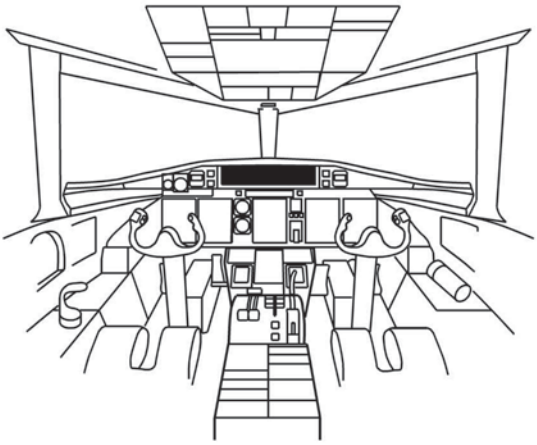
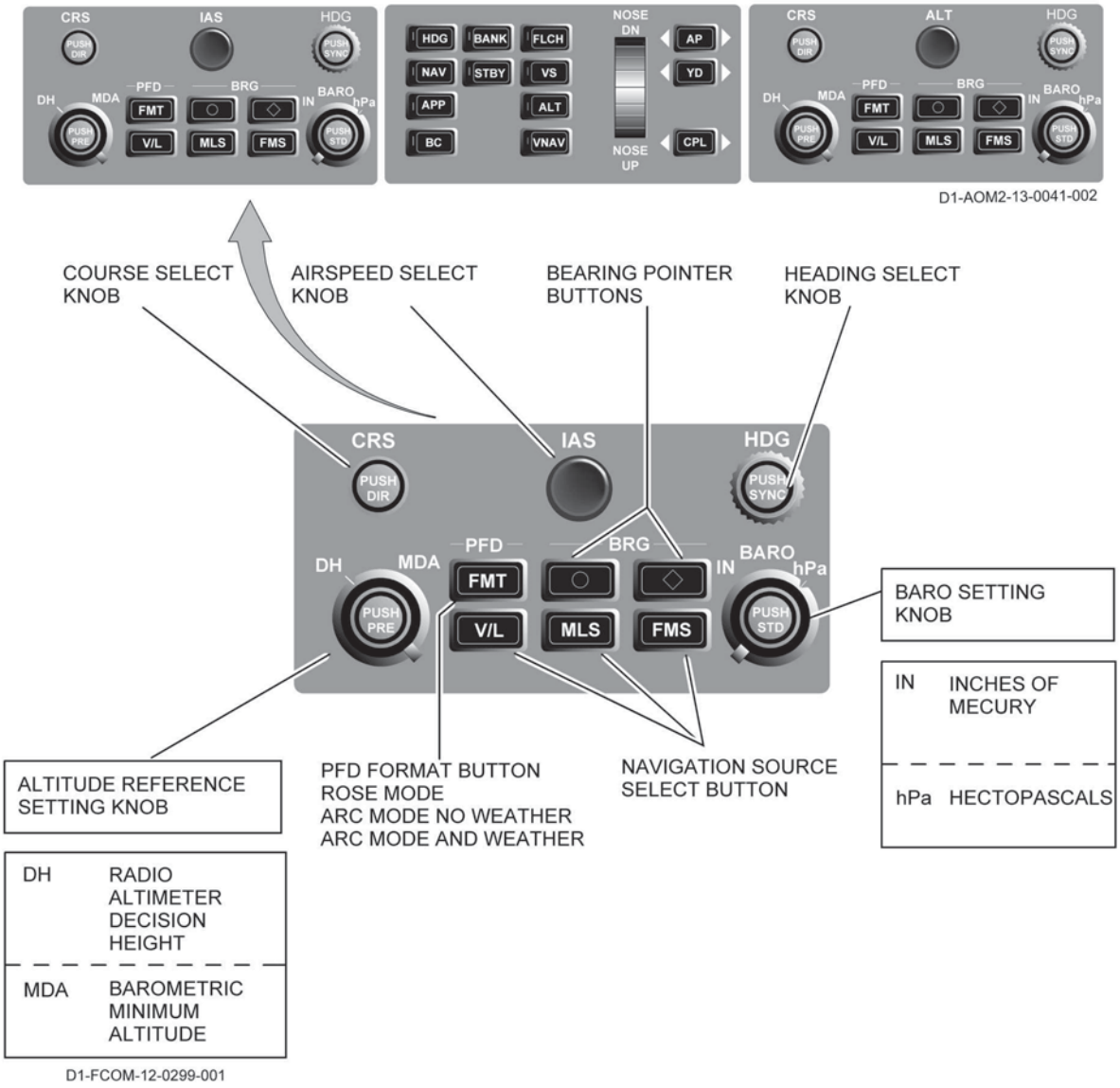
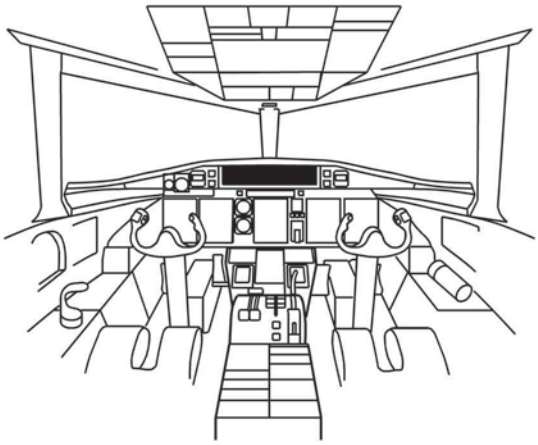




