

# Challenger Global 300 - Flight Instruments

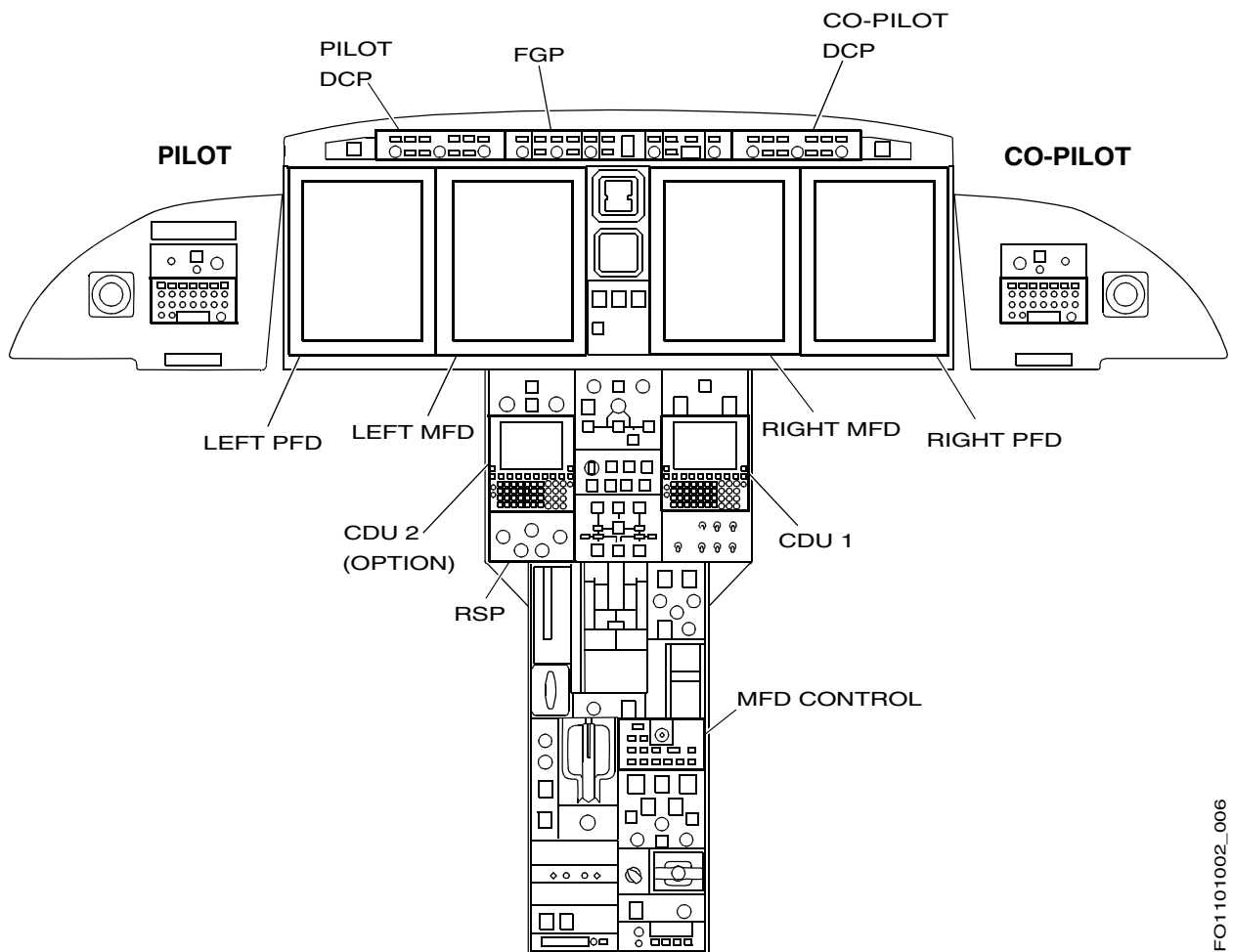
## INTRODUCTION

The Challenger 300 is equipped with an electronic flight instrumentation system (EFIS). The EFIS consists of four adaptive flight displays (AFD), grouped as a left primary flight display (PFD) and multifunction display (MFD) and a right MFD and right PFD. The control portion of the system is made up of two display control panels (DCP), one MFD control panel, and one reversion switch panel (RSP). A DCP on the pilot and copilot side provides configuration and selection controls for the appropriate PFD, as well as radio controls for the MFD. The reversion panel provides the means for selecting a compressed PFD format on either AFD, as well as selecting reversion to cross-side attitude/heading data, air data, and radio tune control.

The adaptive flight displays provide airspeed, altitude, attitude, heading, navigation, and system information. Each pilot is presented with this information on a primary flight display (PFD) and a multifunction display (MFD).

A major interface with the EFIS is the integrated avionics processor system (IAPS), data concentrator units (DCU) and the remote data concentrators (RDC). The IAPS is the focal point of information flow for the entire aircraft. In addition to performing the integration function required to connect the various aircraft systems, the IAPS contains flight guidance computer, flight management computer (FMC), and maintenance diagnostic computer (MDC) modules. Other systems provide information to the EFIS for display as conventional flight instruments. This includes the air data system and the attitude and heading reference system.

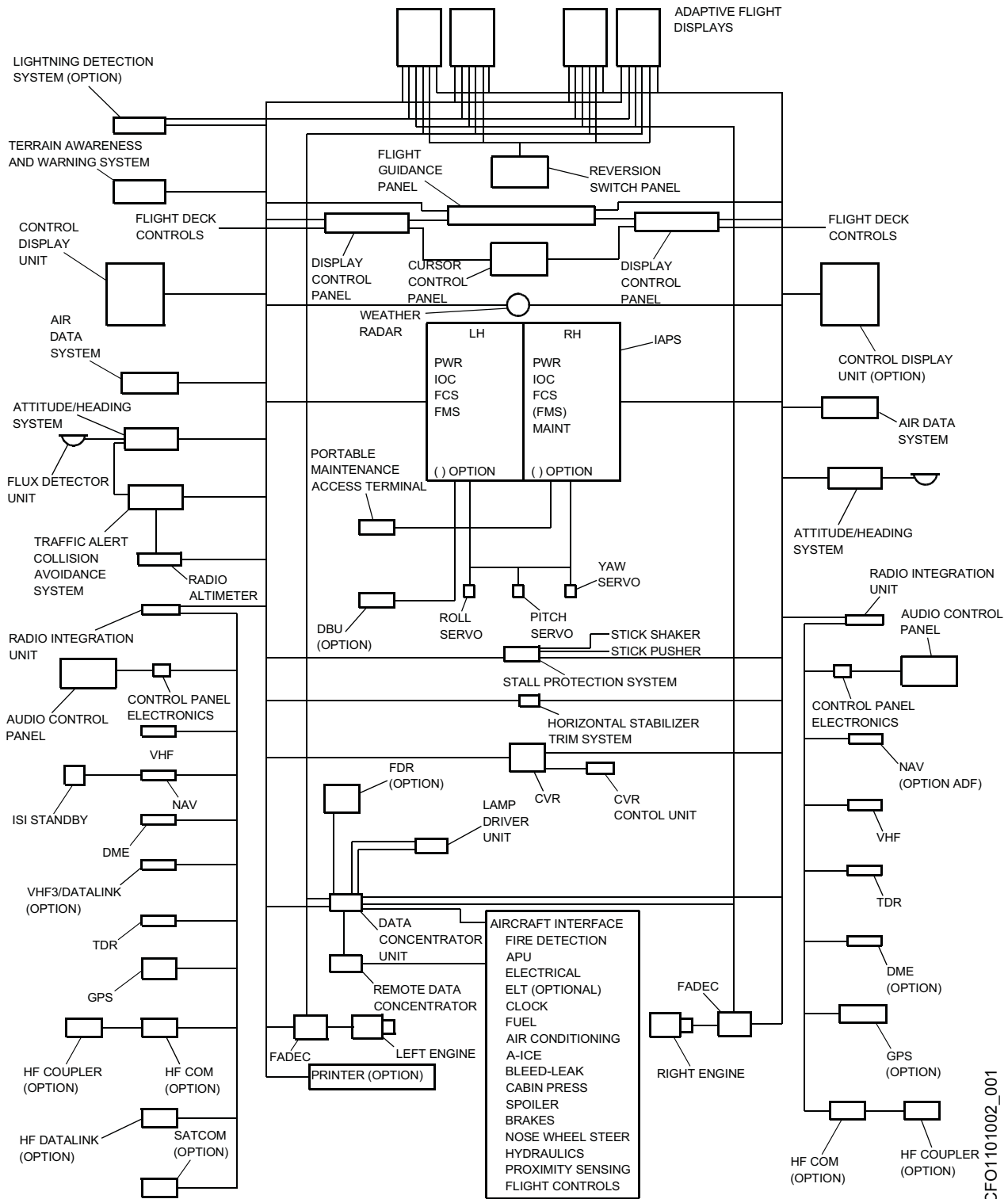
Control for the EFIS display modes are provided by switches and push buttons located on the glareshield, the center console and the side instrument panels.



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# Challenger Global 300 - Flight Instruments

## INTRODUCTION (Cont)



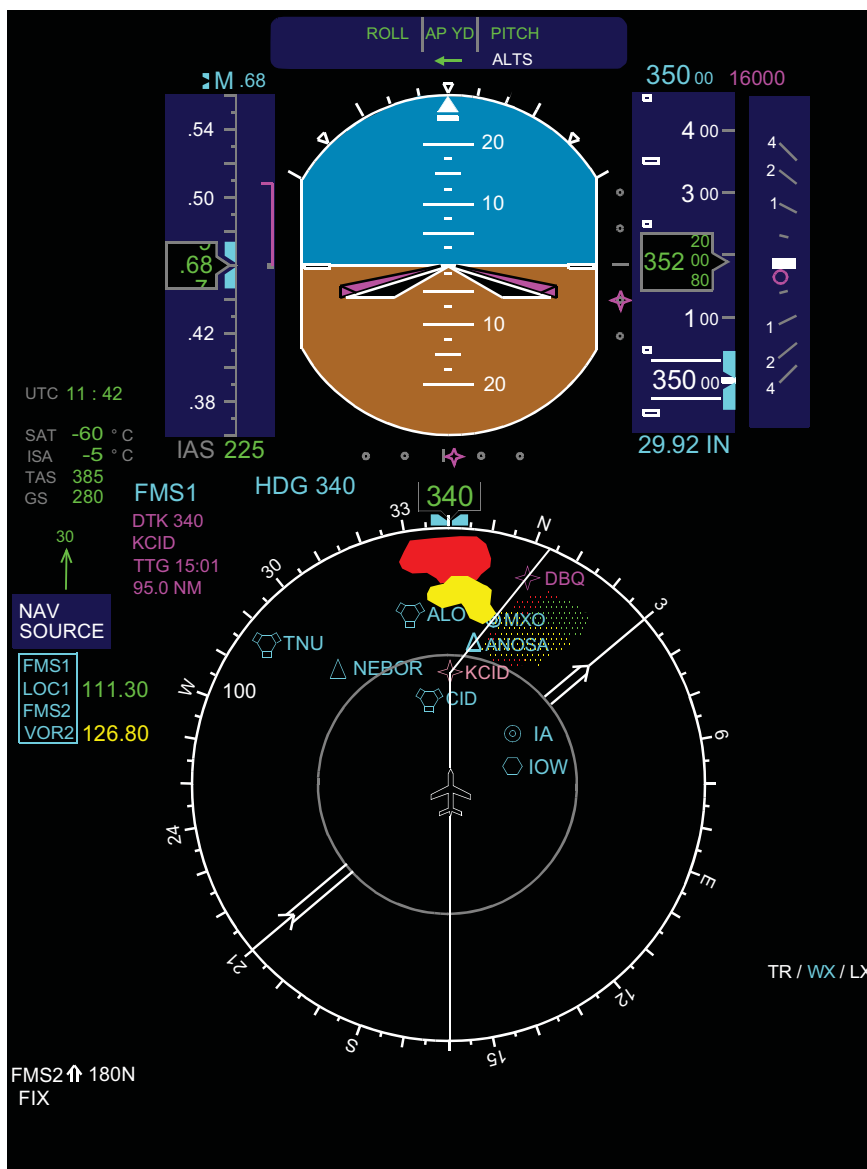
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**PRIMARY FLIGHT DISPLAYS**

**DESCRIPTION**

The primary flight displays (PFD) are integrated displays of attitude, air data, and navigation information. The PFD is divided into the following main areas:

- Attitude display
- Airspeed/Mach display
- Altitude display
- Vertical speed display
- AFCS mode display
- Navigation display



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## PRIMARY FLIGHT DISPLAYS (Cont)

### COMPONENTS AND OPERATION

#### ATTITUDE DISPLAY

The aircraft attitude indication on the primary flight display (PFD) provides pitch, roll, and yaw information supplied by the AHRS.

