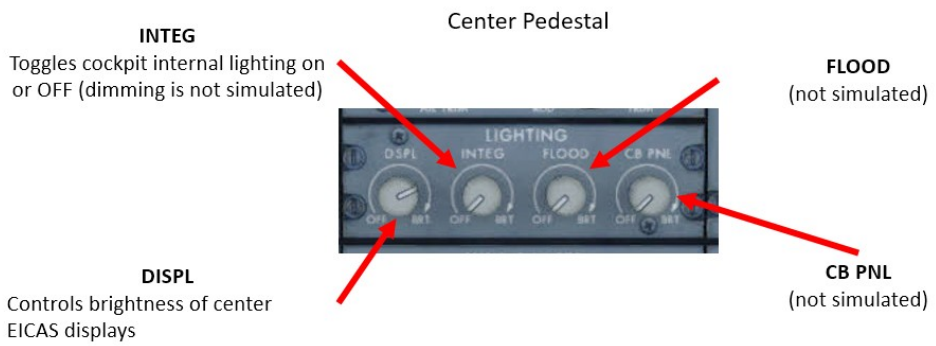
- Cockpit lighting
  Controls on overhead panel
- Passenger compartment lighting
  Controls on forward attendant's panel → not simulated
- External lighting
  Controls on overhead panel
- Emergency lighting
  Controls on overhead panel

COCKPIT LIGHTING

Several types of lighting are available in the cockpit:

- **General area illumination**
  - ***Dome light***
    Not simulated
  - ***Floor lights***
    Not simulated
- **Instrument and panel lighting**
  - ***CRT intensity control***
    Allows to control intensity of the pilots displays (PFD, MFD, EICAS)
  - ***Integral lighting***
    Switches cockpit internal lighting on and off
  - ***CB braker panel lighting***
    Not simulated
- **Map and reading lights**
  Not simulated

Center Pedestal



Pilot's / Copilot's Side Pedestal

Center Pedestal

LAMP TEST
Switching to 1 or 2 illuminates all annunciator lights. Difference between channel 1 and 2 not simulated.

IND LTS
(not simulated)

Overhead Panel

DOME LIGHT
Activates / Deactivates Dome Lights

OVHD
(not simulated)

STB COMP
(not simulated)

PASSENGER COMPARTMENT LIGHTING

The real aircraft offers several types of lighting for the passenger compartment, like ceiling and sidewall fluorescent lights.
The only lights that may be controlled in FS are the NO SMOKING and FASTEN SEAT BELTS signs.

NO SMKG

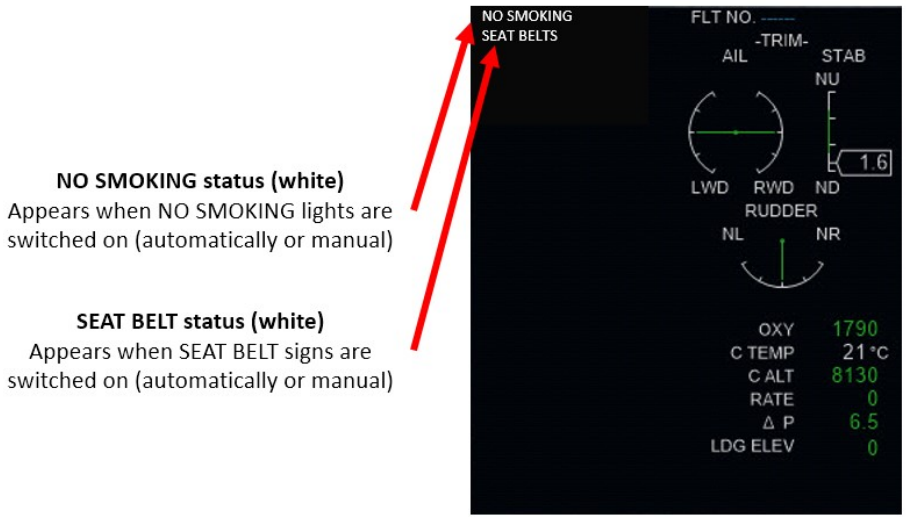
Controls illumination of NO SMOKING Lights

- ON – NO SMOKING lights are turned on
- OFF – NO SMOKING lights are turned off
- AUTO – Lights are switched off when aircraft climbs through 10,000ft and switched on when landing gear is extended.

SEAT BELTS

Controls illumination of SEAT BELTS signs

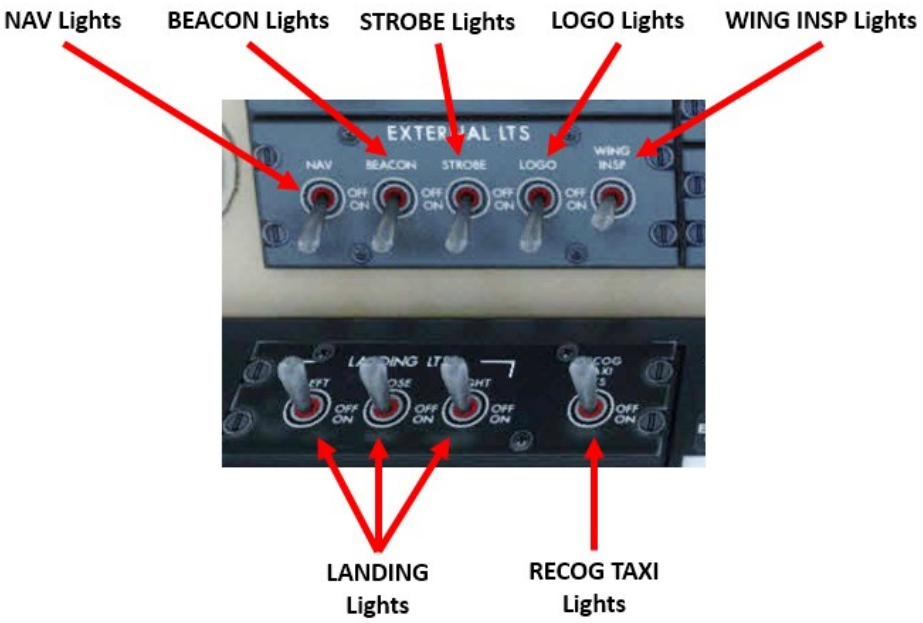
- ON – SEAT BELT signs are turned on
- OFF – SEAT BELT signs are turned off
- AUTO – Signs are switched off when aircraft climbs through 10,000ft and switched on when landing gear is extended or flaps are extended to first position

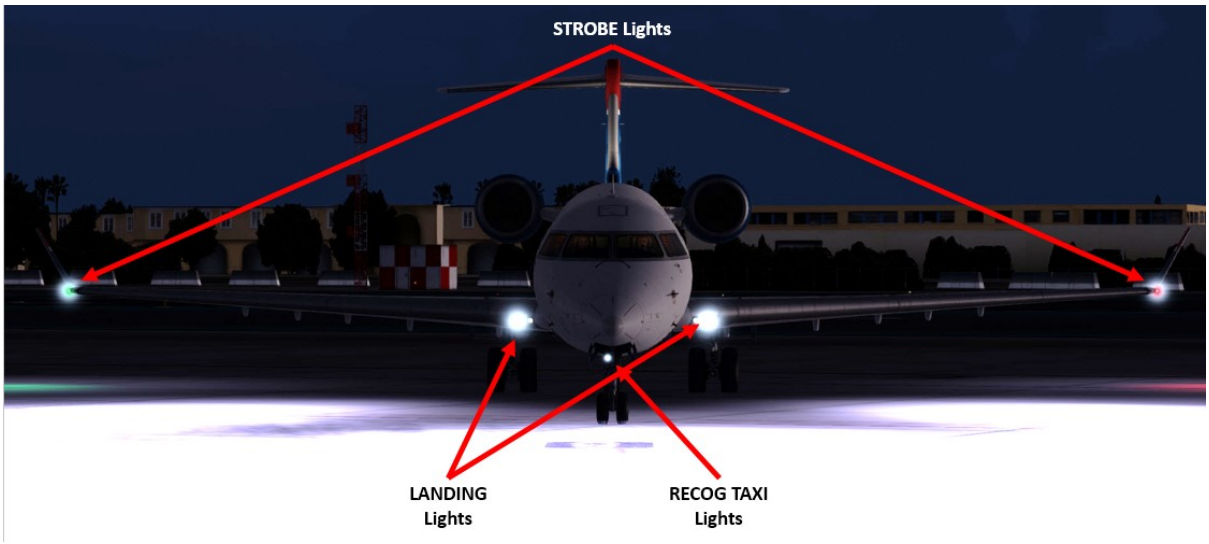


EXTERNAL LIGHTING

External lighting is simulated identical to the real aircraft. The external lights comprise:

- ***Landing and taxi lighting***
  The CRJ has three landing lights – one in each wing's leading edge and one installed on the nose gear. The 2 taxi lights are installed next to the landing lights in the wind's leading edge.
- ***Navigation lighting***
  The navigation lights are installed in each wingtip. Each navigation light assembly consists of two lights – two green lights on the right hand side and two red lights on the left hand side.
  The lights are controlled via the NAV light switch on the overhead panel.
- ***Beacon light***
  Two beacon lights are installed on the CRJ – one on top of the fuselage and the other one on the bottom of the fuselage. Activated beacon lights indicate that the aircraft is powered and the engines may be running.
  The BEACON light switch controls the beacon lights.
- ***Anti-Collision strobe lights***
  Three anti-collision lights are installed on the aircraft. Two on either wingtip and one on the aft end of the vertical stabilizer. The anti-collision lights flash continuously as soon as activated and are normally activated after take-off clearance is received and switched off when leaving the runway.
  The STROBE switch is used to switch the anti-collision lights on and off.
- ***Logo lights***
  As the name suggests the logo lights illuminate the aircrafts logo depicted on the tail. Two white lights are installed in the engine pylons – one on either side.
  The lights are controlled by the LOGO switch.
- ***Wing inspection lighting***
  The wing inspection lights are used to inspect the forward part of the wing for ice accumulation. The wing inspection lights are installed on either side of the fuselage and controlled by the WING INSP switch.


NAV Lights
BEACON Lights
STROBE Lights
LOGO Lights
WING INSP Lights
LANDING Lights
RECOG TAXI Lights


STROBE Lights
LANDING Lights
RECOG TAXI Lights


ANTI-COLLISION STOBE Light & NAVIGATION Light (White)
LOGO Lights
BEACON Light
US AIRWAYS EXPRESS
N247LR

EMERGENCY LIGHTING

Emergency lighting of the real airplane consists of the overwing exit paths, the exterior area around the passenger doors / emergency exits, interior exit paths, lighting of the emergency exits and so on.

Even though the controls are available in the virtual cockpit, the emergency lighting is not simulated and hence not further explained.