Display Control Panel 1 (DCP 1) – LH Side



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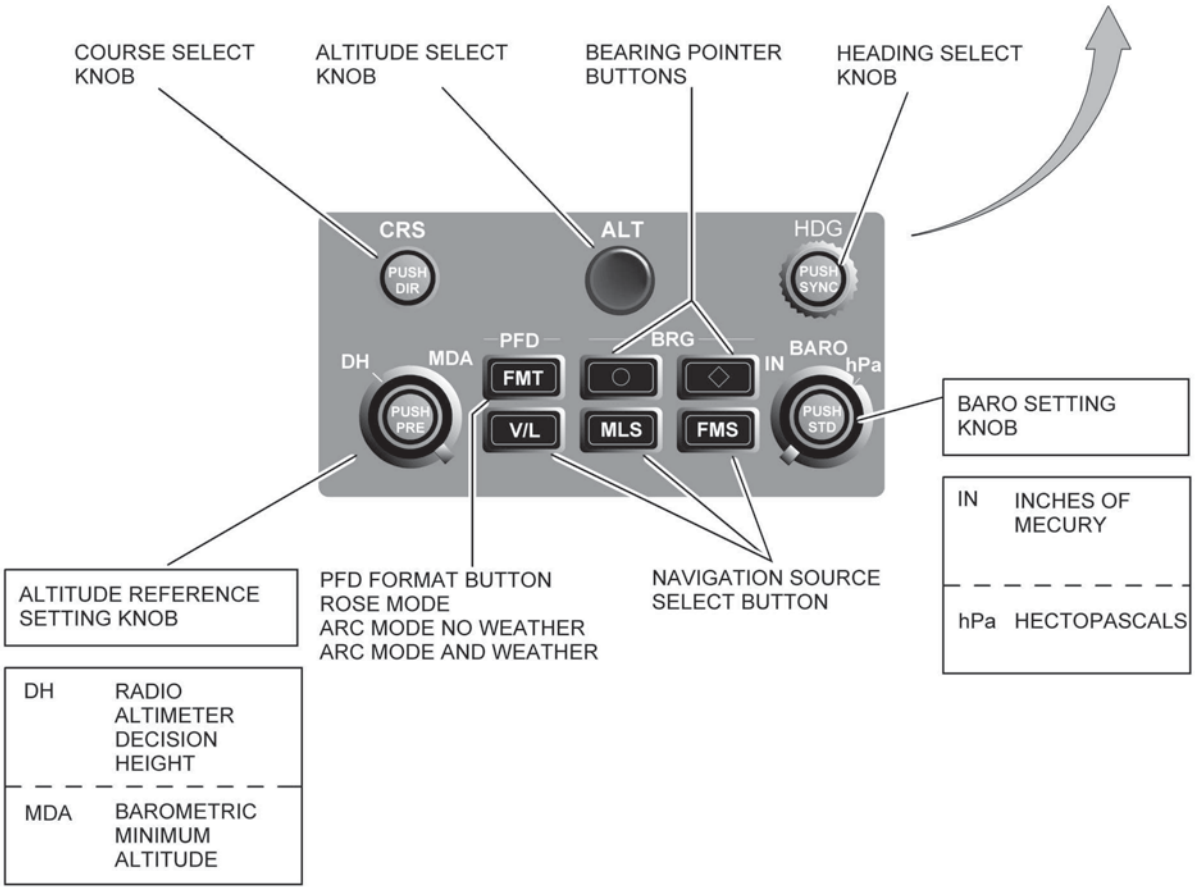
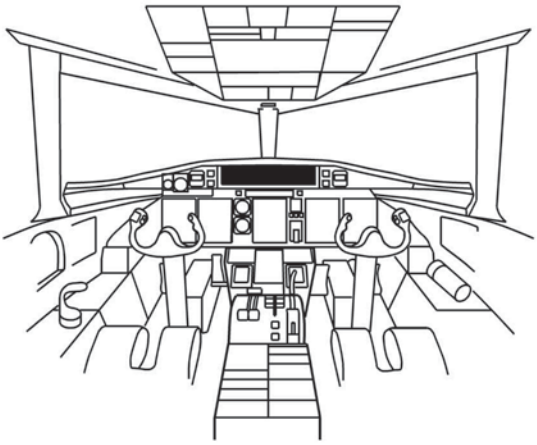
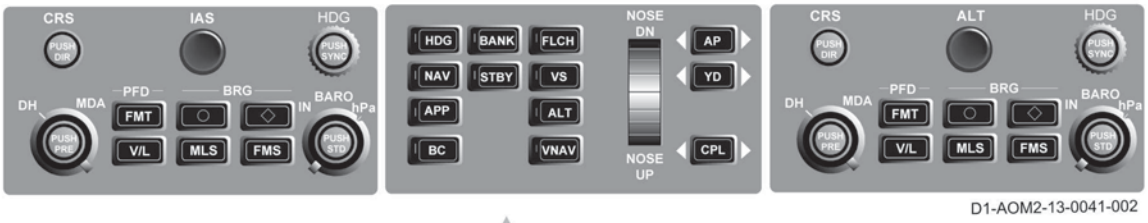