#### AIRCRAFT SYMBOL

The aircraft symbol is a stationary representation of the aircraft and is represented by a black symbol with a white outline. Two small white rectangular wing symbols are shown to the left and right of the aircraft symbol. The aircraft symbol horizontal wings can be used with the cross pointers or the triangle shape used with the V-bars flight director.

#### HORIZON LINE

The horizon line is the midpoint indication of aircraft attitude. With zero degrees of pitch and roll, the white horizontal line touches the apex of the aircraft symbol and passes through the center of the aircraft wing symbol.

#### SKY/GROUND DISPLAY

This blue-and-brown image provides a visual representation of the actual position of the sky and ground with respect to the aircraft.

#### PITCH TAPE AND CHEVRONS

The pitch tape is fixed on the attitude sphere and moves with the horizon line. The tape has wide line markings every 10 degrees, medium line markings every 5 degrees and small line markings every 2.5 degrees.

Red warning chevrons appear during maneuvers of excessive pitch attitude pointing toward the zero degree position.

## PRIMARY FLIGHT DISPLAYS (Cont)

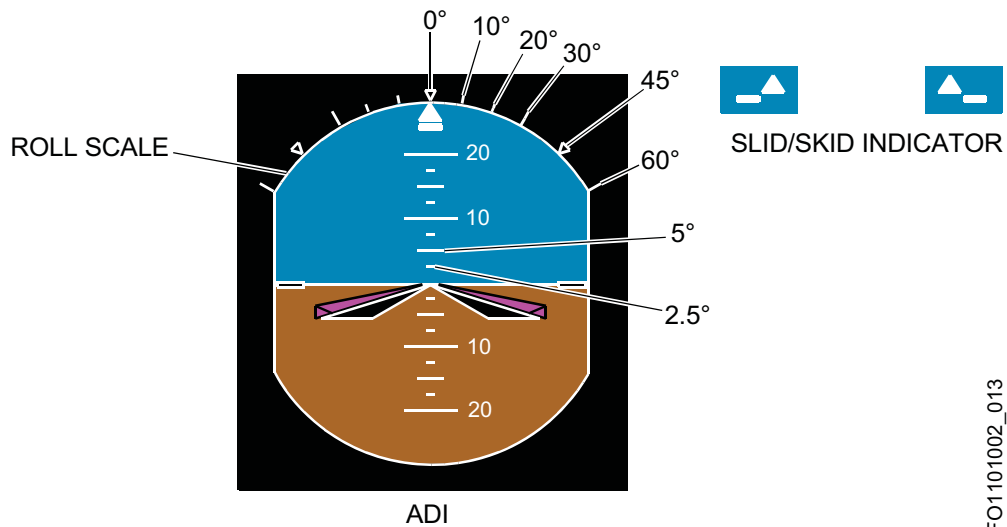
### ROLL SCALE AND POINTER

At the top of the blue display is a roll scale and pointer. The scale covers  $\pm 60$  degrees from level attitude.

The scale is marked as follows:

- Small triangle at 0 degrees of bank angle
- Large tick marks at  $\pm 30$  and  $\pm 60$  degrees
- Small tick marks at  $\pm 10$  and  $\pm 20$  degrees
- Small triangle at  $\pm 45$  degrees

The roll pointer moves in reference to the center of the aircraft symbol and indicates aircraft roll angle.



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### SLIP/SKID INDICATOR

The slip/skid indicator is a small rectangle located below the roll pointer. The slip/skid indicator is driven by lateral acceleration. It turns with the roll pointer and moves laterally with respect to the base of the roll pointer.

One brick width deflection of the rectangle is equivalent to a displacement of one ball width on a conventional slip/skid indicator.

### VERTICAL DEVIATION DISPLAY

The vertical deviation display is shown to the right of the attitude display. It is a white fixed scale employing a moving deviation icon. The color of the deviation icon is green when displaying the on-side data and is amber when displaying cross-side data.

The scale has two dots above and below a reference line with each dot representing a  $1/4$  degree deviation above or below the glideslope beam. There is a diamond for glideslope data and a star for VNAV data.

### GLIDESLOPE FLAG

During an ILS, with invalid glideslope information, a red boxed GS flag is displayed, replacing the pointer and scale.

## PRIMARY FLIGHT DISPLAYS (Cont)

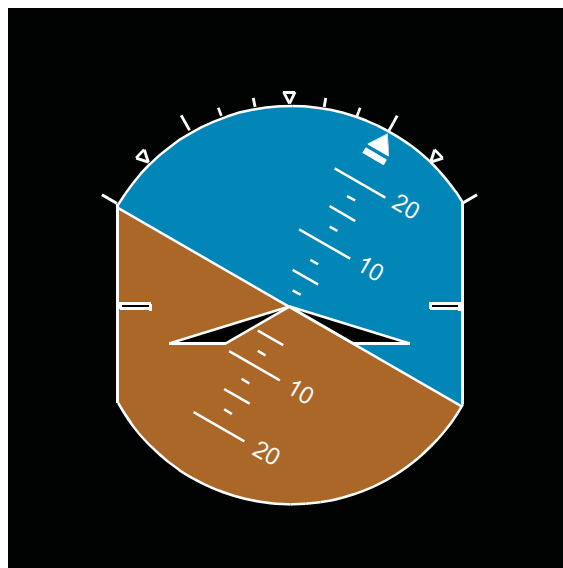
### DECLUTTER

De-clutter is used to clear all nonessential information from the PFD during aircraft upset or unusual attitudes.

When the pitch angle exceeds +30 or -20 degrees, or roll exceeds 65 degrees left or right, only the following information is displayed on the PFD:

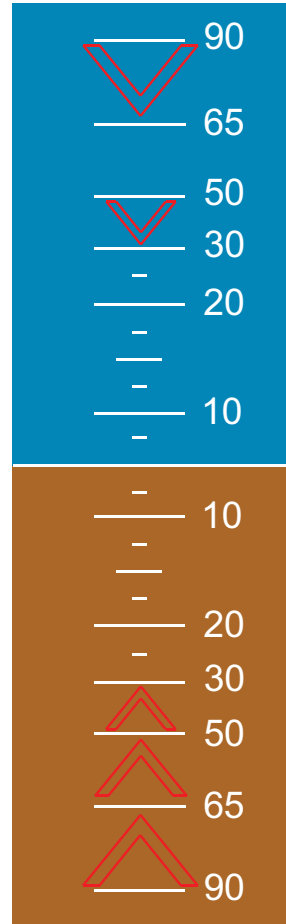
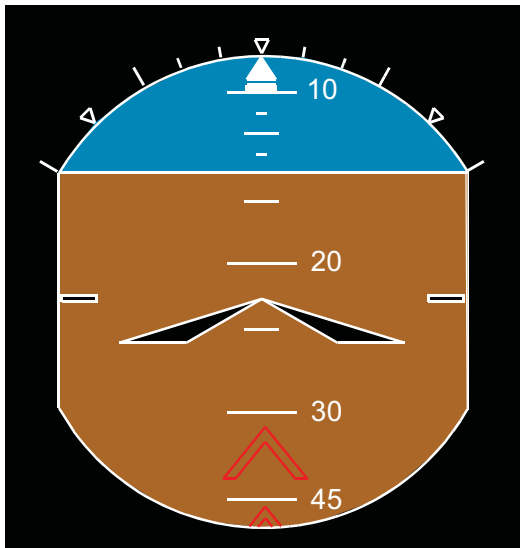
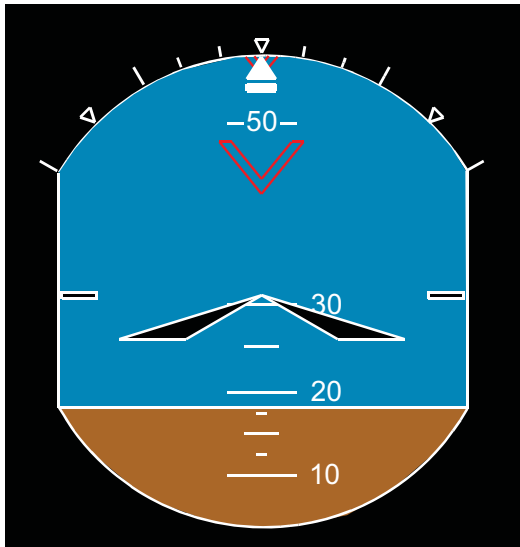
- Altitude
- Airspeed
- Attitude
- Vertical speed
- Heading indication
- FCC transfer indicator

When the pitch and roll limits are restored, the PFD resumes displaying all information.



Example of decluttered EADI in excessive roll

PRIMARY FLIGHT DISPLAYS (Cont)



Example of decluttered EADI in excessive pitch

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## PRIMARY FLIGHT DISPLAYS (Cont)

### ALTITUDE

Barometric altitude information on the PFD consists of:

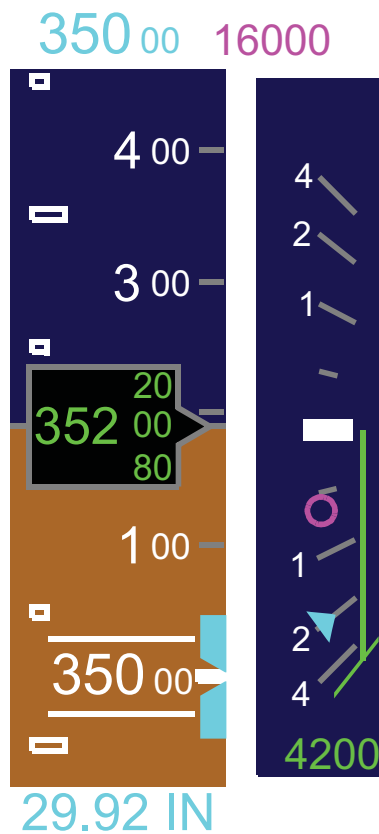
- Altitude display and readout
- Preselect altitude
- Altitude alert
- Barometric pressure setting readout
- Minimum descent altitude (MDA)

The ADC calculates the pressure altitude and barometric corrected altitude. The altitude is preselected with the controls on the FGP. Barometric pressure setting and DH/MDA is set through the REFS menu.

### ALTITUDE DISPLAY

The altitude display is shown on the right side of the PFD as a moving tape with a fixed digital readout window.

The fine portion of the tape is marked and numbered every 100 feet. The coarse portion of the tape is used to assist the pilot in altitude captures and gross altitude awareness and is not numbered. It is marked with large rectangles for increments of 1000 feet and small rectangles for 500 feet. The barometric altitude readout ranges from -1000 feet to 50 000 feet. The digital readout in the fixed altitude window indicates the actual altitude.





## PRIMARY FLIGHT DISPLAYS (Cont)

### ALTITUDE DISPLAY (Cont)

#### PRESELECTED ALTITUDE

The preselected altitude bug and digital readouts are set by using the ALT knob on the FGP. The preselect altitude is a reference for the altitude alert and autopilot systems. If the spring operated ALT knob is pushed, the preselect altitude increments are 100 feet or 10 meters. If the ALT knob is in the normal out position, the preselect altitude increments are 1000 feet or 100 meters. If a hundred foot value has been previously set, this will be reset to the next higher/lower thousands value with the first rotation of the knob.