EMER LTS
Controls emergency lighting system

- ON – Emergency Lights are turned on
- OFF – Emergency Lights are turned off
- ARM – Emergency Lights illuminate automatically when AC or DC power is lost.

EMER LTS OFF caution (caution)
Appears when Emergency Lights are switched off.

EMER LTS ON status (white)
Appears when Emergency Lights are switched on

NAVIGATION SYSTEMS

This chapter describes several navigation systems, each is described in its own section. The chapter is comprised of the following sections:

- Flight Management System (FMS)
- Global Positioning System (GPS)
- VHF Navigation (VNAV)
- Automatic Direction Finder (ADF)
- Distance Measuring Equipment (DME)
- Air Traffic Control Transponder System (ATC)
- Traffic Alert and Collision Avoidance System (TCAS)
- Ground Proximity Warning System (GPWS)
- Weather Radar (WXR)

FLIGHT MANAGEMENT SYSTEM (FMS)

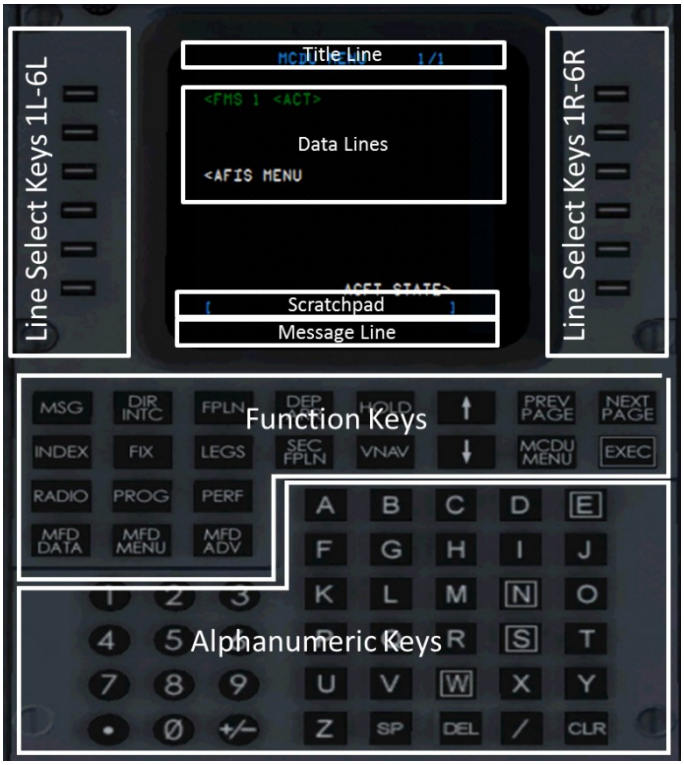
The CRJ is powered by two Collins FMS-4200 flight management computers. The control display units (CDU) are the interface between pilots and the FMS units itself by means of data / information display and data entry. The FMS provides lateral guidance and vertical advisories based on the entered flight route, performance data and data collected from several sensors.

The stored performance database is advisory only, as the FMS has no ability to control vertical or speed modes of the autopilot. Only heading information based on the programmed route are provided to the autopilot in LNAV mode.

This chapter in the systems manual only provides a very basic introduction to the flight management system. More details will be introduced in a dedicated manual (Vol. 6).

WHERE TO FIND THE FMS/CDU AND BASIC LAYOUT

The control display units, CDUs sit on the upper part of the pedestal. Both CDUs are identical regarding functionality and layout.
The following picture shows the basic layout of the control display unit, CDU.



- ***Title line***
  The title line shows the page title, or mode as well as the current page number and number of total pages, of applicable

- ***Label line***
  The label lines are aligned with the respective line select keys. They show information related to the current page. Pressing the line select key adjacent to the label line, allows copying the indicated information into the scratchpad or vice versa.

- ***Prompts / Dashes***
  Boxes indicate where information need to be entered in the FMS.
  Dashes indicate where information may be entered.

- ***Data lines***
  Provide further information to the indicated data in the same label line (i.e. distance information on the LEGS page)

- ***Scratchpad***
  Text entered via the keypad or copied from a label line via the line select key is displayed in the scratchpad

- ***Message line***
  The message line indicates system generated

- ***Left Line Select Keys LSL1L to LSK6L***
  Allow to enter and copy data from the data lines into the scratchpad and vice versa.

- ***Right Line Select Keys LSL1R to LSK6R***
  Allow to enter and copy data from the data lines into the scratchpad and vice versa.

- ***Function Keys***
  Pressing a function key calls /opens the associated page
  - MSG
    Opens the FMS message page
  - DIR/INTC
    Opens the DIRECT-TO page
  - FPLN
    Opens the Flightplan page to enter and modify a flightplan
  - DEP/ARR
    Opens the Departure and Arrival page to select SIDs and STARs
  - HOLD
    Opens the HOLDING page to program holdings
  - ↑ and ↓
    For scrolling up and down – for example to modify the center for the flight plan page
  - PREV PAGE
    Opens previous page
  - NEXT PAGE
    Opens next page
  - INDEX
    Opens INDEX page to access FMS functions which have no direct-access-keys
  - FIX
    Opens the FIX INFO page
  - LEGS
    Opens the LEGS page to modify a flightplan's legs
  - SEC FPLN
    Opens secondary fligthplan page
  - VNAV
    Opens VNAV page for VNAV advisories
  - MCDU MENU
    Opens the ENU page
  - EXEC
    The EXEC button executes modifications made
  - RADIO
    Opens the radio programming page (NAV, COM, ADF)

- PROG
  Opens the Progress page to show a summary of the current flight status
- PERF
  Opens the Performance page
- MFD DATA
  Allows to switch between map and text display
- MFD MENU
  Allows to look deeper into the FMS data source regarding airports, navaids, fixes and modify data
- MFD ADV
  Opens the DISPLAY ADVANCE page to move through the MFD text pages.

- ***Keypad***
  Used to enter alpha-numerical data in to the scratchpad.

You may use your mouse to enter data into the FMS and select certain functions, nevertheless you may also activate a mode to use keyboard commands to directly enter data / select functions from the FMS. Please bear in mind that as long as the keyboard mode is activated other key assignments in your flightsim won't work.

Note

In case you are using the keyboard entry mode do not forget to deactivate it when entries are completed to gain full function of regular flightsim functions.

The table on the following page shows the available key commands.

Function	German Keyboard	U.S. Keyboard
Toggles left MCDU keyboard entry mode ON/OFF	Strg+Umschalt+1	Ctrl+Shift+1
Toggles right MCDU keyboard entry mode ON/OFF	Strg+Umschalt+2	Ctrl+Shift+2
LSK 1L	F1	F1
LSK 2L	F2	F2
LSK 3L	F3	F3
LSK 4L	F4	F4
LSK 5L	F5	F5
LSK 6L	F6	F6
LSK 1R	F7	F7
LSK 2R	F8	F8
LSK 3R	F9	F9
LSK 4R	F10	F10
LSK 5R	F11	F11
LSK 6R	F12	F12
MSG	Strg+F1	Ctrl+F1
Dir/Intc	Strg+F2	Ctrl+F2
Fpln	Strg+F3	Ctrl+F3
Dep/Arr	Strg+F4	Ctrl+F4
Hold	Strg+F5	Ctrl+F5
MCDU Menu	Strg+F6	Ctrl+F6
Index	Strg+F7	Ctrl+F7
Fix	Strg+F8	Ctrl+F8
Legs	Strg+F9	Ctrl+F9
Sec Fpln	Strg+F10	Ctrl+F10
VNAV	Strg+F11	Ctrl+F11
Exec	Return oder Strg+F12	Return or Ctrl+F12
Radio	Umschalt+F1	Shift+F1
Prog	Umschalt+F2	Shift+F2
Perf	Umschalt+F3	Shift+F3
MFD Data	Umschalt+F4	Shift+F4
MFD Menu	Umschalt+F5	Shift+F5
MFD Adv	Umschalt+F6	Shift+F6
A-Z	A-Z	A-Z
0-9	0-9	0-9
.	.	.
+	+	+
-	-	-
/	/	/
SP	Leertaste	Space
DEL	Entf	Delete
CLR	Zurück	Backspace

PREFLIGHT SETUP AND SEQUENCE OF PAGES

During flight preparation the FMS is set up as well. This setup follows a certain sequence of events which will be briefly introduced in this chapter. Check the tutorial flight and FMS manual for more information.

1. Status Page
   After startup the FMS displays the STATUS page – review the displayed information for consistency
2. POS Init
   Now you need to enter the aircrafts position.
3. FLTPLN
   a. Enter Origin
   b. Enter Destination
   c. Enter Origin Runway
   d. Enter Alternate airport
   e. DEP/ARR
      i. Enter a SID
      ii. Enter a STAR
   f. Modify SID/STAR
   g. Enter route in FLTPLN page according your route string
4. LEGS
   Check route & altitude / speed restrictions
5. PERF
   Review / set up the selected climb, cruise and descent profiles
6. PROG
   Review the data on the progress page

GLOBAL POSITIONING SYSTEM (GPS)

The global positioning system works according the same principle as smartphones or handheld GPS-units – the unit receives satellite signals to compute the current positions, altitude and velocity. The main difference between the CRJs GPS and a handheld device is the accuracy of the GPS signals and hence the aircrafts position as well as redundancy.

The CRJ has two independent antennas and receivers which have an interface to the integrated avionics processor system (IAPS). The IAPS connects data from the FMS, the inertial reference systems and other navigation sources to provide navigation, position information and guidance.

GPS data may be considered via opening the respective FMS pages on the control display unit.

VHF NAVIGATION

Two VHF navigation systems NAV 1 and NAV 2 are available on the CRJ. Both provide receiving and processing of the following signals

- VOR stations
- Localizer (LOS) / glideslope (GS) / ILS stations
- Marker beacon (MB)

The radio tuning unit is the primary device to tune navigation or communication frequencies. Nevertheless, there is a backup tuning unit to tune NAV 1 and 2:

Bild und Kontrollen Backup Tuning unit

The VOR/LOC receivers operate in the following ranges:

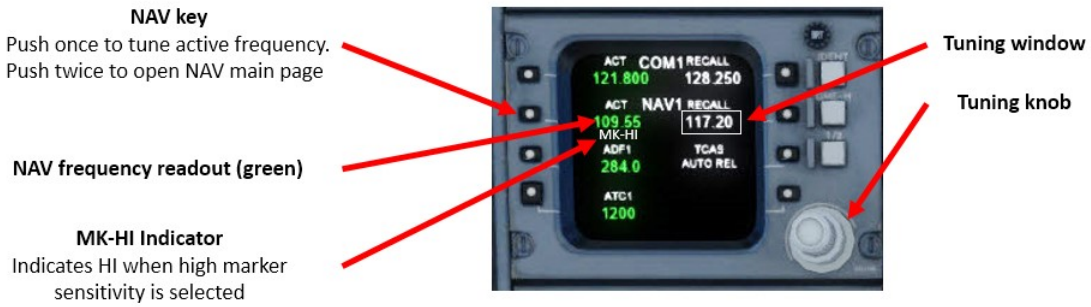
- VOR frequencies all **even** frequencies from 108.00 to 111.90 MHz and all frequencies from 112.00 to 117.95 MHz.
- LOC frequencies all **odd** frequencies from 108.10 to 111.95 MHz

The received data is displayed on the pilot and copilots PFD and MFD depending on the selected modes.