D1-FCOM-12-0298-001

Display Control Panel 2 (DCP 2) – RH Side





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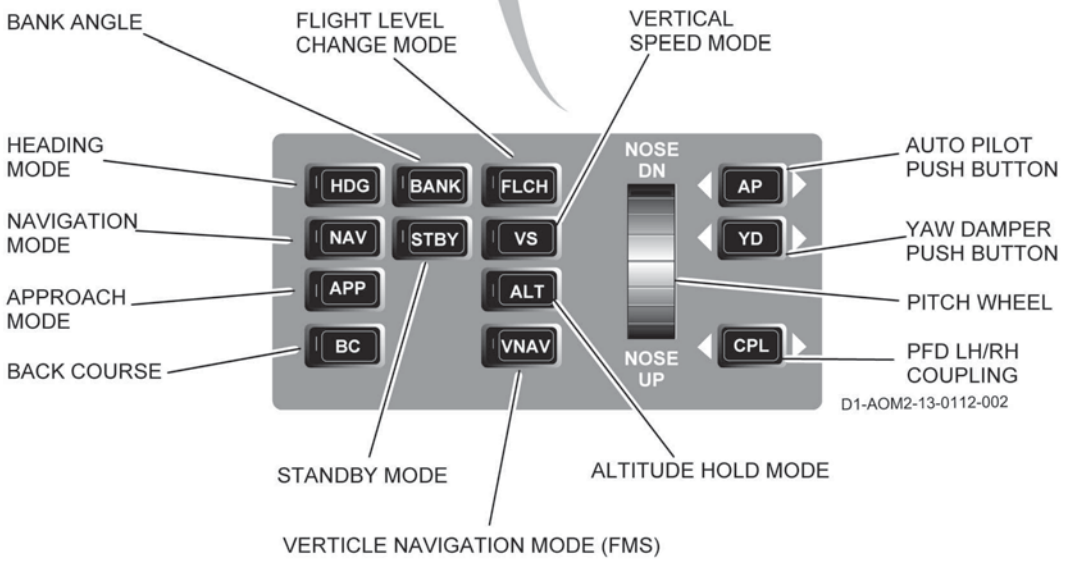