When BARO MIN is ON, the preselect altitude can be set at the value of BARO MIN. Rotating the knob one click counterclockwise from the closest thousand foot increment above the baro minimums will result in the altitude preselect being set at the exact baro minimums. This allows leveling off at the exact non-precision approach minimums using the flight director or autopilot on approach.

The cyan preselect altitude readout is displayed above the altitude tape and has a selection range of -1000 feet to 45 000 feet in increments of 100 feet.

The range of the metric preselect altitude is from -300 meters to 17 000 meters.

#### ALTITUDE ALERT MODES

The altitude alert functions in the acquisition, deviation, and tracking modes.

The preselect altitude bug will change color and flash when the altitude acquisition and deviation parameters are exceeded. Aural alerts accompany the visual alerts for acquisition and deviation modes.

Pressing the ALT knob will cancel an altitude alert if active.

#### ACQUISITION MODE

Both preselect altitude bugs flash cyan and an aural "C-chord" tone is heard when the aircraft altitude is 1000 feet above or below the preselected altitude.

#### DEVIATION MODE

When an altitude deviation of 200 feet or more above or below the selected altitude occurs, both preselect indicators flash amber and the "C-chord" tone is heard.

#### TRACKING

Monitoring of the preselected altitude tracking is a function of the ADCs.

### VERTICAL NAVIGATION

When vertical navigation is selected (VNAV), the following are displayed:

- FMS reference altitude
- Vertical deviation and scale
- Suggested vertical speed (circular bug)

### VERTICAL SPEED FIELD

The vertical speed (VS) display consists of a vertical analog scale and pointer with a green "drag line". A part-time digital readout of the vertical speed is also provided. The VS pointer moves up and down the scale to indicate current VS. As the pointer moves, the drag line appears to emphasize the VS.

The vertical speed scale has a range of  $\pm 4000$  fpm. A part-time digital readout of the vertical speed is displayed on either the top or bottom of the vertical speed scale respective of climb or descent.

Selected VS shows on the VS scale as a reference bug, and as a digital readout on the automatic flight control system (AFCS) mode field above the attitude ball.

## PRIMARY FLIGHT DISPLAYS (Cont)

### VERTICAL SPEED FIELD (Cont)

Selected VS only shows when the AFCS VS mode is active and the UP/DOWN wheel on the flight guidance panel is used to set the selected VS. When VS mode is selected, the VS readout in the AFCS mode field appears. It is preceded by a VS bug icon, and followed by an arrow. The readout, icon, and arrow remain in view as long as the VS mode is active. The VS bug and display in the AFCS mode field show in cyan when commanded by the UP/DOWN wheel on the FGP. The readout icon and bug are magenta when the FMS is in control.

The vertical speed scale is also used to display TCAS advisory deviations. The FMS vertical speed required (VSR) advisory pointer is a magenta open circle, that indicates the minimum average VS required to climb or descend from the present position to the next climb (or descend) altitude constraint. The FMS must be the active NAV source for the pointer to be displayed.

### RADIO ALTITUDE DISPLAY

The PFD radio altitude display is presented as both a digital and moving tape readout.

The digital readout is displayed from -20 to 2500 feet above ground level (AGL), in the lower center part of the ADI ball.

To set the RA/ BARO MIN, or MIN ALERT, push the REFS button on the DCP to display and scroll through the menu pages on the PFD. Rotate the MENU knob to position the cyan cursor box around the selectable value for the RA/BARO MINS. The PUSH SELECT button on the DCP selects the next MIN ALERT option in the sequence. Rotating the DATA knob, on the DCP, increases or decreases the values to be set. To change a value, the cyan selection box must be moved to that value. The selected value shows in large cyan text; non-selected text will show in small white text. The menu pages are automatically removed from the PFD 20 seconds after the last activity.

### RADIO ALTITUDE FLAG

If the radio altitude data is invalid, a red boxed RA label is displayed and the radio altitude tape and digit readouts are removed.

### RA MIN

The digital range can be selected from 0 to 999 feet and is set on the REFS menu. When the aircraft descends to decision height, an amber boxed MIN indication is displayed when selected minimums are reached.

### BARO MIN

BARO MIN has a range of 0 to 15 000 feet and is set on the REFS menu. The selected minimums will display in cyan as MIN XXX RA or MIN XXX BARO, depending on which was set. The XXX represents the selected digital value.

As minimum descent altitude is approached, the cyan minimums pointer appears on the altitude tape. When the aircraft reaches minimums, a flashing amber MIN label is presented on the right edge of the attitude indicator.

### AIR DATA FLAGS

When ADC airspeed, altitude or vertical speed data is invalid, red air data flags are presented to replace the affected systems information.

## AIR DATA SYSTEM

### DESCRIPTION

Air data information is sensed by the pitot static system and total air temperature (TAT) probe. This data is processed by the air data computers (ADCs) and sent to the flight displays, IAPS, and several aircraft systems. Cockpit controls include the BARO SET knob, ADC REVERSION switch, several flight guidance panel (FGP) controls, and the reference speeds (REFS) menu settings.

### COMPONENTS AND OPERATION

Airspeed information displayed on the PFD include:

- Airspeed display
- Reference speeds
- Low/high/speed cues
- Airspeed trend vector
- Mach number display

The  $V_1$ ,  $V_R$ ,  $V_2$ ,  $V_{REF}$ ,  $V_{GA}$ , and  $V_T$  reference speeds are set through the REFS push button on the display control panel. The SPEED knob, on the flight guidance panel (FGP) is used to set the cyan speed bug on the airspeed display.

### AIRSPEED DISPLAY

The airspeed display is a moving vertical tape, with the digital display of the current airspeed in the fixed window. The display is located to the left of the attitude sphere on the PFDs. The current Mach number is indicated as a digital value at the bottom of the tape. If the aircraft speed is greater than 0.4 Mach, the crew can select a Mach tape, which replaces the airspeed tape.

The indicated airspeed tape has an airspeed range from 40 to 400 kt. The tape has a scale that is marked every 5 kt and numerically marked every 20 kt.

### REFERENCE SPEEDS

The takeoff reference speeds are presented on the speed scale as a  $V_1$ ,  $V_R$ ,  $V_2$ , and  $V_T$ . Manually set V speed values show in cyan characters; optional FMS-calculated V speed characters show in magenta.

The FGP SPEED knob is used to select and set the airspeed reference bug to the desired speed on the airspeed tape. The speed bug is located beside the selected speed with a  $\pm 5$  knot deviation indication.

When the center of the SPEED knob is depressed, the speed reference toggles between Mach and speed.

### LOW/OVERSPEED/FLAP SPEED CUES

A low speed cue indicates a calculated airspeed of 1.06  $V_S$ . It appears from the lower portion of the airspeed scale and is displayed as a solid red line that changes to an expanded alternating red and black band when the aircraft is within a few knots of activating the stickshaker. The top of this cue visually represents the speed at which the stick shaker will activate.

An overspeed cue is provided to indicate the maximum operating speed. It appears in the upper portion of the airspeed scale and is displayed as a solid redline that changes to an alternating red and black band when approaching overspeed. The overspeed cue reduces to the flap operating speed limit when the flaps are extended.

### TREND VECTOR

The airspeed trend vector originates from the tail of the indicated airspeed arrow. The magenta trend vector moves vertically in response to the aircraft acceleration or deceleration indicating the speed predicted in the next 10 seconds.

## **AIR DATA SYSTEM (Cont)**

### **ALTIMETER BAROMETER KNOB**

The ALTM BARO knob is rotated to increase or decrease barometric pressure setting. The barometric setting is displayed on the PFD. The standard barometric pressure setting of 29.92 inches of mercury, or 1013 hPa, is selected when the center of the BARO knob is pressed.

### **AIR DATA REVERSION SWITCH**

The AIR DATA switch is located on the reversion panel on the center pedestal. When NORM is selected, the pilot's and copilot's adaptive flight displays receive data from their respective air data computer (ADC).

When '1' is selected, the pilot's and copilot's adaptive flight displays receive data from ADC 1 only. An amber ADC 1 message is displayed on both PFDs.

When '2' is selected, the pilot's and copilot's adaptive flight displays receive data from ADC 2 only. An amber ADC 2 message is displayed on both PFDs.

### **AIR DATA COMPUTERS**

Each ADC senses total pressure, static pressure, and total temperature. The pressure sensors are solid-state piezoresistive type, and transform the pressure to an analog electrical signal. The analog signal is then digitized and used for all ADC calculations. Data is then passed from the ADCs to the cockpit displays, IAPS, other aircraft systems.

The ADC calculates the following air data parameters:

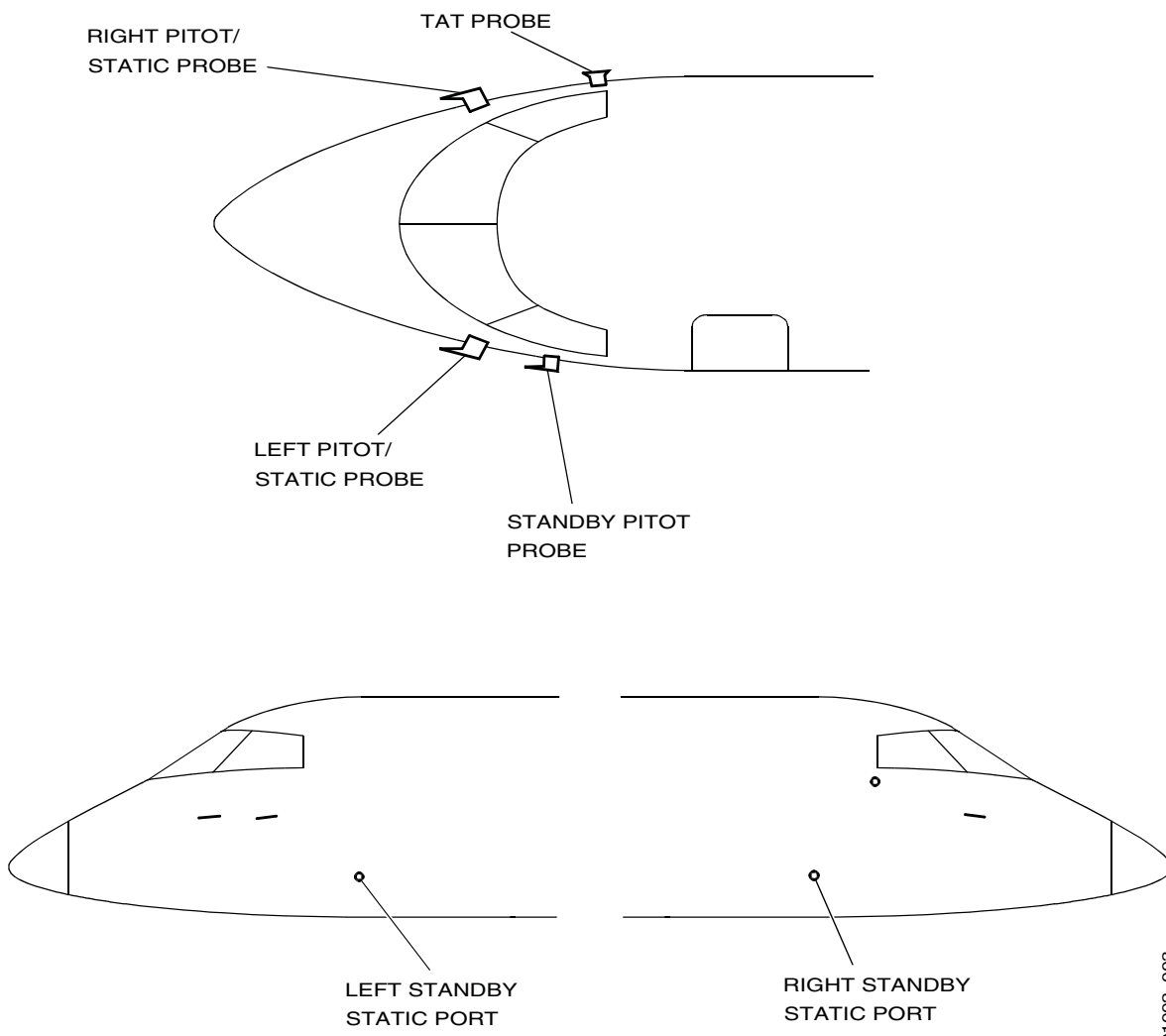
- Pressure altitude
- Static pressure
- Total pressure
- Vertical speed
- Airspeed
- Mach number
- Maximum airspeed (VMO)/maximum mach number (MMO)
- Baro correction
- Barometric corrected altitude
- Static air temperature
- Total air temperature
- True AIRSPEED
- Temperature difference from standard (ISA)

**AIR DATA SYSTEM (Cont)**

**PITOT STATIC SYSTEM**

The aircraft is equipped with a primary pitot static system and a standby pitot static system. The primary pitot static system provides total and static pressures to air data computers (ADC) 1 and 2. The pressures are sensed by left and right pitot static probes. The standby pitot static system provides total and static pressures to the integrated standby instrument. The pressures are sensed by a standby pitot probe and two flush mounted standby static ports.