In case an ILS is tuned horizontal and glideslope information are displayed accordingly.

The marker beacons provide information on the distance to runway threshold by aural signals and visual cues on the PFD and MFD.

VOR/LOC stations may be identified by aural designators when selected accordingly on the audio's integrated system.



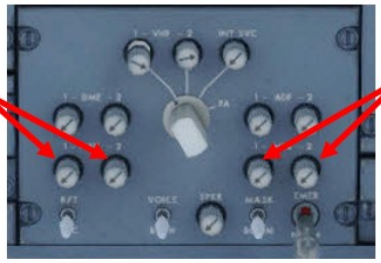
NAV frequency readout (green)

AUT indicator
Appears when Auto tune is activated on the FMS Radio page

MKR SENS Key
Enables to toggle between high and low sensitivity

PRE or RECALL
- PRE – frequency was changed by tuning knobs
- RECALL – frequency was swapped with active frequency

1 – NAV - 2
Monitors respective navigation receiver for aural identification (morse code). Press to activate (switch illuminates) then rotate to adjust sound volume and press again to switch off.



1 - MKR - 2
Monitors marker beacon signals. Press to activate (switch illuminates) then rotate to adjust sound volume and press again to switch off.

BRG
Selectors for bearing pointers. Click to cycle through possible waypoints

NAV SOURCE
Used to select navigation source. In clockwise direction: FMS 1, VOR/LOC 1, OFF, VOR/LOC 2, FMS 2.

PUSH X-SIDE
Pushbutton to swap the navigational sources from opposite side's MFD.

Bearing Source
Indicates the selected bearing pointer's navigation sources.
Bearing pointer No. 1 is a magenta single line.
Bearing pointer No. 2 is a cyan double line.

Bearing pointers
No.1 = single magenta line
No. 2 = cyan double line

Marker Beacon Indicator

- OM - Outer Marker (cyan)
- MM - Middle Marker (yellow)
- OM - Inner Marker (white)

Navigation Source Indicator
Indicates the selected navigation source

Vertical Deviation Bar
Indicates (lateral) deviation from selected course.
Colour matches navigation source

Lateral Deviation Bar
Indicates (lateral) deviation from selected course.
Colour matches navigation source

Marker Beacon Indicator

- OM - Outer Marker (cyan)
- MM - Middle Marker (yellow)
- OM - Inner Marker (white)

Navigation Source Indicator
Indicates the selected navigation source

Vertical Deviation Bar
Indicates (lateral) deviation from selected course.
Colour matches navigation source

Lateral Deviation Bar
Indicates (lateral) deviation from selected course.
Colour matches navigation source

AUTOMATIC DIRECTION FINDER (ADF)

The ADF system is used to display the bearing from the aircraft to a ground station. The ground station may either be a non-directional beacon (NDB) or a standard amplitutde modulation (AM) broadcast station sending within the frequency range of 190.0 to 1799,5 kHz.

The CRJ has two ADF receivers ADF 1 and ADF 2 which may be operated independently.

Bearing selection is made on the pilot or copilots display control panel (DCP) whereas the bearing-to-station data is displayed in the HSI section of the PFD or on the MFDs.

ADF key
Push once to tune active frequency.
Push twice to open NAV main page

ADF frequency readout (green)

Tuning window

Tuning knob

ADF frequency readout (green)

ADF Mode Key
Used to select ANT or ADF antenna setting.
Active mode is displayed in cyan

- ANT – (not simulated) used for range navigation, station tuning or monitoring broadcasting services
- ADF – directional antenna is used – the ADF displays the bearing to the tuned station on the HSI portion of the PFD and on the MFD.

ADF TONE Key
(not simulated)
Used to toggle tone circuit for aural supported tuning ON or OFF.

1 – ADF - 2
Monitors activated ADF receiver.
Press to activate (switch illuminates) then rotate to adjust sound volume and press again to switch off.

BRG
Selectors for bearing pointers. Click to cycle through possible waypoints

Bearing Source
Indicates the selected bearing pointer's navigation sources.
Bearing pointer No. 1 is a magenta single line.
Bearing pointer No. 2 is a cyan double line.

Bearing pointers
No.1 = single magenta line
No. 2 = cyan double line

DISTANCE MEASURING EQUIPMENT (DME)

Most of the time the DME signal is tuned automatically corresponding to the tuned VOR station. The DME system then computes the straight-line distance between aircraft and ground station. Furthermore, it provides information on ground speed, time to station and station identification.

The CRJs two DME systems operate with three channels each. Normally the first channel is tuned automatically corresponding to the tuned VOR station. Channels 2 and 3 are tuned automatically by the system to support the FMS multisensory navigation.

Nevertheless, the systems allows the pilot to tune channel 2 manually first for distance measuring and then tune a VOR station on channel 1 for bearing information.

Tuning is performed on the radio tuning unit, backup radio tuning unit. Visual indications of tuned stations, distance readouts and DME hold indication are provided on the PFD and MFDs.

NAV key
Push twice to open NAV main page

DME-H
Saves the currently tuned frequency as the DME frequency and allows NAV receiver to be tuned again independently

DME hold indicator (yellow)
Appears when DME hold is activated

Tuning knob

DME Frequency Readout (green)

Frequency Change Key (green)
Push once to tune DME frequency directly

DME hold indicator (yellow)
Appears when DME hold is activated

1 – DME- 2
Monitors respective DME receiver for aural identification (morse code). Press to activate (switch illuminates) then rotate to adjust sound volume and press again to switch off.

Distance Readout
Indicates the distance in nautical miles to the tuned / next waypoint, depending on the navigation source. The colour matches the navigation source.

DME Hold (H) Symbol (yellow)
Appears when DME Hold is enabled. Not displayed, if FMS is navigation source

Ground Speed Readout
Indicates ground speed.
Colour of prefix matches navigation source

Distance Readout
Indicates the distance in nautical miles to the tuned / next waypoint, depending on the navigation source.
The colour matches the navigation source.

Time To Do (TTG)
Indicates the time to reach tuned navaid or next waypoint based on current airspeed.
The colour matches the navigation source

DME Hold (H) Symbol (yellow)
Appears when DME Hold is enabled. Not displayed, if FMS is navigation source

AIR TRAFFIC CONTROL TRANSPONDER SYSTEM (ACT)

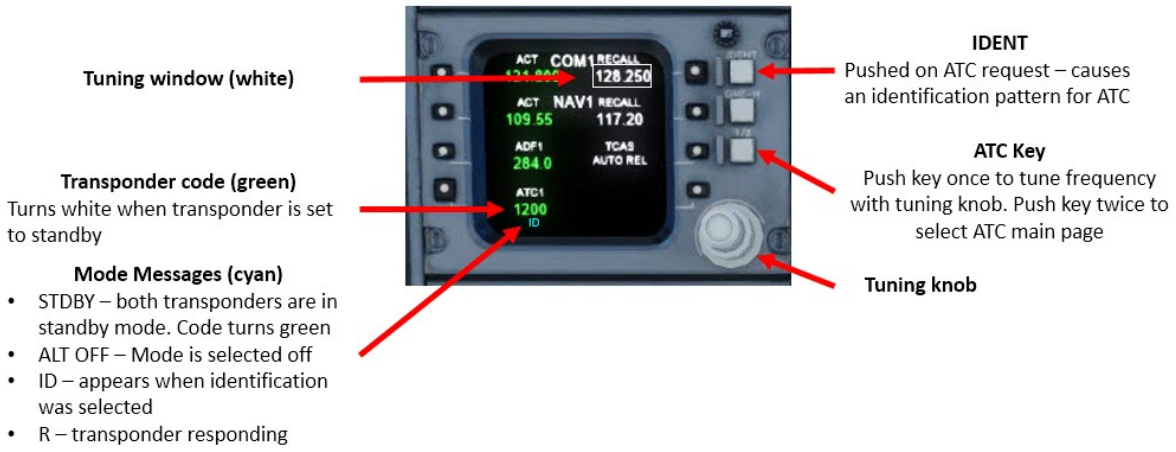
Two air traffic transponders (ATC 1 and ATC 2) do have three operating modes:

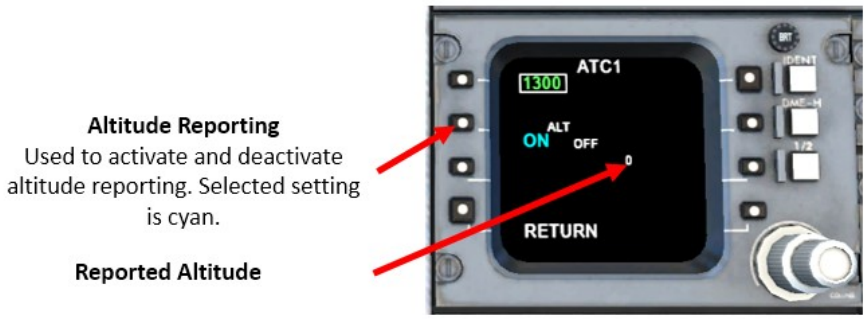
- Mode A
- Mode C
- Mode Select (S) – in this mode the transponder exchanges information with other aircraft with transponders in mode S which feed the TCAS system.

The transponder code is tuned via the radio tuning unit, the FMS / CDU. ATC identification is selected using the IDENT button on the radio tuning unit.

ATC SEL
Selects the transponder

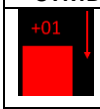
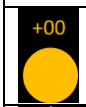
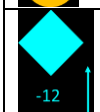
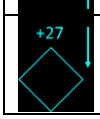
- 1 – ATC 1 transponder is activated and ATC 2 transponder is deactivated
- 2 – ATC 2 transponder is activated and ATC 1 transponder is deactivated
- STDBY – Both transponders are on standby





TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM (TCAS)

The TCAS system exchanges information regarding the aircrafts position, heading and speed to estimate possible conflicts or collisions. Activating mode S on your transponder enables the aircraft transponders to interrogate their positions, relative approximation and hence trigger warning messages. Surveillance range is 40 miles and can detect up to 30 aircraft simultaneously.