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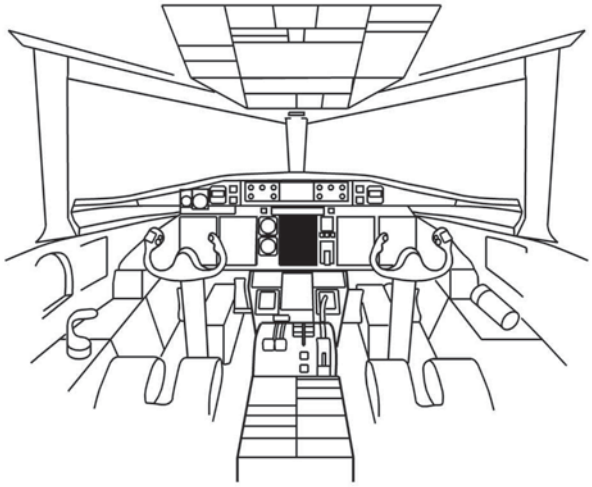
D1-FCOM-12-0300-001

Mode Selector Panel (MSP) – Center



D1-FCOM-12-0115-003

CAS FIELD MESSAGES

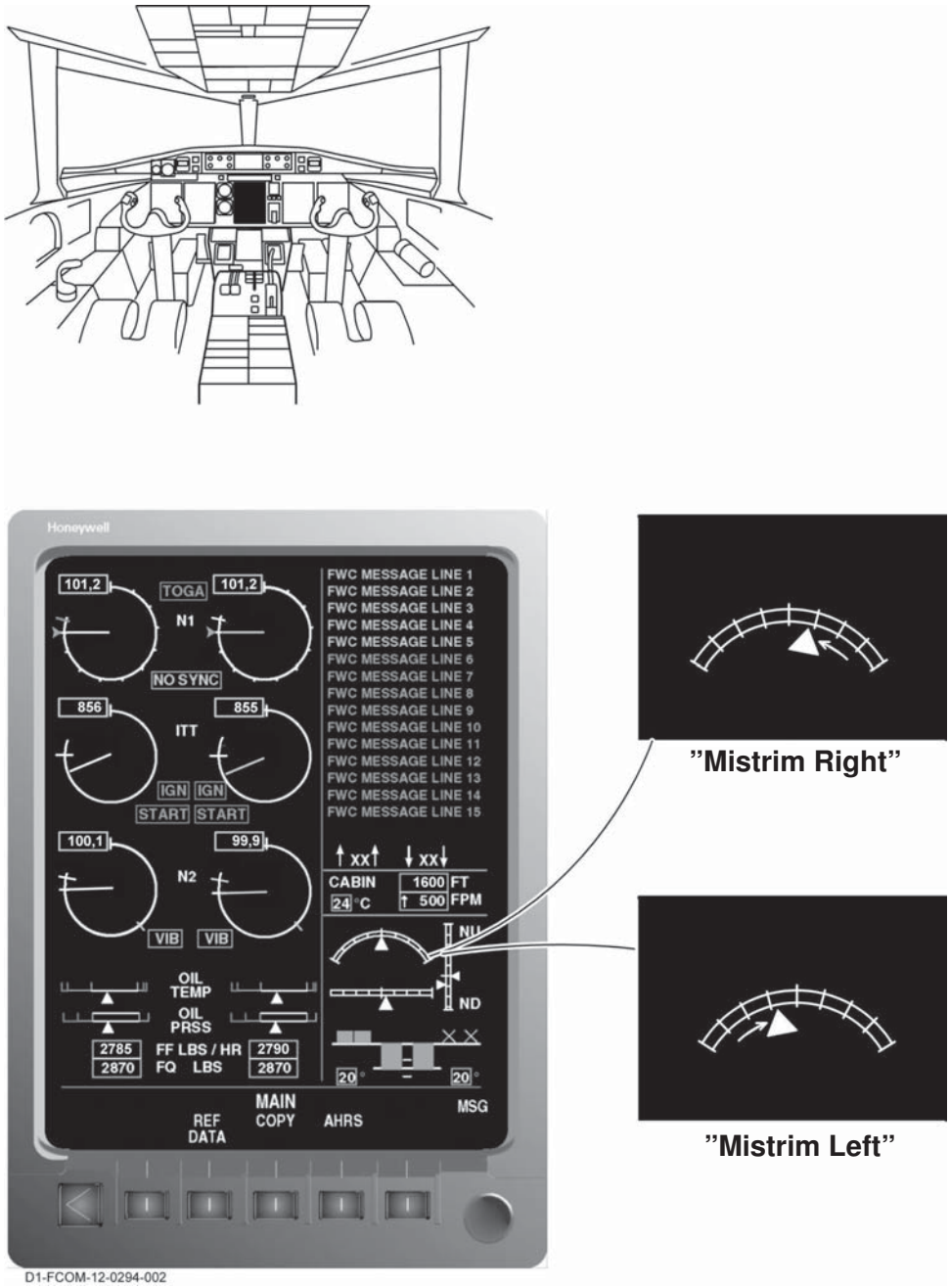
The following messages can be displayed:

– AIL MISTRIM	(amber)
– ELEV DISC LOAD HI	(amber)
– EL MISTRIM NOSE DN	(amber)
– EL MISTRIM NOSE UP	(amber)
– EL TRIM FAIL	(amber)
– FGC DATA FAIL	(amber)
– FGC FAIL	(amber)
– FGC HDG HLD OFF	(amber)
– FGC LAT MODE OFF	(amber)
– FGC VERT MODE OFF	(amber)
– YD OFF	(amber)
-- CAT2 INVALID	(amber)
– AP OFF-YD/FD AVAIL	(blue)
– AP/YD OFF-FD AVAIL	(blue)
– CPL DATA INVALID	(blue)
– FGC ATT/HDG DATA	(blue)
– FGC FLCH MISMANAGE	(blue)
– FGC MADC DATA	(blue)
– FGC NAV SOURCE	(blue)
– FGC OVSP PROTECT	(blue)
– FGC SERVO PWR OFF	(blue)
– FGC SYSTEM TEST	(blue)
– NAV MISCMP L SEL	(blue)
– NAV MISCMP R SEL	(blue)
-- CAT 2 ADC	(blue)
-- CAT2 ATT / HDG	(blue)
-- CAT 2 RAD ALT	(blue)
-- CAT 2 RADIOS	(blue)
-- CAT 2 SG REV	(blue)
-- CAT 2 NOT AVAIL	(blue)

On PFD 1 and 2:

– AP	(PFD 1 and 2) (red)

Indications/Messages on EICAS Display



Aileron Mistrim Indication

Aileron Trim

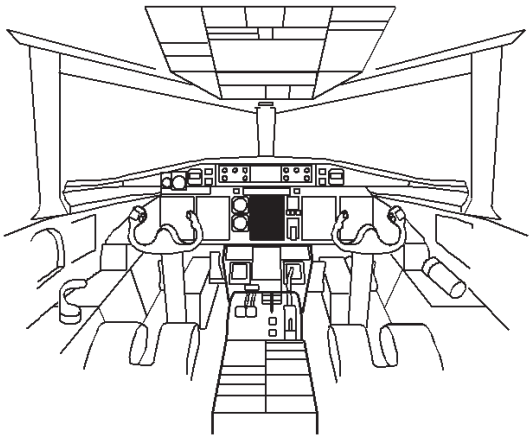
If the airplane is mistrimmed in roll with the autopilot engaged the amber caution AIL MISTRIM becomes active.