The primary pitot static probes each have one total pressure port and two static pressure ports. The standby pitot probe has a single pressure port. All of the probes and the flush standby static ports are electrically heated.



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**AIR DATA SYSTEM (Cont)**

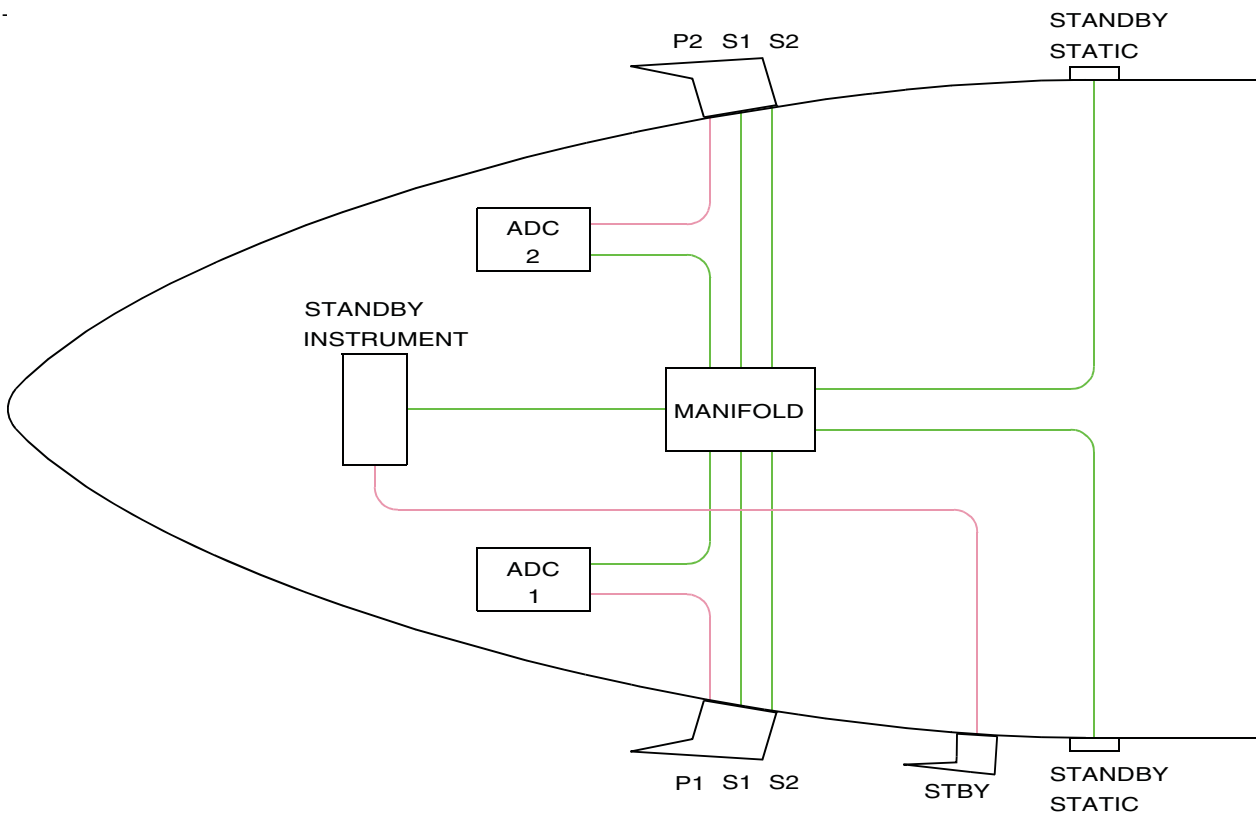
**TOTAL AIR TEMPERATURE PROBE**

An electrically heated total air temperature (TAT) probe is mounted on the right forward fuselage. The TAT probe has two independent temperature sensors. One sensor is connected to ADC 1 and the other to ADC 2.

The ADCs use the total air temperature to calculate the static air temperature (SAT) and the true airspeed (TAS).

The use and distribution of the pitot and static sources are as follows:

- P1 is the normal pitot input to ADC 1
- S1 is the normal static input to ADC 1
- P2 is the normal pitot input to ADC 2
- S2 is the normal static input to ADC 2



**LEGEND**

- PITOT ——— (red line)
- STATIC ——— (green line)

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## ATTITUDE AND HEADING REFERENCE SYSTEM (AHRS)

### INTRODUCTION

The aircraft attitude and heading reference system (AHRS) is a strapped gyro reference system that generates angular rate and linear acceleration information about the aircraft axes.

Combining the acceleration gyro information with heading data from the flux detector provides highly accurate three-axes AHRS information.

The AHRS interfaces with the following systems:

- EFIS
- Weather radar
- Autoflight control system (AFCS)
- Flight data recorder (FDR)
- Integrated avionics processor system (IAPS)
- Terrain awareness warning system (TAWS)
- Traffic alert and collision avoidance system (TCAS)
- Stall protection system

The AHRS consists of two computers, two flux detector units and two external compensator units. Both Attitude Heading Reference Systems are active permanently. AHRS mode selections are carried out through the COMPASS HEADING and COMPASS SLEW switches. The AHRS normally operates in magnetic mode (MAG). Directional gyro mode (DG) may be selected in areas where magnetic field disruptions exist.

The AHS-3000/3000A system is not designed for use as a polar navigator. Flying in or around the fringe of low magnetic flux areas can cause temporary dropouts in required flux levels for the system to operate properly.

Initialization and operation of the AHRS occurs automatically when electrical power is established and the aircraft is stationary. Initialization takes approximately 40 seconds in MAG mode and 4.5 minutes in DG mode.

## ATTITUDE AND HEADING REFERENCE SYSTEM (Cont)

### COMPONENTS AND OPERATION

#### AHRS COMPUTERS

Each AHRS computer has a dual-sensor assembly. Each sensor assembly has four pairs of piezoelectric accelerometer sensors mounted on a rotating wheel. These sensors provide the rate and acceleration data.

The sensor data combined with ADC and heading information is processed by the AHRS computers and transmitted for use by the adaptive flight displays (AFD), and by the integrated avionics processor system (IAPS), which itself interfaces with the flight guidance computer (FGC) and flight management system (FMS).

#### MAGNETIC FLUX DETECTORS

Each of the two magnetic flux detectors senses the earth's magnetic field and provides corrected heading information to its respective attitude heading computer.

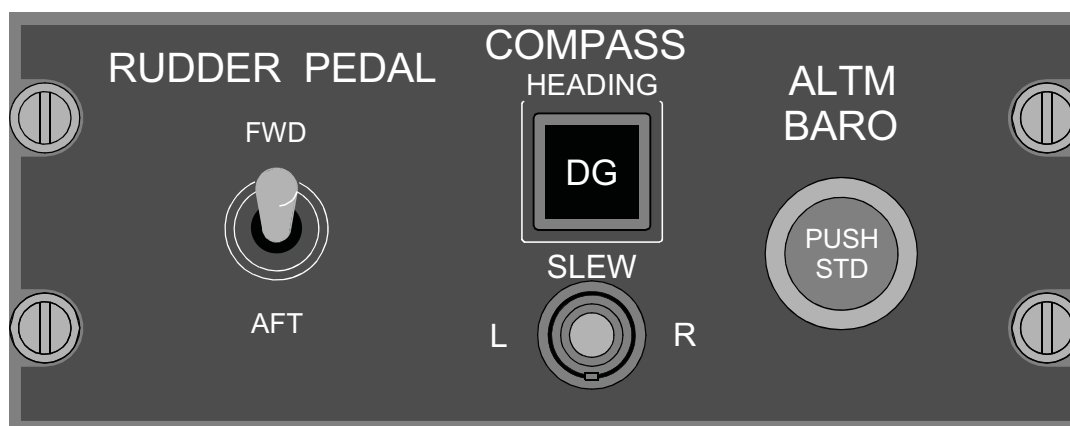
External compensator units store corrections for any north/south, east/west or misalignment of the flux detectors.

#### COMPASS CONTROL AND SLEW SWITCHES

There are two COMPASS HEADING switches and SLEW switches located on either side of the main flight instrument panel. There are two modes of operation, magnetic heading (slaved) mode, and directional gyro (DG or free gyro) mode. The HEADING switches are used to select the mode.

In the magnetic heading mode, heading computations are slaved to the attitude heading computer and the flux detectors. In DG mode, magnetic flux detector data is removed. DG mode is not intended for long term heading reference.

In DG mode, the selection of the SLEW switch causes the heading to slew in the selected direction.



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#### ATT/HDG REVERSION SWITCH

The ATT/HDG switch is located on the center pedestal. When NORM is selected, the left PFD and MFD receive data from AHRS1 and the right PFD and MFD receive data from AHRS2.

When the switch is selected to 1, all displays receive data from AHRS 1 only. An amber AHS1 message is displayed on both PFDs.

When the switch is selected to 2, all displays receive data from AHRS 2 only. An amber AHS2 message is displayed on both PFDs.



## ATTITUDE AND HEADING REFERENCE SYSTEM (Cont)

### GROUND ALIGNMENT

During the ground alignment process, the PFD displays the red ATT and MAG flags along with the message ATT/HDG ALIGNING DO NOT TAXI.

When the alignment is complete, the messages are removed and the attitude sphere is displayed. The aircraft can be moved at this time.

If excessive airplane motion is detected during a ground alignment, the AHRS automatically re-initializes.

### FLIGHT ALIGNMENT

If an airborne alignment occurs due to power interruption, the system will take 40 seconds to realign. During the in-flight alignment process, the aircraft must remain in a straight and level unaccelerated flight.



## HEADING DISPLAY

### DESCRIPTION

The aircraft is displayed on a partial compass card located at the bottom of the PFD. Data required to produce the display is supplied by the AHRS system.

With an AHRS installation, magnetic or directional gyro may be displayed.

### COMPONENTS AND OPERATION

#### HEADING INDICATORS

The heading indications are represented on the compass card, the display shows 360° from the current heading. The compass card has 10° major indices, 5° minor indices, cardinal point characters at N, S, E, W, and numeric labels at 30° intervals.

At the top center position of the compass card is the fixed lubber line. The lubber line indicates the aircraft heading reference.

#### SELECTED HEADING REFERENCE

The selected heading reference is presented on the heading display as a heading bug, bug vector and heading readout.

The heading bug indicates the heading selected at the HDG knob on the flight guidance panel.

#### ATTITUDE AND HEADING FLAGS

When the attitude or heading data from the AHRS becomes invalid, warning flags are presented.

A red boxed attitude flag 'ATT' is displayed when the attitude information is invalid. All other attitude information disappears from the PFD.

A red boxed heading flag HDG is displayed when the heading source is invalid. When the flag is in view, it replaces the heading readout, the compass rose (or arc) is rotated to north-up, and the lubber line around the digital heading is removed.

## NAVIGATION DISPLAYS

### DESCRIPTION

The navigation indications on the primary flight display provide course, course deviation, bearing and distance information from the selected navaid. The data is presented in a conventional HSI format.