SYMBOL	COLOR	THREAT LEVEL	THREAT LEVEL DEFINITION	CAUSE
	RED	Resolution Advisory (RA)	Intruding Aircraft 25 seconds from closest point of approach	Intruding aircraft is above by 100 ft and descending at least 500 feet per minute
	AMBER	Traffic Advisory (TA)	Intruding Aircraft 40 seconds from closest point of approach	Intruding aircraft level with and not climbing or descending
	CYAN	Proximate Traffic	Any traffic within surveillance range and ± 1,200ft vertical	Traffic below 1,200 feet and climbing at least 500 feet per minute
	CYAN	Other Traffic	Any traffic within TCAS range limit	Traffic above 2,700 feet and descending at least 500 feet per minute

TFC

Directly activates TCAS display on the MFD

RANGE – Inner selector

Selects display range on MFD. Possible selections: 5, 10, 20 and 40 nm.

TCAS Key

Opens the TCAS page

Altitude Format (cyan)

Indicates the selected altitude format (relative vs. absolute)

TCAS Mode (cyan)

Indicates the selected TCAS format

Mode Selection

Selects TCAS mode. Active mode is displayed in cyan.

- AUTO – all advisories are displayed
- STBY – TCAS is inhibited
- TA ONLY – only traffic advisories are displayed

Altitude Format

Selects altitude format.

- REL –relative to own airplane altitude
- ABS – absolute altitude (according selected barometric pressure)

Traffic selection

Toggles traffic display mode.

- ON – all transponder traffic is displayed
- OFF – only advirsory traffic is dplsayed

Altitude Range

Selects surveillance airspace relative to own airplane altitude. The selected range is displayed in cyan.

- ABOVE – 9,900ft above and 2,700 below own aircraft
- NORM – 2,700ft above and below own aircraft
- BELOW – 2,700ft above and 9,900 below own aircraft

TRAFFIC ADVISORY (TA)

A traffic advisory, TA is triggered when the relative position of intruding aircrafts is 45 seconds from the closest point of approach and 1,000 feet or less above or under the aircrafts current altitude.

The TA is displayed on the PFD as well as on the MFD when TCAS mode is active.

It allows the crew to visually locate the intruding aircraft and the TA disappears automatically as soon as vertical distance is 1,000ft or higher and/or is more than 45 seconds from the closest point of approach.

TAs are also accompanied by a voice warning.

RESOLUTION ADVISORY (RA)

A resolution advisory, RA, is triggered when the intruding aircraft is 30 seconds from the closes point of approach.

The RA will display either a climb or descent to increase separation and avoid a conflict. Hence it is displayed on the vertical speed indicator, VSI section of the PFD.

There are two kinds of RAs:

- Corrective RAs which show a red and a green zone on the VSI – always fly from the red to the green zone
- Preventive RAs which only indicate red zones into which you must not fly.

RAs are also accompanied by voice warnings.

TCAS Message Area

- TRAFFIC (red) – appears when a traffic resolution advisory is triggered (flashes for first 10 seconds)
- TRAFFIC (amber) – appeares when a traffic advisory is triggered (flashes for first 10 seconds)
- TA ONLY (white) – appears when TCAS is set to TA ONLY (manually or automatically when descending through 1,000ft)
- TCAS OFF (white) – appears when TCAS is selected in standby mode
- TCAS TEST (white) – appears while TCAS system test is ongoing

AURAL WARNING

The TCAS system provides the following aural warnings

- Traffic advisories (TA)
- TRAFFIC - TRAFFIC
- Resolution Advisories (RA)
    - CLIMB, CLIMB, CLIMB
    - DESCEND, DESCEND
    - MONITOR VERTICAL SPEED
    - CLIMB – CROSSING CLIMB, CLIMB – CROSSING CLIMB
    - DESCENT – CROSSING DESCENT, DESCENT – CROSSING DESCENT
    - INCREASE CLIMB, INCREASE CLIMB
    - INCREASE DESCENT, INCREASE DESCENT
    - CLIMB – CLIMB, NOW, CLIMB – CLIMB, NOW
    - DESCENT – DESCENT, NOW, DESCENT – DESCENT, NOW
    - MAINTAIN VERTICAL SPEED, MAINTAIN
    - MAINTAIN VERTICAL SPEED, CROSSING MAINTAIN
    - ADJUST VERTICAL SPEED, ADJUST
- When clear of conflict
    - CLEAR OF CONFLICT
- TCAS self-system test performed without any faults
    - TCAS SYSTEM TEST OK
- TCAS self system test performed with a fault
    - TCAS SYSTEM TEST FAILED

GROUND PROXIMITY WARNING SYSTEM (GPWS)

The ground proximity warning system, GPWS, helps the flight crew to prevent unsafe flight manoeuvers in terrain proximity or when detecting wind shears.

The current flight path and aircrafts configuration is compared to a terrain database and different aural and visual warnings are triggered when possible collisions or unsafe flight manoeuvers are detected.

The GPWS features the following modes / warnings:

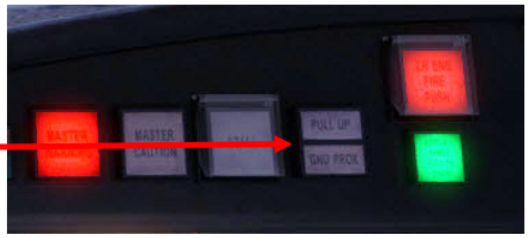
- Mode 1 – Excessive descent rate
- Mode 2 – excessive terrain closure rate
- Mode 3 – Altitude loss after take-off
- Mode 4 – Unsafe terrain clearance
- Mode 5 – Below glideslope alert
- Mode 6 – callouts (descent below minimum, altitude callouts and bank angle alert)
- Mode 7 –windshear detection and alerting
- Terrain clearance floor and terrain / obstacle awareness alerting and display

GRND PROX TERRAIN (Guarded)
Inhibits the terrain map display (terrain clearance floor, terrain obstacle awareness alerting and display functions). Basic GPWS modes (1-6) and windshear mode (7) remain active.
An OFF light indicates that inhibit is selected.

GRND PROX FLAP (Guarded)
Mutes the TOO LOW FLAPS or TERRAIN aural warning. An OVRD light indicates that override is selected

PULL UP / GND PROX
The PULL UP / GND PROX warning light is triggered and flashes by certain EGPWS modes.

- PULL UP – flashes red during ground proximity warning. Flashing stops as soon as aircraft recovered from situation.
- GND PROX - flashes amber during ground proximity alerts. Flashing stops as soon as aircraft recovered from situation.
  Pressing the GND PROX switch also triggers the GPWS test sequence.



RDR / TERR
Selects either a radar mode or terrain to be displayed on the MFD.

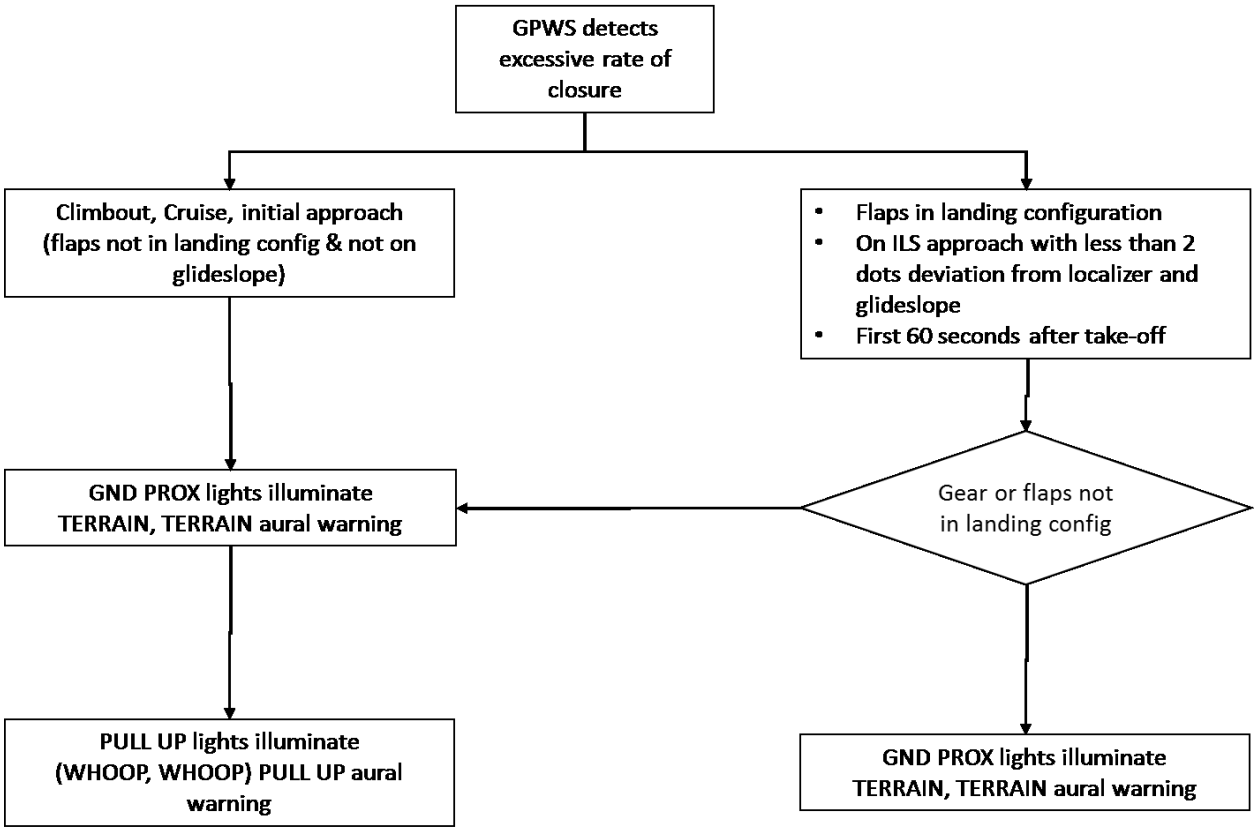
MODE 1 – EXCESSIVE DESCENT RATE

Mode 1 is used during the approach phase of the aircraft and is independent of the aircrafts config.

In case the GPWS detects excessive sink rate close to terrain during approach the “SINKRATE, SINKRATE” aural warning is triggered first together with the GND PROX lights coming on. In case the condition persists the “(WHOOP, WHOOP) PULL UP” aural warning sounds and the PULL UP lights illuminate.

MODE 2 – EXCESSIVE TERRAIN CLOSURE RATE

Mode 2 alerts are triggered when the aircraft is nearing terrain at an excessive rate. Depending on the configuration different sub-modes are activated.



The GND PROX lights remain illuminated until 300 ft of barometric altitude has been achieved, or 45 seconds have elapsed, or the GND PROX FLAP OVRD has been selected, or flaps are in landing configuration.