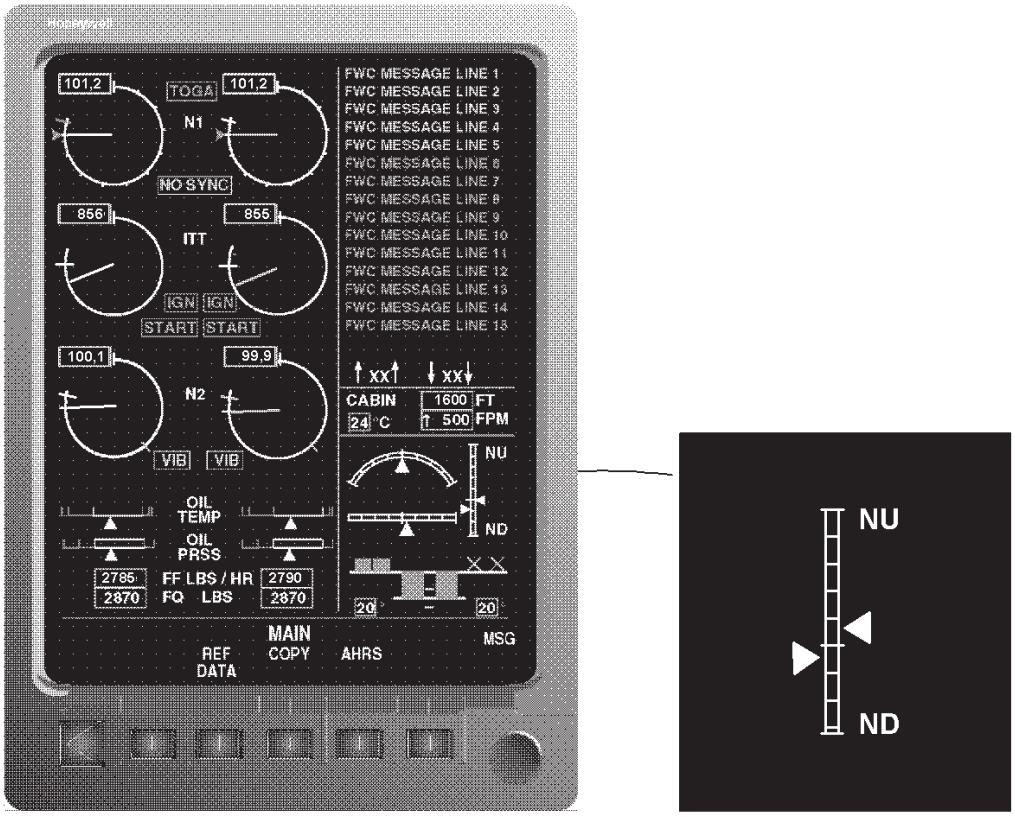
The AFCS Message "mistrim left" activates an green arrow, at the left side of the trim pointer.

The AFCS Massage "mistrim right" activates an green arrow at the right side of the trim pointer .

The mistrim arrow then moves with the mistrim pointer. The arrowhead points to the opposite side to show the pilot the correct trim direction.

If an invalid Aileron Trim signal arrives the scale pointer will not be displayed.