### COMPONENTS AND OPERATION

#### NAVIGATION DATA

Navigation data is displayed on the lower part of the PFD. The display includes:

- Navigation source indicator.
- Course display.
- Distance display.
- Station identifier.

#### NAVIGATION SOURCE INDICATOR

The navigation source indicator is presented in digital format. Navigation source is selected at the NAV SRC button on the DCP. This opens a menu window vertically on the left side of the PFD. By repeatedly pushing the NAV SRC switch on the DCP the available list will be shown.

- VOR 1/LOC 1
- VOR 2/LOC 2
- FMS 1/FMS 2
- OFF (no display)

#### COURSE DISPLAY

The selected source display is a three-digit display preceded by a CRS label.

The course range is from 1 to 360 degrees and is selected from the CRS knob on the FGP.

#### COURSE POINTER

The course pointer is an arrow that points to the course position of the compass card.

The course pointer is controlled by the CRS selector knob on the FGP. The on-side color is green and cross-side is amber.

#### LATERAL DEVIATION BAR

The lateral deviation bar indicates aircraft deviation from the selected course.

The lateral deviation bar moves from side to side and its position is read against the deviation scale.

#### TRACK POINTER

The track pointer is positioned on the compass rose or compass tape at the current aircraft track over the earth. The track pointer is a green open circle shape. The difference between the track pointer position and the lubber line is the drift angle.

## NAVIGATION DISPLAYS (Cont)

### BEARING POINTERS

The bearing pointers display bearing information from a selected navaid.

Two bearing pointers can be displayed on the compass rose or PPOS map format; one from number 1 bearing source, and the other from number 2 bearing source. The bearing pointer from the number 1 source is a cyan single lined pointer. The bearing pointer from number 2 source is a white double lined pointer. Bearing icons are miniature representations of the bearing pointers that are used to identify the actively selected bearing pointer. The bearing source display is blank if the BRG source selection is OFF. The bearing pointer is removed from view when bearing source is invalid.

The source indicator and pointers are selectable through the BRG SRC push button on the DCP. The bearing source indicators are displayed vertically in the lower left portion of the PFD. The selection box is moved with the MENU knob to select the number 1 or number 2 bearing pointers. The PUSH SELECT or DATA knob is used to select the bearing source or OFF.

As in the navigation source indicator, the bearing source indicator and bearing pointers show which bearing source is in use:

- VOR 1/VOR 2
- ADF 1/ADF 2
- FMS 1/FMS 2
- OFF (no display)

### DISTANCE DISPLAY

The distance display shows the DME slant range distance to the navaid station.

When the DME H button is selected on the DCP, the held DME frequency replaces the AUTO annunciation on the NAV CONTROL menu, the DME frequency can be tuned separately from the VOR frequency. When the DME transceiver is in hold mode, a cyan "H" is placed beside the DME frequency in the NAV replaces the normally green "NM" on the PFD.

When the DME TEST control is selected, the TEST annunciation shows in large cyan text. The DME distance is 100 NM, the TTG is 60 minutes, the station ID is AOK, and the ground speed is 100 knots. This test lasts about 10 seconds.

### STATION IDENTIFIER

The navaid identifier is shown in the navigation data field above the distance display. Data for the identifier is supplied by the DME. In DME hold, the identifier is removed from view.

### NAVIGATION ALERT FLAGS

#### NAVIGATION SOURCE WARNING FLAG

A red boxed navigation source flag (VOR, LOC, and FMS) is displayed during a failure of the selected NAV source. The navigation display is removed from view when the flag is displayed.

#### BEARING FLAG

Invalid data from the selected bearing source causes the bearing source annunciator to be replaced by a red boxed warning flag. The bearing pointer is removed from view when the flag is displayed.

### HORIZONTAL SITUATION INDICATOR (HSI)

The horizontal situation indicator (HSI) represents the compass card, which incorporates selectable navaids, bearing and course pointers. HSI indications include:

- Course pointer
- Lateral deviation bar
- Lateral deviation scale
- To/from indicator

## NAVIGATION DISPLAYS (Cont)

### LATERAL DEVIATION SCALE

The lateral deviation scale has two dots on each side of the course arrow. Each dot represents:

- In VOR, 5° of deviation
- In LOC, 1° of deviation
- In FMS, 5 nautical miles

### TO/FROM INDICATOR

The TO/FROM arrow is an outlined triangle on the course/desired track pointer. The arrow points toward the head of the pointer to indicate a “TO” and toward the tail to indicate a “from”.

The color of the TO/FROM indicator is green for VOR outside information and amber for cross-side information.

In FMS mode the entire display is magenta.

### AUTO FLIGHT CONTROL SYSTEM DISPLAY

The PFD presents automatic flight control system (AFCS) information consisting of flight guidance mode, autopilot mode indications, and flight director command bars.

### AUTOPILOT INDICATION

Autopilot information concerning engagement, disengagement and flight director in use is displayed in the top center portion of the attitude display. A green AP indicates the autopilot has been engaged and the horizontal arrow points to the FD coupled side.

A flashing red AP indicates that the autopilot has disengaged. The AP symbol flashes for five seconds and the aural cavalry charge is heard. A white arrow indicates that the autopilot is not engaged and control of the FD is transferred to the indicated side when engaged.

### FLIGHT GUIDANCE MODE

Flight Guidance modes are displayed on the top center portion of the PFD, with three fields divided by thin vertical grey lines. The left field of the line represents the lateral modes. The center field represents AP/YD engagement. The right side represents the vertical modes. Active modes are green and armed modes are white.

### 1/2 BANK INDICATOR

When the aircraft climbs above 31 600 ft, the 1/2 bank flight director commands are automatically generated. The flight director 1/2 BANK mode can be manually selected on the FGP.

When the 1/2 BANK mode is active, a green arc is drawn above the top of the attitude scale above the ADI. The length of the marks represent 15 degrees of roll. Selecting the 1/2 BANK a second time disengages the mode.

### FLIGHT DIRECTOR WARNING FLAG

A red boxed FD warning flag appears when either the pitch or the roll attitude input to the flight director becomes invalid. The flight director command bar is removed when the FD label is displayed.

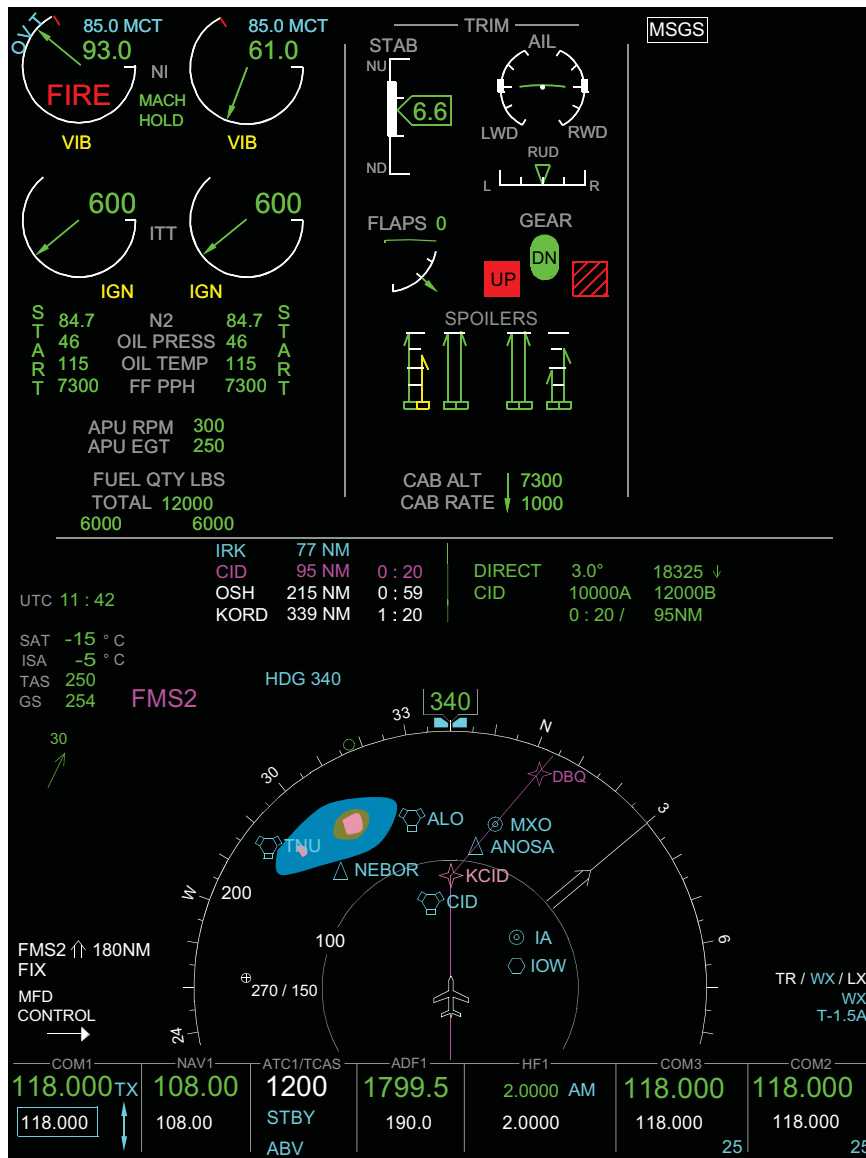
### FLIGHT DIRECTOR COMMAND BARS

The flight director command bars provide flight control computer guidance instructions. The magenta flight director command bars are a V-shaped cue symbol or cross pointers that are directed to move horizontally and vertically around the apex of the black stationary aircraft symbol. Selection of the command bars option is by pressing the REF button on the DCP. This provides a vertical menu on the left side of the PFD, with three pages of menus. Rotating the MENU/DAT knob scrolls through the various options and on the third page, the VBAR or XPNTR is selected by toggling the PUSH/SELECT button in the MENU/DATA knob on the DCP.

## MULTIFUNCTION DISPLAYS (MFDs)

### DESCRIPTION

The left and right multifunction displays (MFDs) are located in the center of the instrument panel. During normal operation, the top half of the left MFD displays EICAS data, including engine indications, full time system indications, and CAS messages. The top half of the right MFD displays the summary page, or the electronic checklist. For maintenance actions, the top half of the right MFD can also display maintenance diagnostic system information. The lower half of both the left and right MFDs can display synoptic or navigation information. The MFDs are controlled using the MFD control panel.



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## MULTIFUNCTION DISPLAYS (MFDs) (Cont)

### COMPONENTS AND OPERATION

#### MFD CONTROL PANEL

The MFD control panel is located on the center pedestal. The position of the L/R toggle switch determines which MFD will be controlled when button selections are made. The CCP controls CAS paging, electronic checklist functions, navigation displays, and synoptic displays.



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The following is a brief description of the MFD controls:

#### CAS

Pressing the CAS button will alternately page the CAS list out of view, or re-display the CAS list. Messages, except for warnings (Red), may be hidden by paging through all existing messages to a blank page. New messages will then appear on this blank page. All messages can be retrieved by subsequently pressing the CAS button on the MFD control panel.

#### CKLST

The CKLST switch is used to present or remove a checklist display on the MFD.

#### SKIP

The SKIP switch is used to skip checklist items on the display.

#### FRMT

The FRMT switch is used to select the MFD format (PPOS, Plan, and TCAS modes).

#### TFC

The TFC switch is used to select TCAS overlays on the MFD.

#### TR/WX

The TR/WX switch is used to select terrain, weather and lightning overlays on the MFD.

#### ENTER

The ENTER switch is associated with the joystick and enters the PPOS waypoint or selects the current menu item in the top half of the MFD.

#### SUMRY

The SUMRY switch is used to display the EICAS summary display on the MFD.

### **MULTIFUNCTION DISPLAYS (MFD) (Cont)**

#### **A/ICE**

The A/ICE button is used to display the Anti-Ice synoptic page.

#### **ECS**

The ECS button is used to display the Environmental Control System synoptic page.