MODE 3 – ALTITUDE LOSS AFTER TAKE-OFF

In case the aircraft loses a significant amount of altitude during the following flight phases

- After take-off
- Low altitude go-around with gear or flaps not in landing configuration

The GND PROX lights illuminate and the DON’T SINK DON’T SINK aural warning is sounded. The tolerated amount of altitude loss depends on the aircrafts altitude above terrain.

MODE 4 – UNSAFE TERRAIN CLEARANCE

This mode provides visual and aural warnings in case of insufficient terrain clearance. It has three sub-modes 4A, 4B and 4C which depend on the aircraft configuration and phase of flight.

Sub-Mode	Phase	Config	Visual warning	Aural warning
4A	Cruise & approach	Gear and flaps not in landing config Altitude between 500 and 1,000ft (depends on airspeed)	IAS < 190 kts GND PROX lights flash IAS > 190 kts GND PROX lights flash	IAS < 190 kts TOO LOW GEAR IAS > 190 kts TOO LOW TERRAIN
4B	Cruise & Approach	Gear and flaps not in landing config Altitude between 245 and 1,000ft (depends on airspeed)	IAS < 159 kts GND PROX lights flash IAS > 159 kts GND PROX lights flash	IAS < 159 kts TOO LOW FLAPS IAS > 159 kts TOO LOW TERRAIN
4C	Take-off	Gear or flaps not in landing config Terrain climbing more steeply than aircraft	GND PROX lights flash	TOO LOW TERRAIN

MODE 5 – BELOW GLIDESLOPE ALERT

Depending on the deviation from the glideslope, two different warnings may occur:

- A soft warning, when more than 1,3 dots below the glideslope, which illuminates the GND PROX lights and sounds the GLIDESLOPE aural warning at approximately half of the volume of other aurals.
- A hard warning, when the aircraft is below 300 feet radio altitude and is more than 2 dots below the glideslope. The GND PROX lights flash and the GLIDESLOPE aural is sounded.

The warnings will cease as soon as the deviation is less than 1.3 dots or when the PULL UP / GND PROX light is pushed when the aircraft is below 2,000 feet altitude.

Modes 1 to 4 override mode 5 warnings.

MODE 6 – CALLOUTS (DESCENT BELOW MINIMUM, ALTITUDE CALLOUTS AND BANK ANGLE ALERT)

This mode provides three callouts during different flight phases:

- Transition through approach minimums
  A voice warning is triggered as soon as the aircraft descends below decision height, DH or minimum descent altitude, MDA.
  The function is enabled between 1,000 and 10 feet for DH and when the corrected altitude exceeds the MDA value by 200 feet and with the landing gear extended.
- Altitude callouts
  The altitude callout is a voice warning that is sounded as soon as the aircraft descends through the preset altitude.
- Excessive bank angle alerting
  In case an excessive bank angle is detected, the BANK ANGLE BANK ANGLE aural warning is sounded once and as soon as the bank angle is increased by 20%. The threshold is computed as a function of roll angle in respect to altitude above ground.

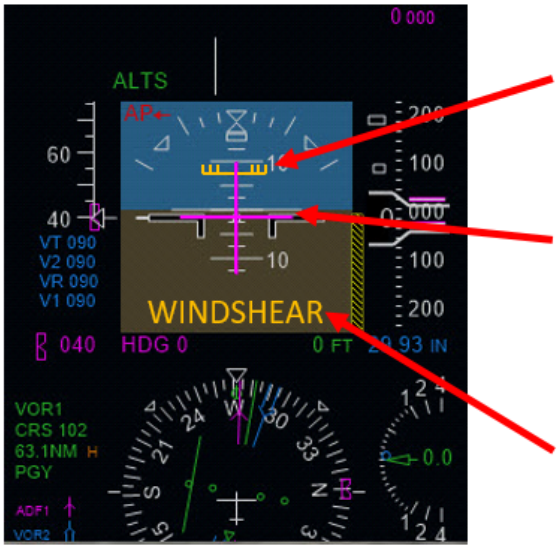
MODE 7 –WINDSHEAR DETECTION AND ALERTING

During take-off and final approach and altitudes between 10 and 1,000 feet the GPWS detects windshear conditions and triggers respective warnings.

The system distinguishes whether a condition with a tail-wind and downdraft or a headwind and upwind is experienced. In either case the flight director will command a suitable attitude to escape the windshear condition and pitch limit indicators (alpha-margin indicators) will appear on the PFDs.

In case of a tailwind and downdraft windshear, a siren and the WINDSHEAR WINDSHEAR WINDSHEAR aural warning will sound as well as a red windshear warning is displayed on the PFD.

In case of a headwind and upwind windshear, an amber windshear alert is displayed on the PFD.



Pitch Limit Marker (amber)
Appears during the windshear warning or alert. Indicates the maximum pitch attitude before the aircraft reaches stall angle of attack

Flight Director Command Bars (magenta)
Direct a way out of the windshear – the bars turn magenta as long as the warning is active.

Windshear message
Appears when a windshear condition is detected. Flashes first, then stays on.

- Amber – windshear with increasing aircraft performance
- Red – windshear with decreasing aircraft performance

TERRAIN / OBSTACLE AWARENESS ALERTING AND DISPLAY

The GPWS is supplied with a terrain and obstacle database. This database enables the GPWS to compute possible collisions with terrain or obstacles based on a comparison of the computed flight path. Either way the system first triggers cautions and if the flight path does not change then it triggers a warning.

To display terrain data on the MFD, press the RDR/TERR button on the display control panel.

Green, yellow and rot dots with varying density display the terrain relative to the aircrafts position.
Terrain more than 2,000ft below the aircraft or within 400ft of the nearest runway elevation is not displayed.
In case a terrain warning is triggered, the terrain display is automatically selected on both multifunctional displays and the range defaults to 10nm.

In case the aircraft is safely above all terrain, the terrain is displayed without any relation to the currents aircraft altitude. Furthermore, two numbers appear on the MFD – the upper one shows the highest displayed altitude (in hundreds of feet MSL) and the lower one shows the lowest altitude. Terrain within 400 feet (vertical) of the nearest runway elevation is not displayed.

Obstacle cautions are displayed in solid yellow.
Obstacle warnings are displayed in solid red.

	Terrain	Obstacle
Caution	GND PROX lights flashing & CAUTION TERRAIN, CAUTION TERRAIN aural warning	GND PROX lights flashing & CAUTION OBSTACLE, CAUTION OBSTACLE aural warning
Warning	PULL UP lights flash and TERRAIN, TERRAIN PULL UP aural warning	PULL UP lights flash and OBSTACLE, OBSTACLE PULL UP aural warning

TERRAIN CLEARANCE FLOOR

The terrain clearance floor mode triggers the same warnings as mode 4 but calculations in the background are different as this mode is for flying in landing configuration and based on a database of hard-surfaced runways with more than 3,500ft length.

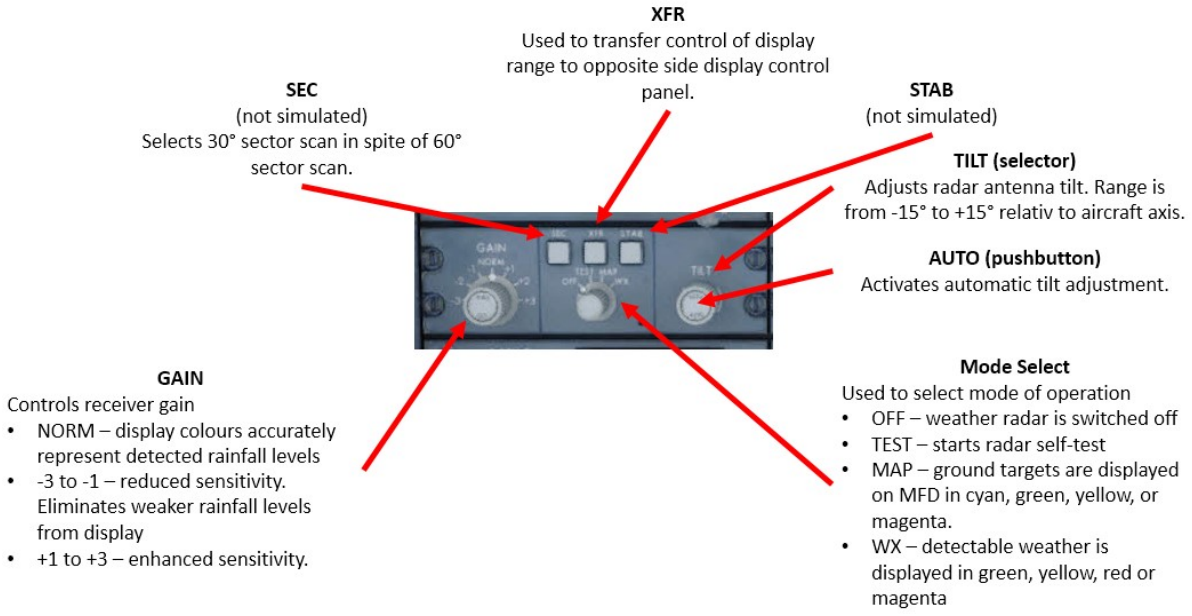
Terrain Display Anunciations

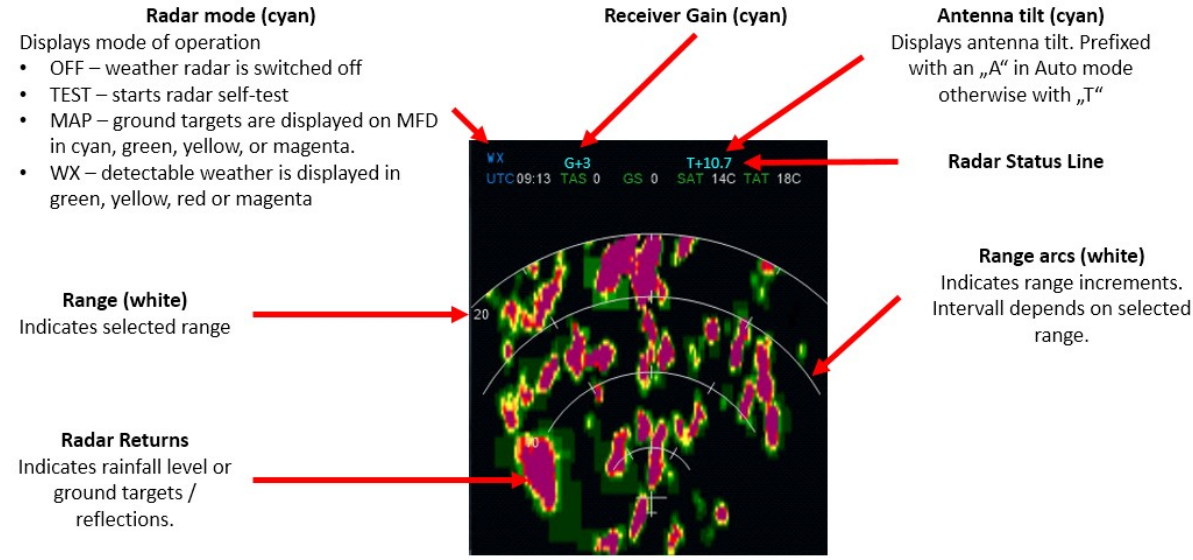
- TERRAIN (cyan) – Terrain display is activated
- TERRAIN TEST (cyan) – GPWS self test running
- TERRAIN OFF (white) – Terrain display is selected but terrain functions have been manually inhibited

WEATHER RADAR (WXR)

The weather radar assists the pilots to avoid areas of 'bad weather'. The basic principle is that water drops create a certain radar echo. The intensity of the echo correlates with the density of the water drops. An echo with a low intensity is indicated green and normally depicts thick clouds or light rain showers whereas an high intensity echo is depicted in red and equals heavy rain or thunderstorms – basically an area which you'd like to avoid to fly through. The CRJs weather radar has a maximum range of 320nm and the radar cone deflects to 60° on either side of the aircraft.