#### **ELEC**

The ELEC button is used to display the Electrical synoptic page.

#### **FLT**

The FLT button is used to display the Flight Controls synoptic page.

#### **FUEL**

The FUEL button is used to display the Fuel synoptic page.

#### **HYD**

The HYD button is used to display the Hydraulic synoptic page.

### **3D Map Display (Optional)**

The optional 3D Map Format is an advanced FMS feature that provides lateral, vertical and performance predicted flight plan information in a single combined three-dimensional (3D) format on the MFD. The 3D presentation depicts the flight plan and predicted vertical trajectory of the aircraft so the pilot can interpret the current and future aircraft situation. The display is referenced to true North and the waypoints are drawn at their actual latitude and longitude. The CCP Joystick, SHLDR, SIDE, and PLAN are used to control the presentation. The Joystick is used to rotate the display clockwise, counterclockwise, and vertical viewing angles from 90° to 0°. Refer to the Rockwell-Collins Pro Line 21 Avionics System Operator's Guide for a more detailed description.

#### **AUTO**

When AUTO view is on, the MFD will automatically rotate the view to maintain a consistent viewing angle as the inbound course changes. When flying a curved flight leg or holding pattern, the viewing angle is the inbound course relative to the abeam point angle.

#### **PLAN**

When the PLAN switch is pushed, the display will give a vertical view of the inbound course.

#### **SHLDR**

When the SHLDR view is displayed, the viewing angle is 22° lateral and 75° vertical, relative to the inbound course.

#### **SIDE**

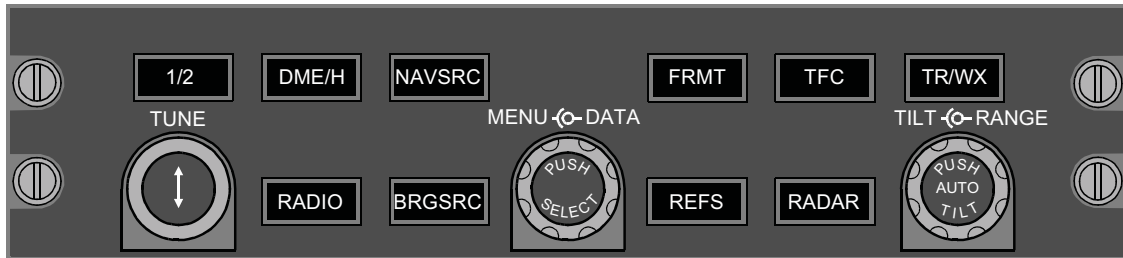
Selecting SIDE view on the 3D display will provide the pilot with 90° lateral and 90° vertical viewing angles, relative to the inbound course.



## DISPLAY CONTROL PANEL (DCP)

### DESCRIPTION

The display control panel (DCP) controls the information displayed on the PFD and controls the radio functions on the MFD.



### COMPONENTS AND OPERATION

The following is a brief description of the DCP control knobs, switches, and push buttons:

#### 1/2

The 1/2 button selects and deselects the cross-side radio menu on the MFD. When a radio submenu is in view, the equivalent cross-side radio submenu is selected/deselected, when the RADIO button is pushed.

#### DME/H (DME HOLD)

The DME H button selects and deselects the DME hold function. When DME hold is selected, the DME holds the current NAV frequency while allowing the VOR radio to be independently tuned.

#### NAVSRC (NAVIGATION SOURCE)

The NAV SRC button enables the display of a list of NAV sources on the PFD with the next NAV Source selected. Repeated pushes of the NAV SRC button select the next listed NAV source as the new active NAV source. The NAV source list automatically times out.

#### FRMT (FORMAT)

The FRMT button directly selects the current PFD display format between present position (PPOS) and compass rose (ROSE).

#### TFC (TRAFFIC)

The TCAS is overlaid on the PFDs compass rose or map mode display by momentarily depressing the DCP TFC button. When there is not an active RA or TA, the range is the last active TCAS range. A second momentary press of the TFC button removes the TCAS overlay. Continuously pressing TFC for more than 1 second selects the compass rose/TCAS format with the range set to the default 10 mi full range. Radar or terrain overlays, if previously displayed, are removed.

#### TR/WX (TERRAIN/WEATHER/LIGHTING)

The TR/WX button is a multiple mode selection button that selects and deselects the display of terrain, weather, and lighting (if installed) on the PFD. The first push of the TR/WX button selects a new state in the TR/WX list. The PFD automatically changes the range to an appropriate range if required. Pushing the TR/WX button again moves the cursor to the next available state. If the TAWS declares a terrain awareness warning or caution, pressing the TR/WX button causes an immediate response, regardless of the current format. The first momentary press of the TR/WX button selects terrain for display at its default 10 nm range and PPOS format.

#### TUNE

The tune knob is a rotary control used for MFD radio tuning. The larger and smaller knobs change the most significant and least significant digits of the frequency respectively. The up down arrow button in the center of the TUNE knob swaps the recall and the active frequencies.

### DISPLAY CONTROL PANEL (DCP) (Cont)

#### RADIO

Pressing the RADIO button selects and deselects, on the MFD, the tuning control sub-menu of the radio associated with the current position of the tuning control. Pressing the RADIO button when another menu is displayed closes the menu and returns the tune box to its home position.

#### BRGSRC (BEARING SOURCE)

The BRG SRC button displays a menu of Bearing pointer sources on the PFD with the current Bearing pointer source highlighted. The Menu knob and Data knob and Push Select are used to select and deselect the Bearing pointers.

#### MENU/DATA/PUSH SELECT

The MENU knob is a rotary control used to move a cyan selection box, to allow activation of various display items on the PFD and MFD. The DATA knob is a rotary control used to change the value in the selection box.

The PUSH SELECT button located in the center of the MENU/DATA knob makes the value entered with DATA knob, the active display value or change the state of the item in the selection box.

#### REFS (REFERENCE)

The selected V-speed references are displayed on the airspeed display. V1, VR, V2, VT, V<sub>GA</sub>, and VREF are initialized to default values but deselected, which the pilot may change as required.

The REFS push button located on the DCP is used to select the desired reference menu. Repetitive pushes of the REFS button toggle through the three pages of the REFS menu.

#### RADAR

The RADAR button selects and deselects the radar control menu on the PFD. The radar control menu provides mode, ground clutter suppression, gain, sector scan, and target.

#### TILT-RANGE/PUSH AUTO TILT

The RANGE knob is a rotary knob with a function to control the decrease or increase of the PFD and MFD Nav display range until the minimum or maximum range is reached.

The TILT knob is a rotary control to select the radar antenna tilt range (-15 to +15 degrees).

The PUSH AUTO TILT button located in the center of the RANGE/TILT knob selects and deselects automatic tilt control.

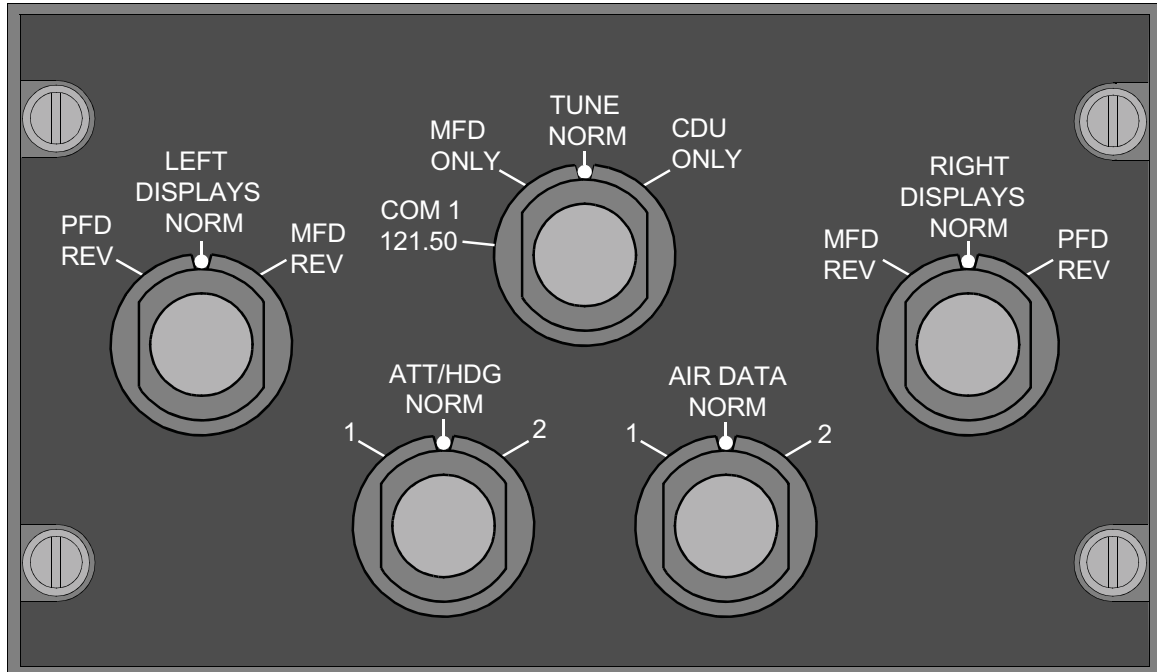
### DISPLAY CONTROL PANEL WARNING FLAG

A display control panel (DCP) failure results in the display of an amber boxed DCP flag. This flag will appear on the PFD and MFD displays.

## REVERSION SWITCH PANEL

### DESCRIPTION

The reversion switch panel provides an EFIS system capability for the selection of alternate sources of sensor data, radio tuning, and the selection of reversionary PFD modes.



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### COMPONENTS AND OPERATION

The following is a brief description of the reversion switch panel switches:

#### LEFT DISPLAYS

The left display reversion switch is a three-position rotary switch, dedicated to enable the reversion of the left MFD/PFD displays.

Position — PFD REV

L-PFD displays compressed format. L-MFD is shut down.

Position — NORM

L-PFD format is normal. L-MFD format is normal.

Position — MFD REV

L-PFD is shut down. L-MFD displays compressed PFD format.

## REVERSION SWITCH PANEL (Cont)

### RIGHT DISPLAYS

The right display reversion switch is a three position rotary switch, dedicated to enable the reversion of the right MFD/PFD displays.

Position — MFD REV

R-MFD displays compressed PFD format. R-PFD is shut down.

Position — NORM

R-MFD format is normal. R-PFD is normal.

Position — PFD REV

R-MFD is shut down. R-PFD displays compressed format.

### ATTITUDE/HEADING

The attitude/heading reversion switch is a three-position rotary switch.

Position — 1.

All displays present AHRS 1 data.

Position — NORM

The displays present outside AHRS (pilot-1, copilot-2).

Position — 2.

All displays present AHRS 2 data.

### AIR DATA

The air data reversion switch is a three-position rotary switch.

Position — 1.

All displays present ADC 1 data.

Position — NORM.

The displays present outside ADC data (pilot-1, copilot-2).

Position — 2.

All displays present ADC 2 data.

### TUNE

The tune switch is a four-position rotary switch.

Position — COM 1 121.50

L-VHF com tuned to 121.50 MHz emergency frequency

Position — MFD ONLY

Tuning of the radios by the CDU is disabled, tuning enabled only by MFD.

Position — NORM

Tuning is normal.

Position — CDU ONLY

Tuning of the radios by the MFD is disabled. Tuning is enabled only by CDU.

## STANDBY INSTRUMENT

### DESCRIPTION

The self-contained standby indicator supplies the pilots with backup attitude, barometric altitude and airspeed indications. The standby instrument receives information from the standby pitot static system.

### COMPONENTS AND OPERATION

#### STANDBY INDICATOR

The indicator supplies the flight crew with displays of aircraft speed, attitude, slip/skid, and glideslope/localizer data as long as 28 vdc power is available.

The localizer and glideslope data come from the VHF navigation receiver 1. The localizer and glideslope pointers and scales are not in view until an ILS frequency is selected.

If the localizer data becomes invalid, a red LOC or GS flag is visible and the pointer, and scale are removed from sight.

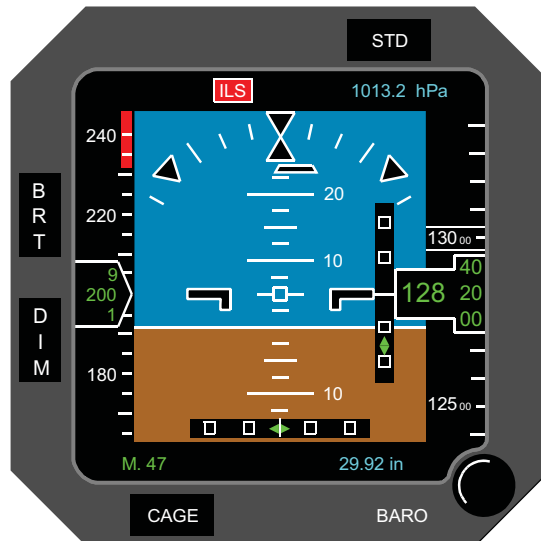
#### ALIGNING FLAG

When the standby instrument is first energized, an ALIGNING flag is visible. From initial application of the 28vdc power, the display requires a maximum of 90 seconds to stabilize, providing aircraft attitude is less than 5°. After aligning, the flag is no longer visible.

#### STANDBY INSTRUMENT FUNCTIONS

The standby instrument is operated as follows:

- Gyro caging (CAGE)
- Baro-settings (STD)
- Dimming adjustment (BRT and DIM)
- A rotary knob (BARO) is provided to enter the barometric pressure correction.



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## CLOCK/CHRONOMETER

### DESCRIPTION

A digital electronic clock/chronometer is installed on the center of the instrument panel just below the standby instrument.

### COMPONENTS AND OPERATION

#### FLIGHT TIME (FLT/RST)

Flight time (FLT) represents the time that the aircraft is “in air” as determined by the status of the in air/on ground discrete input. The FLT starts counting from zero (00:00) when the on-ground/in-air input transitions from ground (on-ground) to open (in-air). The FLT stops counting when the on-ground/in-air input transitions from open (in-air) to ground (on-ground). The FLT resets to 00:00 by pressing the FLT RST switch for a period of 2 or more seconds.

#### CHRONOGRAPH (CHR)

The chronograph (CHR) begins counting upon depression of the CHR switch. The first switch actuation starts the CHR from zero (00:00). Pressing the switch again stops the CHR timer. Pressing the switch a third time deletes the display and resets the CHR timer.

#### GPS/MAN MODE

##### GPS

The chronometer uses external GPS time when the user has selected GPS mode. GPS mode is indicated by an illuminated “GPS” indication on the LCD display.

##### MAN

The chronometer uses a highly accurate internal time base when the user has selected manual mode. Manual mode is indicated by the absence of the “GPS” indication on the LCD display.

#### MODE

The mode push button provides two functions. Pressing the mode button will toggle between the UTC (zulu time), LOC (local time) and date displays. By pressing and holding the mode button for more than two seconds, the chronometer will enter the UTC, LOC and date mode.



## STANDBY COMPASS

### DESCRIPTION

The standby compass supplies the flight crew with the magnetic heading data. This system is in constant operation and is used as an auxiliary display.

### COMPONENT AND OPERATION

The standby compass is installed in a bracket on the center post of the windshield, above the flight guidance panel. The compass is aligned with the aircraft longitudinal axis.

The standby compass is a self-contained unit that has a transparent and molded bowl and is filled with silicon fluid. In the fluid is a sphere with a compass dial. Silicone fluid is used to insure free and smooth movement in order to provide an accurate indication. Metal bellows in the compass let the fluid volume expand and contract to changes in temperature and altitude.

The standby compass is lighted and uses a special non-magnetic bulb. The light unit is powered by 5 vdc from the integral light controller.

The compass dial shows markings for the four cardinal heading (N, E, S, W) and has numerals every 30°, with bars every 10°. The last numeral is not shown (for example "24" means "240"). Heading of the aircraft is read against the vertical lubber line.

To operate correctly, the compass needs installation adjustments and also corrections for heading indication errors caused by magnetic interference from the aircraft electrical and avionics system. During the adjustment procedure, the heading reference is supplied by the attitude and heading references system (AHRS).

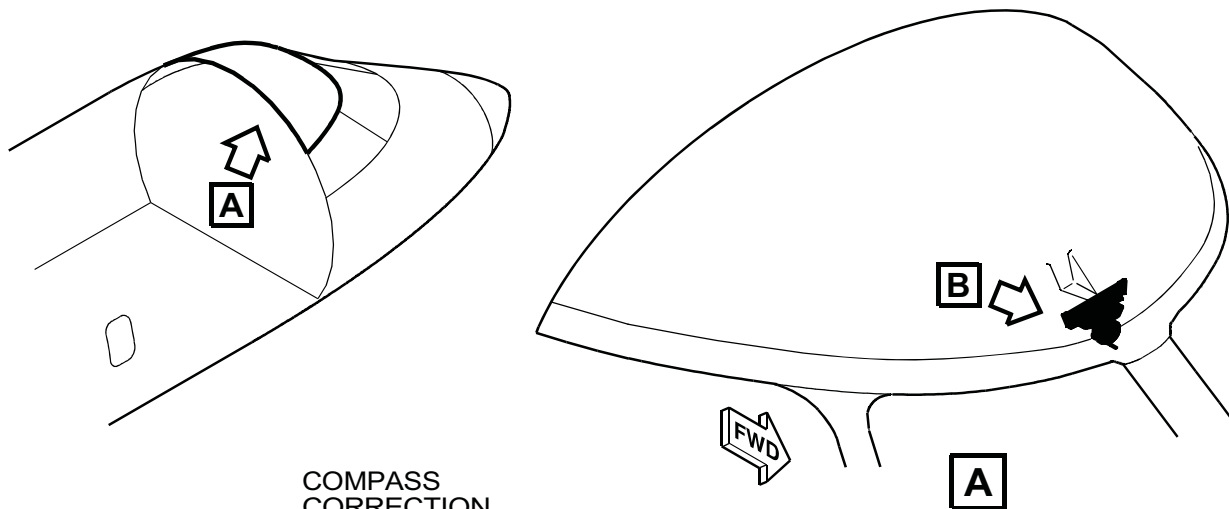
The standby compass is adjusted in the vertical axis with two adjustment screws that attach the compass to the mounting bracket through two extended holes. At the top of the compass there is an index error adjustment scale. The center major index mark on this scale is used as a reference point during the adjustment procedures.

The standby compass has also two compensators (B and C) installed at the top area of the compass. They are used to adjust the readings for the magnetic interferences.

### COMPASS CORRECTION CARD

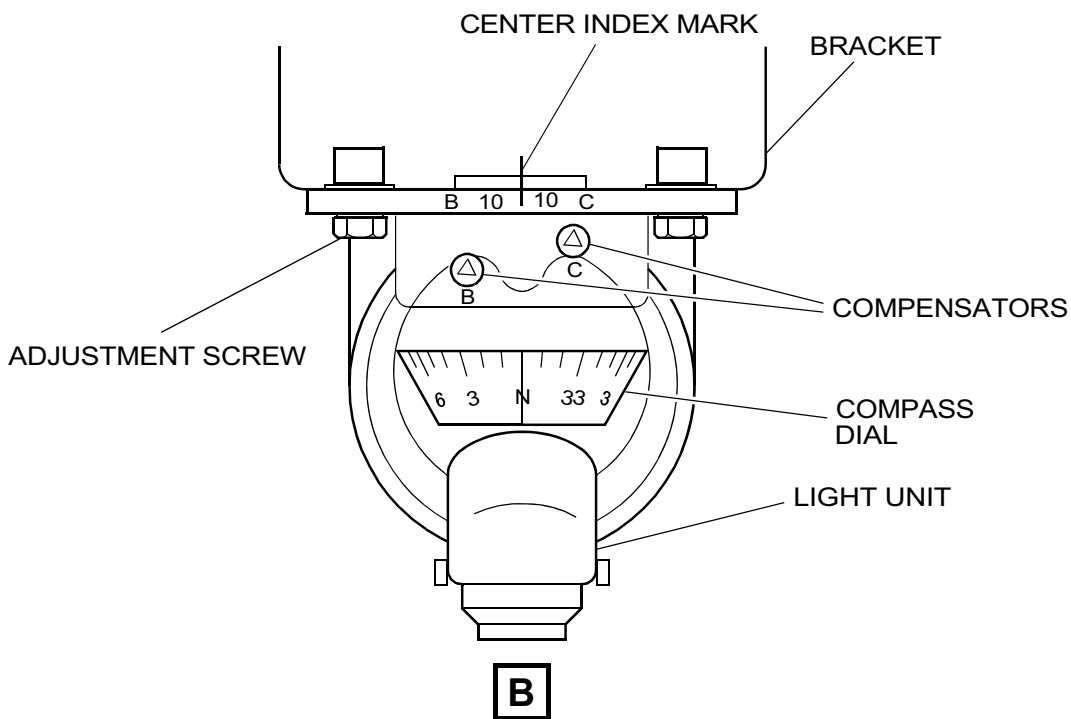
The standby compass system includes a compass correction card installed on a bracket above the standby compass. The compass correction card has a STEER row used to write the corrected heading for each of the cardinal headings and for the 30° increments.

STANDBY COMPASS (Cont)



COMPASS CORRECTION CARD

STANDBY COMPASS WITH ALL RADIOS ON SWUNG // BY <input type="checkbox"/>												
TO FLY	N	30	60	E	120	150	S	210	240	W	300	330
STEER												