Within FSX and Prepar3d the weather radar only returns valid signals when used in conjunction with Hifi Sims Active Sky Next.





POWER PLANT

Two General Electric CF34-8C5 engines provide 13,600 pounds of thrust each. In case one engine fails, the automatic power reserve (APR) function will increase thrust on the remaining engine to 14,510 pounds. The engine operation and thrust is controlled by the so called FADEC: full authority digital electronic control system. Like all turbo-fan engines the CF34 is comprised of 6 sections:

- Intake
  The air intake has a certain geometry which is supposed to optimise the air flow into the engine and towards the fan.
- Fan
  The fan works like a huge propeller and accelerates the air. After passing the fan, the airflow is divided into two parts: one part is going through the core engine and the other part is passing the core engine and reunites in the exhaust with the airflow from the core engine. The bypass ratio indicates how much of the air-flow passes the core engine while the remainder passes the core engine. The CF34's bypass ratio is 5:1 – 5 parts pass the core engine and 1 part passes through the core engine.
- Compressor
  Several compressor stages are supposed to increase the pressure of the airflow to the possible maximum. Stator vanes with variable geometry prevent the airflow from stalling. A compressor stall is a serious incident which might destroy the engine and accordingly endanger the flight.
  Normally bleed air is drawn from the compressor.
- Combustion chamber
  The compressed air is injected with fuel and then lit. The following 'explosion' increases pressure further and thus enables the engine to create thrust even though some of the energy is consumed by the following turbine
- Turbine
  The turbine section is very important as transforming the airflow into rotational energy which basically makes the engine 'run' and propels the forward sections like the fan and compressor.
- Exhaust
  The exhaust is important to optimize the airflow leaving the engine and hence creating thrust.

Usually the engine's components are built on two shafts which are connected, that's why the engine instruments display two RPM values: N_1 and N_2.
N_1 indicates the first stages ratio of the current RPM compared to the maximum RPM. The first stage comprises the fan and the aft parts of the turbine section.
N_2 indicates second stages ratio of the current RPM compared to the maximum RPM. The second stages comprise the compressor and forward parts of the turbine section. Several engine-subsystems are connected to the second stage by means of a gearbox:

- Engine lubrication pump and integral oil reservoir
- FADEC alternator
- Hydraulic pump
- Engine fuel pump and metering unit
- Integrated drive AC generator
- Air turbine starter

THRUST CONTROL

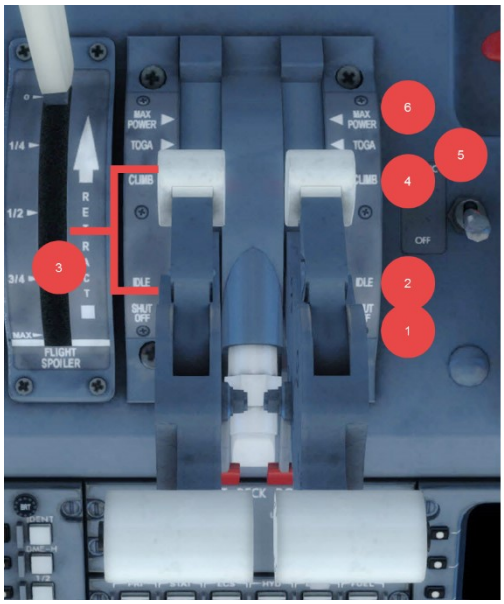
CRJ's thrust is controlled by two thrust levers, installed on the center pedestal.

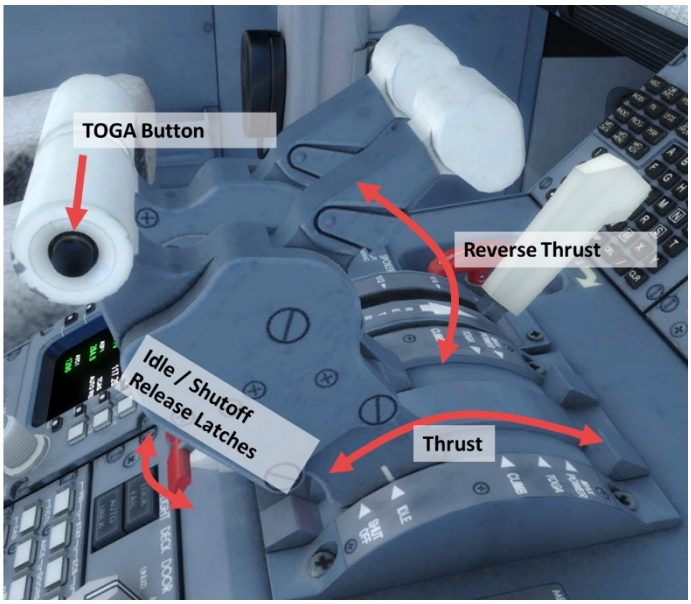
The CRJ has no auto thrust. The FADEC, which is described in more detail in the following chapter, and throttle detents assist the pilots during take-off, climb, descent as well as go-around by automatically setting calculated thrust settings. Nevertheless, during cruise thrust needs to be set manually.

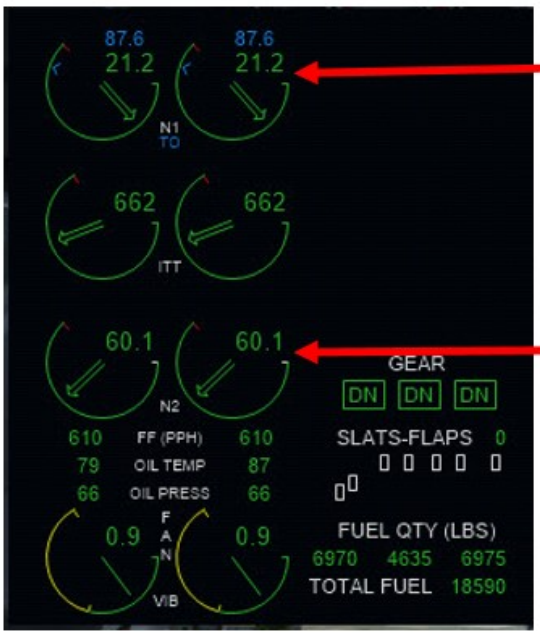
Each lever has 6 possible settings:

1. Fuel shut off
   By lifting the idle / shutoff release latch and pulling the thrust levers full backwards afterwards, the fuel shutoff valve is closed for the respective engine.
   To open the fuel shutoff valve, lift the idle / shutoff release latch and advance the thrust lever to the idle detent.
   To lift the idle / shutoff release latch in FS, move the mouse pointer over the latch and press the right mouse button.
2. Idle thrust setting
   Idle thrust is computed automatically and pulling the thrust lever fully back to the idle position. You may also press "F1" in FS to select idle thrust.
3. Cruise Range
   The range between idle thrust setting and climb thrust setting is called cruise range. The pilots may use the entire range between idle and climb thrust setting to adjust for a proper cruise speed.
4. Climb Thrust Setting
   The climb thrust setting is a detent, which you'd experience as a mechanical stop in the real aircraft. When setting the thrust levers to the climb detent, climb thrust is computed automatically by the FADEC. Use this setting during climb phase.
5. Take-off and go-around thrust setting
   Setting the thrust levers to take-off and go-around setting makes the FADEC compute and command the required thrust setting for take-off or go-around.
   This setting may also be commanded by pushing the TO/GA switch on the throttle lever itself
6. APR thrust setting
   The CRJ provides an Automatic Power Reserve in case one engine fails to ensure sufficient thrust for go-around or take-off. Please see the respective section in this chapter for further details.

In case you are using a throttle quadrant, make sure that the throttle axis is calibrated properly.







N1 Readout, scale and pointer (green)
Indicates fan speed in rounds per minute, RPM. The readout (number) and pointer turn red as soon as N1 limit is exceeded

N2 Readout, scale and pointer (green)
Indicates compressor speed in rounds per minute, RPM. The readout (number) and pointer turn red as soon as N2 limit is exceeded.
As soon as Anti-Ice is activated, the display changes to green and white

L or R ENG SHUTDOWN status (white)
Indicates that the respective engine is shut down.

ENGS HI PWR SCHED status (white)
Indicates that Hi Power Schedule is engaged

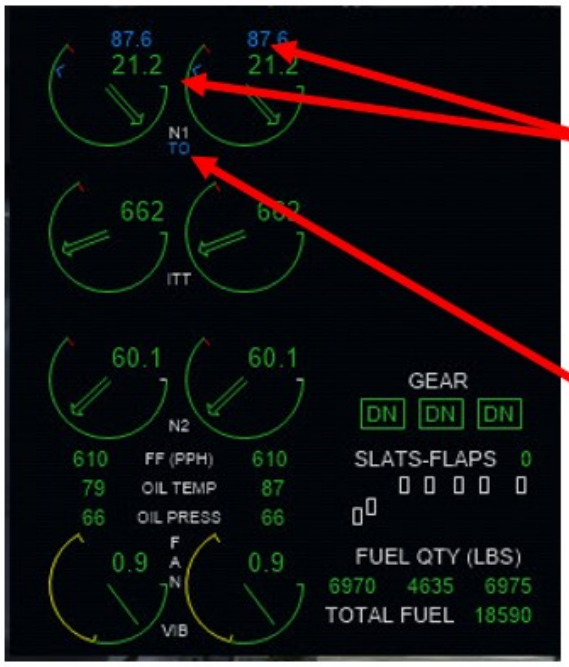
ENG SYNC OFF status (white)
Indicates that engine synchronization is not in N1 or N2 mode

FULL AUTHORITY DIGITAL ELECTRONIC CONTROL (FADEC)

The FADEC assists the pilots by commanding thrust depending on thrust lever setting and several environmental parameters.