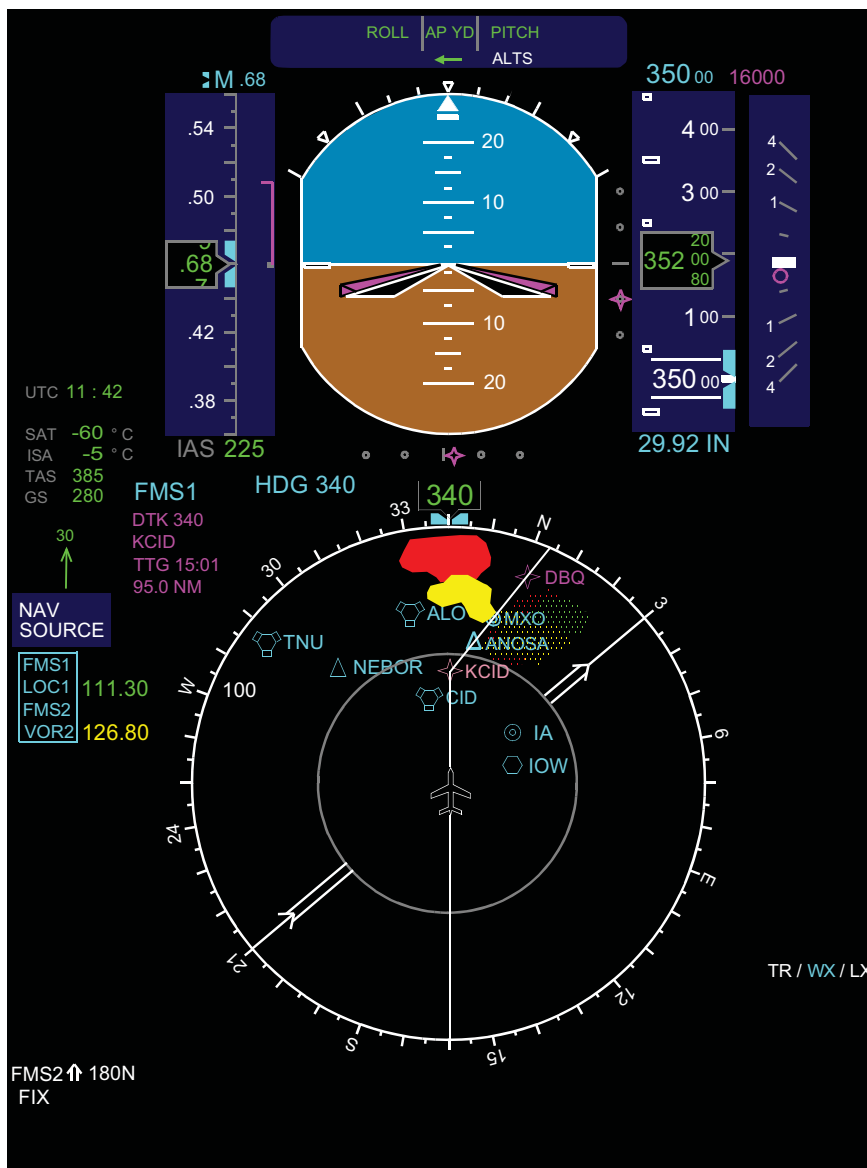


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CONTROLS AND INDICATIONS

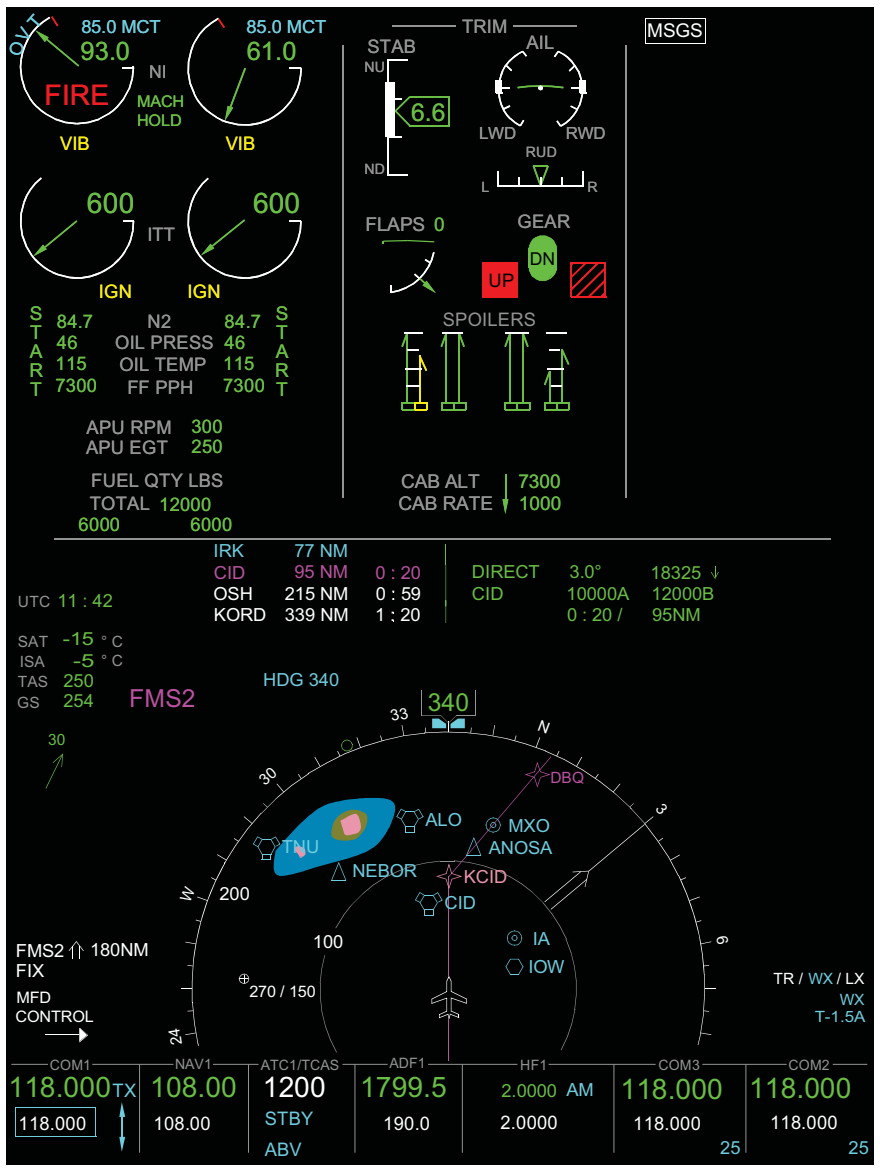
PRIMARY FLIGHT DISPLAY (PFD)



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CONTROLS AND INDICATIONS (Cont)

MULTIFUNCTION DISPLAYS (MFD)



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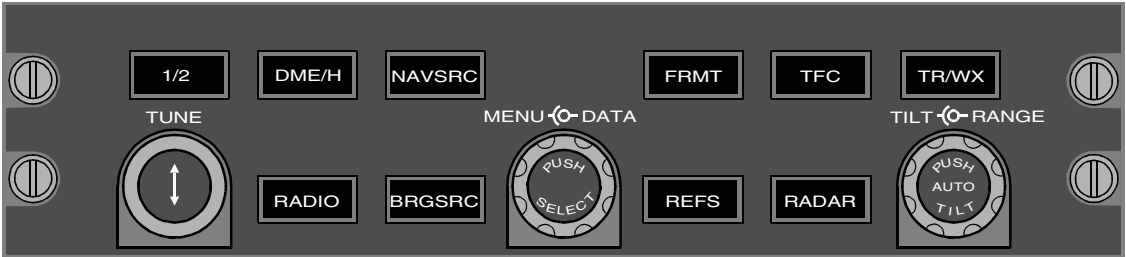
CONTROLS AND INDICATIONS (Cont)

MFD CONTROL PANEL (MCP)



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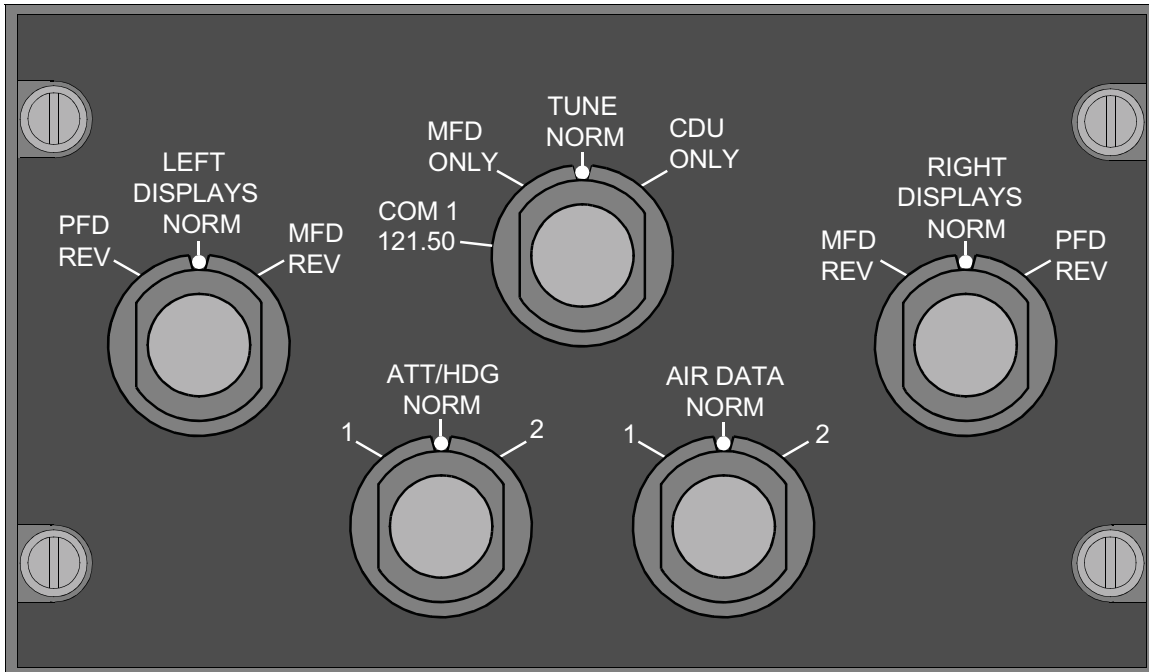
DISPLAY CONTROL PANEL (DCP)



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CONTROLS AND INDICATIONS (Cont)

REVERSION CONTROL PANEL



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STANDBY INSTRUMENT



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**MULTI-FUNCTION/PRIMARY FLIGHT DISPLAY VISUAL ANNUNCIATIONS**

If MFD or PFD data is invalid or missing, the following annunciations will be displayed on the MFD or PFD. A brief explanation of each message is provided.

MESSAGE	INHIBITS	MEANING	AURAL WARNING
<b>AOA</b>		A red, boxed, AOA flag shows to the right of the vertical speed scale when no valid AOA data is available. The flag flashes for five seconds, then remains steady	
<b>ALT</b>		Indicates an invalid altitude source. Crosscheck standby instrument altitude to validate instruments	
<b>AP</b>		Indicates a monitored autopilot disconnect	
<b>ATT</b>		Indicates an invalid attitude source and illuminates in the center of the attitude sphere. Most likely cause is an AHRS fault or failure	
<b>FD</b>		Indicates a fault in the flight guidance computer	
<b>FMS 1 FMS 2</b>		Indicates that data from the active nav source is missing or invalid	
<b>LOC 1 LOC 2</b>		Indicates that data from the active nav source is missing or invalid	
<b>VOR 1 VOR 2</b>		Indicates that data from the active nav source is missing or invalid	
<b>HDG</b>		Indicates an invalid heading source and illuminates in the center of the PFD heading display. Most likely cause is an AHRS failure	
<b>IAS</b>		Indicates an invalid air data source and illuminates in the center of the airspeed tape	
<b>MACH</b>		Indicates an invalid air data source and illuminates in the center of the airspeed tape	
<b>RA</b>		Indicates an unreliable radar altitude	
<b>VNV</b>		Indicates when VNAV data from the FMS is missing or invalid	
<b>VS</b>		Indicates in place of the vertical speed scale when vertical speed data from the air data computer is missing or invalid	

## Challenger Global 300 - Flight Instruments

### EICAS MESSAGES

The flight instruments system messages are shown on the EICAS. In the table below, the EFIS messages and inhibits are listed. A brief explanation of each message is provided.

MESSAGE	INHIBITS	MEANING	AURAL WARNING
<b>AIR DATA 1 (2) FAULT</b>	TO/LAND	The angle of attack input to the ADC has failed. The affected altitude may indicate up to 150 ft low	
<b>EFIS COMPARATOR INOP</b>	TO/LAND	The EFIS comparator is unable to compare one or more of the following parameters: altitude, airspeed, roll attitude, pitch attitude, heading, radio altitude, flight director, localizer or glideslope	
<b>EFIS MISCOMPARE</b>		There is a mismatch between the onside and cross-side data. Accompanied by a PFD annunciation ALT, IAS, ROL, PIT, HDG, LOC, GS, RA or FD	
<b>L IAPS FAIL R IAPS FAIL</b>	TO/LAND	The respective integrated processing system has failed	
<b>PFD X-TALK FAIL</b>	TO/LAND	Communication between the PFDs has failed. REFs menu pages 1, 2 and 3 are not synchronized. The EFIS comparator will be inoperative and is unable to compare one or more of the following parameters: altitude, airspeed, roll attitude, pitch attitude, heading, radio altitude, flight director, localizer or glideslope	
<b>CAS MISCOMPARE</b>		There has been a miscompare of Warning, Caution, Advisory, Status, or Aural for greater than 20 seconds. All current CAS messages will be displayed and aural sounds	
<b>DCU FAN FAIL</b>	TO/LAND	The avionics data concentrator unit fan has failed	
<b>DCU FAULT</b>	TO/LAND	Channel A or B in the data concentrator unit has failed, the yaw damper may fail. The rudder travel limiter monitoring may be inoperative.	
<b>IAPS FAN FAULT</b>	TO/LAND	The IAPS is indicating an over temperature condition or fan failure. Opening avionics rack doors and/or lowering cabin and cockpit temperatures may aid in cooling	
<b>MFD X-TALK FAIL</b>	TO/LAND	Communication between the MFDs has failed, and cross side tuning will not be available	
<b>RDC FAULT</b>	TO/LAND	Channel A or B of the remote data concentrator has failed with no loss of functionality	