Each engine is equipped with dual channel FADEC computers and they are powered by the aircraft's electrical system. The available detents were already introduced in the thrust control section.

Selected detent	Displayed EICAS mode	FADEC mode	Explanation
Fuel shutoff	Solid amber line	shutoff	Engine is off / full shutoff
Idle	-	Idle	Optimized idle thrust (N2) is computed depending on flight phase, environmental parameters
Cruise Range	CRZ	Cruise	N1 is commanded by the thrust setting
Climb	CLB	Climb	Climb thrust is computed and commanded
Take-off	TO	Take-off	Take-off thrust is computed and commanded
TOGA	GA	Go-around	Go-around thrust is computed and commanded
Climb	MCT	Maximum Continuous Thrust	Maximum Continuous Thrust – triggered by OEI activated or high power schedule was selected
Take-off	FLX	Flex Power	Flex Power is a reduced take-off power setting to minimize wear of the engine and fuel consumption. See following description



N1 reference bug and readout (cyan)
The cyan bug and the readout show the computed maximum reference value in accordance with the selected thrust mode (i.e. CLB or TO).
The caret (< Symbol) changes to a circle (o) for cruise power and turns magenta for flex power.

Thrust mode (cyan)
Indicates the selected or armed thrust mode.

FLEX POWER

The logic behind the flex thrust concept is simple. Air gets thinner with rising temperature – you probably noticed that aircraft need more runway on a hot summer day than in winter (given the same weight of course). By entering a 'flex temperature' – it is called "assumed temperature" - the computer is made to believe that you are flying on a hot summer day instead of the, colder, persisting conditions. This means the maximum N1 setting will be lowered, and so reducing wear on the engines (and slightly reducing noise as well).

The flex temperature needs to be calculated for each take-off and each configuration of aircraft weight, runway and environmental conditions like temperature, air density, head wind component and so on. This is normally done by a flight performance tool or looked up in huge tables. Some operators run own departments only being in charge to track their aircraft's fleet performance and keep flight planning tools, performance calculators in sync with their fleet's performance figures. This is also the explanation why we are not able to provide any performance tables regarding flex temperatures. But always remember that use a flex temperature means you have less thrust available.

In case you want to use a flex temp with the CRJ you need to enter the flex temperature on the PERF MENU page of the FMS. You can also set it via the EICAS menu.

Flex temp may only be entered when the following conditions persist:

- Thrust levers are in idle or shutoff
- Aircraft is on ground
- The temperature entered is higher than the ambient temperature.
- Airspeed is less than 65 knots

AUTOMATIC POWER RESERVE (APR)

The automatic power reserve is a feature which enhances the power of the remaining engine in case an engine fails. It is available during take-off and go-around only.

APR is armed during take-off when N_1 reaches take-off thrust within 8% of the commanded setting. On approach, APR is armed for go-around with either engine available, flaps greater than 20° or landing gear down.

APR (Icon) (green)
Indicates that automatic power reserve for the remaining engine was activated or manually selected by moving the throttle levers in the MAX POWER detent.

HIGH POWER SCHEDULE

There is no operational procedure in which the use of the high-power schedule is required.

Nevertheless, by activating the high-power schedule for an engine, the FADEC will compute and command MCT, maximum continuous thrust, as soon as the thrust levers is in climb detent. When advanced further to the take-off detent, APR, automatic power reserve, is activated.

HIGH PWR SCHEDULE (guarded)
In case this mode is selected, the engines operate on the one-engine-inoperative mode.
Thrust setting in CLIMB detent will equal MCT
Thrust setting in TOGA detent will equal APR

N_1 AND N_2 SYNCHRONISATION

To reduce noise the CRJ offers a feature to synchronize N_1 or N_2 of both engines. In both cases the left engine is regarded as the master engine and the right engines is slaved to the left engine.

N_1 sync means the right engine needs to be within 1.5% N_1 of the left engine.
N_2 sync means the right engine needs to be within 7,5% N_2 of the left engine.

SYNCH
Engages or disengages engine synchronization
- OFF – engine RPM is not synchronized
- N1 – fan speed of the right engine is matched to the left engine
- N2 – core speed of the right engine is matched to the left engine

ENGINE OVERSPEED PROTECTION

An overspeed condition exists as soon as N_2 exceeds 107%.

In case an overspeed condition is detected the fuel supply to the engine is cut off automatically and the engine flames out. The FADEC will then detect the flameout and turn the ignition on – as soon as the overspeed condition is cleared fuel flow is reactivated to the engine.

ENGINE N_2 INDICATIONS WHEN USING WING ANTI-ICE

Using wing-anti-ice requires sufficient supply of bleed air. At certain ambient conditions the FADEC will trigger a signal to the N_2 indicators, to display a partial white band below the normal green band.

Maintaining N_2 in the green band will ensure sufficient bleed air supply. In case N_2 is reduced further into the white band, air flow to the wing-anti-ice won't suffice. The N_2 pointers and digital indications will turn white and the L/R WING A/I caution message may be displayed.

Increase N_2 into the green range again to remove the caution message.

STARTING AND IGNITION SYSTEM

Basically, the start-up process is based on bleed air to initiate the core engine start to rotate. As soon as rotational speed is sufficient, fuel is injected in the combustion chamber and the engine gathers more speed until it stabilizes at idle thrust. Obviously, the ignition needs to be switched on during the entire start process. The FADEC monitors the entire start-up sequence.

Bleed air may be provided by:

- The auxiliary power unit, APU
- A ground source
- Cross bleed air from a running engine

DC power needs to be available for the starter circuits and to be transformed to AC power to supply the ignition.

The start sequence is initiated by pressing the START switch on the ignition panel. The FADEC now opens the starter control valve, to rotate the starter. The starter is connected via a gearbox to the second stage / N_2 section and increases rotational speed of the core engine. As soon as 20% N_2 is reached, the thrust levers are advanced from shutoff to idle to start fuel-flow into the engine. The FADEC meanwhile enabled the ignition and the fuel is ignited in the combustion chamber. This accelerates the engine further and after reaching approx. 50% N_2 the starter cuts out and the engine is stabilized at idle by the FADEC.

L ENG and R ENG START
Engine start switches – press the pushbutton to initiate the starting sequence. The button illuminates with a white START light during the startup sequence

CONT IGNITION
Engages or disengages continouos ignition on both engines.
Press pushbutton to activate continouos ignition. A white ON light confirms that continouos ignition is activated.
Press pushbutton again to disengage.

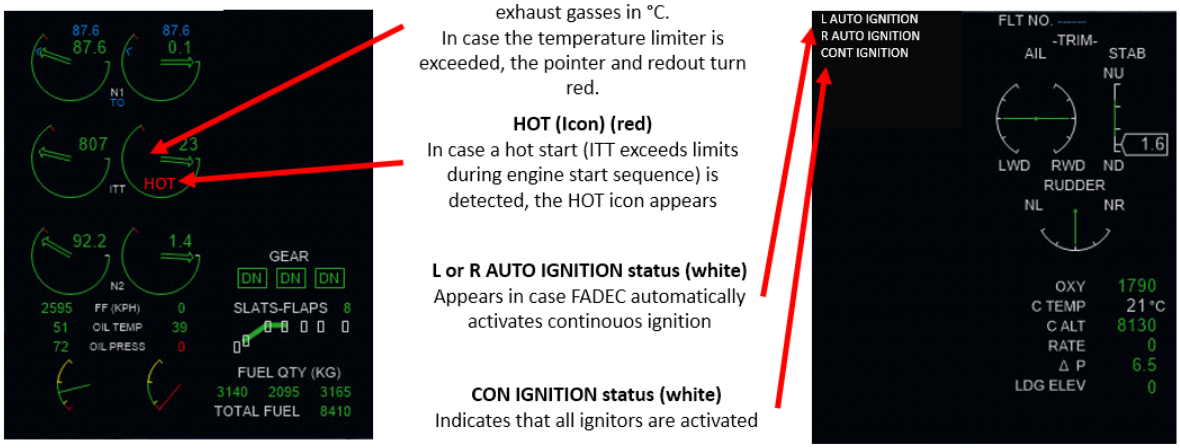
L ENG and R ENG STOP
Aborts the engine start sequence. In case you need to abort the engine start sequence, press pushbutton. A STOP light illuminates to indicate that startup sequence is being stopped.

ITT Readout, scale and pointer
indicates temperature of engine exhaust gasses in °C.
In case the temperature limiter is exceeded, the pointer and redout turn red.

HOT (Icon) (red)
In case a hot start (ITT exceeds limits during engine start sequence) is detected, the HOT icon appears

L or R AUTO IGNITION status (white)
Appears in case FADEC automatically activates continouos ignition

CON IGNITION status (white)
Indicates that all ignitors are activated



Each engine has two AC ignition systems (A & B). Each system is comprised of two ignition exciters and two igniter plugs. Either system is supplied by a different electrical bus (sys A by the AC essential bus and sys B by the battery bus through a static inverter).

The ignition systems are normally controlled by the FADEC but may be activated manually by pressing the CONT button. The CONT button activates both systems simultaneously whereas the FADEC normally alternates between systems.

In case the FADEC senses a failed ignitor, it will automatically switch the system after a 15 second delay and display a L/R IGN A or B fault message. In the event of an engine fire, pressing the FIE PUSH switch on the glare shield makes the FADEC disable the ignition systems on the affected engine.

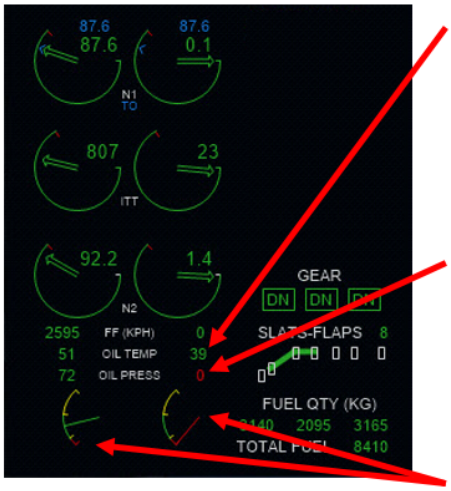
OIL SYSTEM

Each engine has a lubrication system which is independent of the other engine's lubrication system.

The reservoir has a capacity of 7,2 quarts (6,8 liters) oil. Given the maximum allowable oil consumption of 0,05 US gallons per hour (189 ml/hr) the oil capacity allows 36 hours of operation. To monitor the lubrication systems health, two parameters are indicated on the EICAS:

- Oil temperature
- Oil pressure

During engine start, the oil pressure indications on the EICAS page are displayed with an analogue gauge and a digital readout. After start-up and all parameters stabilized in normal bands the indication reverts to N1 vibration gauges. The digital oil pressure indication remains.



OIL TEMP

Indication of engine oil temperature in 1°C increments:

- Green -40° to 155°C
- Amber 156° to 163°C
- Red > 163°C
- Amber dashes invalid data

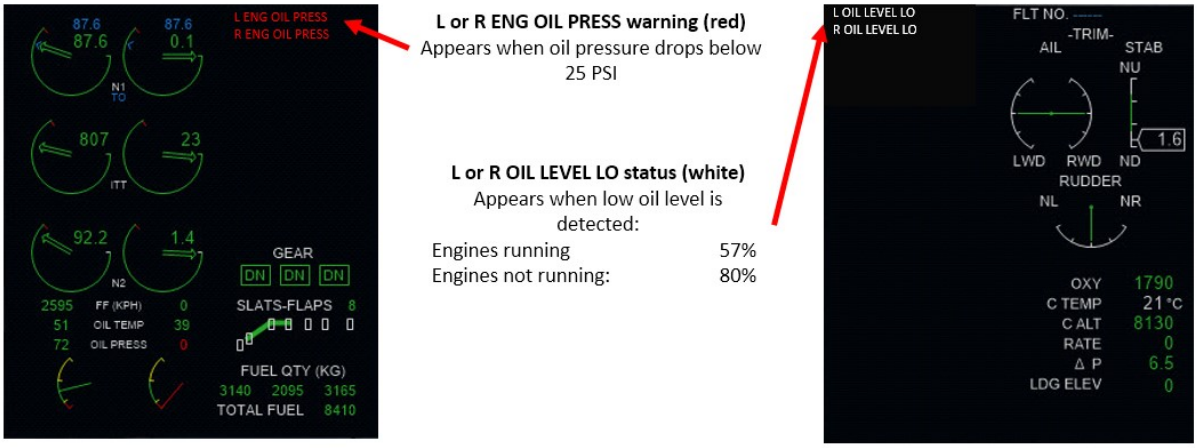
OIL PRESS

Indication engine of oil pressure in 1 PSI increments:

- Green 0 to 24 PSI
- Amber 25 to 116 PSI
- Red > 116 PSI
- Amber dashes invalid data

OIL Pressure gauges

Indication of engine oil pressure until both engines are running and oil pressure is bigger than 24 PSI. These gauges get replaced by the VIB gauges then.



L or R ENG OIL PRESS warning (red)
Appears when oil pressure drops below 25 PSI

L or R OIL LEVEL LO status (white)
Appears when low oil level is detected:

Engines running	57%
Engines not running:	80%

FUEL SYSTEM

Two fuel pumps plus a boost pump per engine supply the engines with fuel. Fuel flow to the engine may be cut by closing the shutoff valve or pushing the FIRE PUSH switch.

The amount of fuel injected into the combustion chamber is controlled by the FADEC. The FADEC calculates the amount. Furthermore, fuel is used for cooling the oil in the lubrication system.

FF (green)
Indication of fuel flow in kg per hour.
Amber dashes indicate invalid data

INTERTURBINE TEMPERATURE (ITT) MONITORING

The temperature is measured in the gas-path after leaving the high-pressure turbine (HPT) by several probes.

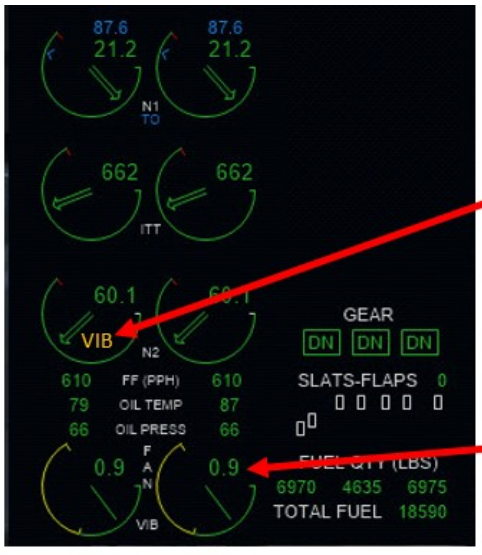
The signals are sent to the FADEC for processing. The FADEC distinguishes between three types of ITT exceedances and triggers equivalent messages which may be temporarily or permanent until N_2 of the affected engine decreases below 2%.

ITT Readout, scale and pointer
indicates temperature of engine exhaust gasses in °C.
In case the temperature limiter is exceeded, the pointer and redout turn red.

HOT (Icon) (red)
In case ITT exceeds 810°C (1.460°F) the HOT icon appears until ITT cooled below 289°F (143°C).

VIBRATION MONITORING

Engine vibration is measured on the first / N_1 stage and second / N_2 stage by accelerometers. In case excessive vibrations are detected, respective messages appear on the EICAS.



VIB (Icon) (amber)
Appears when N2 vibration limit is exceeded

N1 (Fan) vibration gauges
Indicate vibration of N1 stage – displayed as soon as oil pressure exceeds 25 PSI.

Green	< 1.75 MLS
Amber	≥ 1.75 MLS

REVERSE THRUST

Reverse thrust is used to relieve the wheel brakes or reduce stopping distances of the aircraft by redirecting part of the engines outgoing airflow forward.

The CRJ's reverse thrust needs to be armed by placing two switches to the ARMED position and releasing and pulling back the thrust reverse levers.

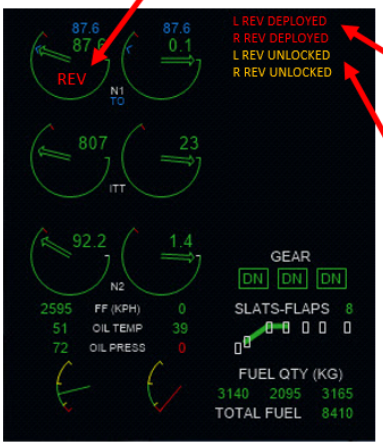
To engage the thrust reverse and unlock the thrust reverse levers, the release triggers need to be pushed which allows pulling back the thrust reverse lever. The thrust reverse levers allow three positions:

- Closed (full forward)
- Thrust reverser deployed / idle reverse (middle position)
- Full reverse thrust / full thrust reverse (fully back)

LR or RH ARMED
Two-position switch to arm the thrust reversers:

- ARMED – thrust reverser are armed and may be deployed
- OFF – thrust reversers are deactivated

REV (Icon)
Red – Uncommanded thrust reverser deployment
Amber – Thrust reverser unlocked
Green – thrust reverser deployed



L or R REV DEPLOYED warning (red)
Appears when respective thrust reverser was not commanded to deploy but is not stowed and locked as well

L or R REV UNLOCKED caution (amber)
Appears when respective thrust reverser has not been armed and is unlocked

L or R REV ARMED advisory (green)
Appears when respective thrust reverser is armed

PNEUMATICS

The pneumatic system draws bleed air from the engines or the APU to supply the following systems:

- Aircraft environmental control system (air-condition)
- Anti-ice systems (wing and cowl anti-ice)
- Engine starters

The bleed air system is managed automatically and accordingly there are only few controls.

BLEED VALVES
The bleed valve selector controls the bleed air modes:

- CLSD – Closes all internal bleed sources (like engines, APU). Must be used in case external supply like air-conditioning cart is used.
- AUTO – system requirements and valve positions are managed automatically
- MANUAL – system is configure

ISOL switch
Used to isolate or interconnect the left and right bleed air system (only active in manual mode)

- OPEN – both systems are interconnected
- CLSD – both systems are isolated

BLEED SOURCE
The bleed valve selector allows to select the bleed source (only active in manual mode):

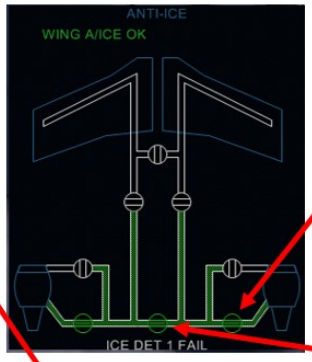
- BOTH ENG – Bleed air is drawn from both engines.
- L or R ENG – Bleed air is drawn from L(eft) or R(ight) engine
- APU – Bleed air is drawn from the APU only

There is not Bleed / Pneumatic EICAS Synoptic Page – valves and messages associated to the pneumatic system are generated / visible on the Environmental Control System page (ECS) and Anti-Ice page. All valve position indications are displayed according the following manner.

BLEED MANUAL (white)
Appears when bleed mode is set to manual

Bleed Pressure
Displays bleed pressure

- White – normal pressure
- Amber – high or low pressure
- Amber dashes – invalid data



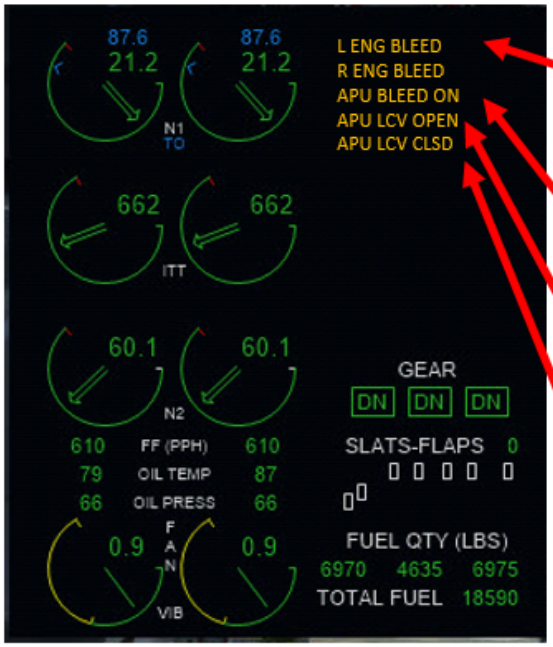
Pressure regulating shut-off valve position indicator

Bleed isolation shut-off valve position indicator

APU Load control valve

Bleed isolation shut-off valve

Pressure Regulationg shut-off valve



L or R ENG BLEED caution (amber)
Appears in case of failure of the following valves:

- High pressure valve
- Pressure regulating shut-off valve
- Pressure regulating controller

APU BLEED ON caution (amber)
Appears when APU bleed is selected above maximum altitude (25,000ft)

APU LCV OPEN caution (amber)
Appears when APU load control valve failed to close and commanded to close

APU LCV CLSD caution (amber)
Appears when APU load control valve failed to open and commanded to open

L or R ENG BLEED CLSD status (white)
Appears in case the respective engine bleed is **not** selected with respective high pressure valve and pressure regulating shut-off valve closed.

BLEED CLOSED status (white)
Appears when all bleeds are closed

BLEED MANUAL status (white)
Appears when bleed system is in manual mode

ISOL OPEN status (white)
Appears when bleed isolation shut-off valve is fully open

ISOL CLOSED status (white)
Appears when bleed isolation shut-off valve is closed

APU LCV status (white)
Appears when APU load control valve is not closed