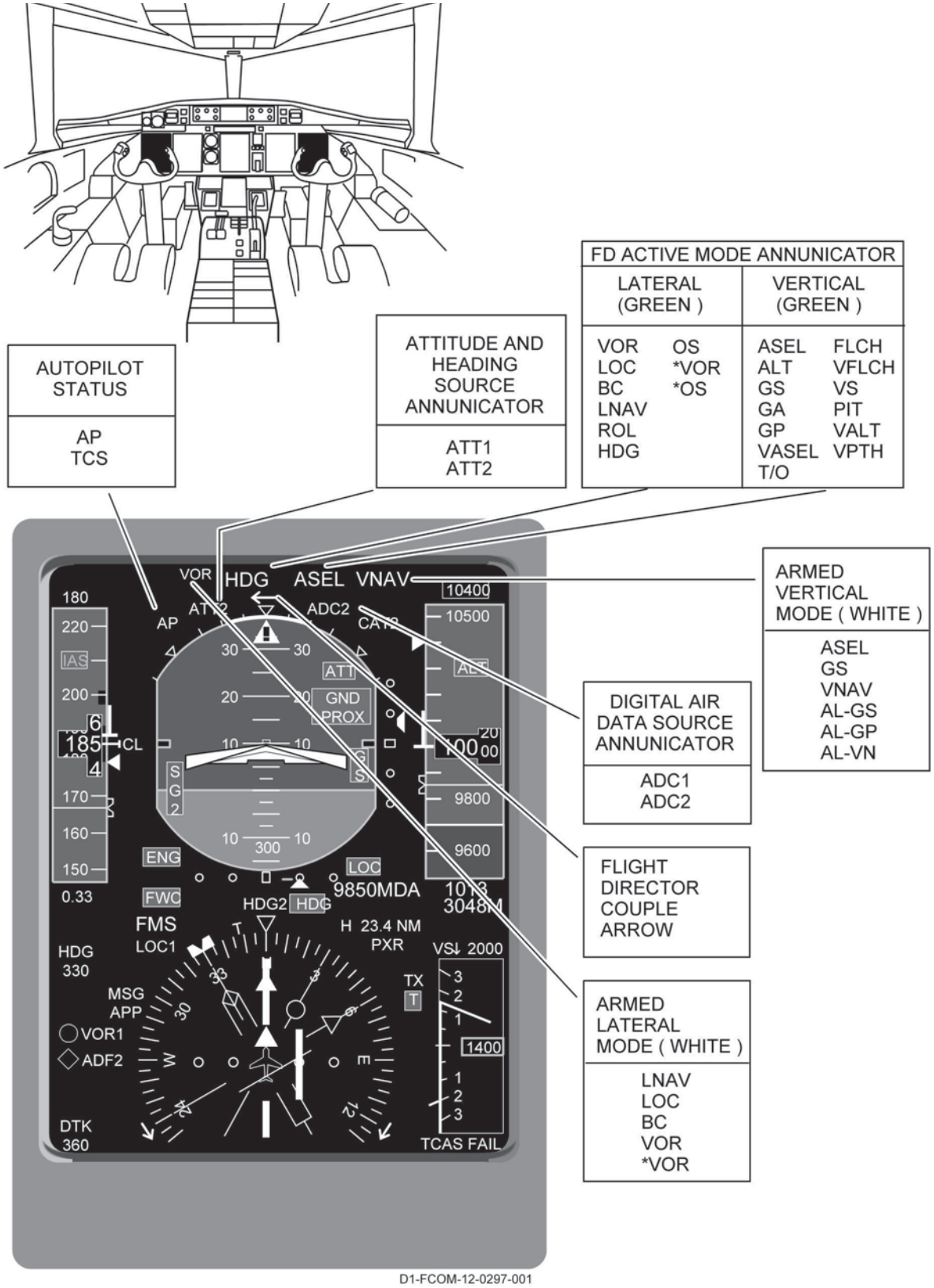


D1-FCOM-12-0295-001

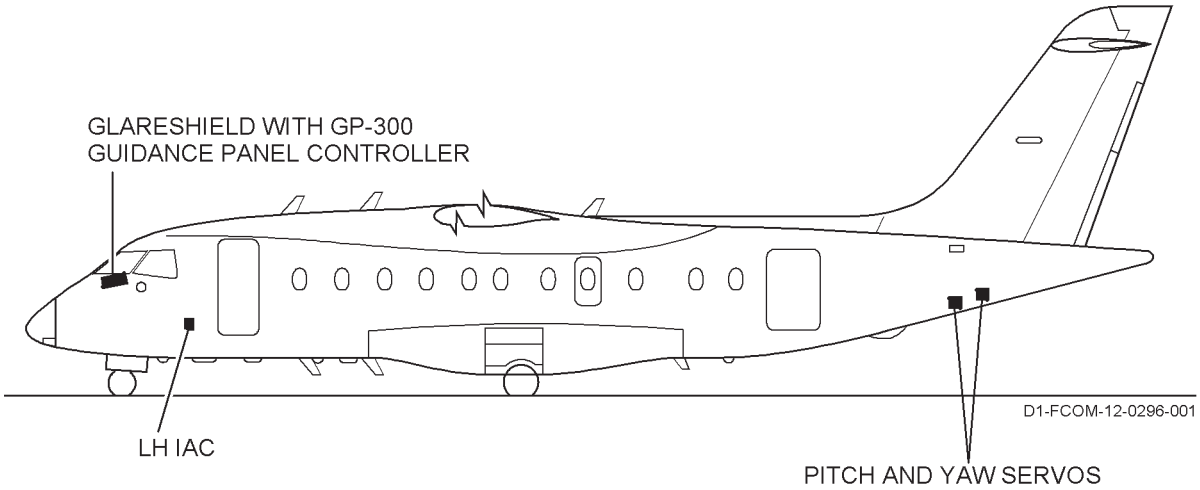
Elevator Trim Asymmetry Indication

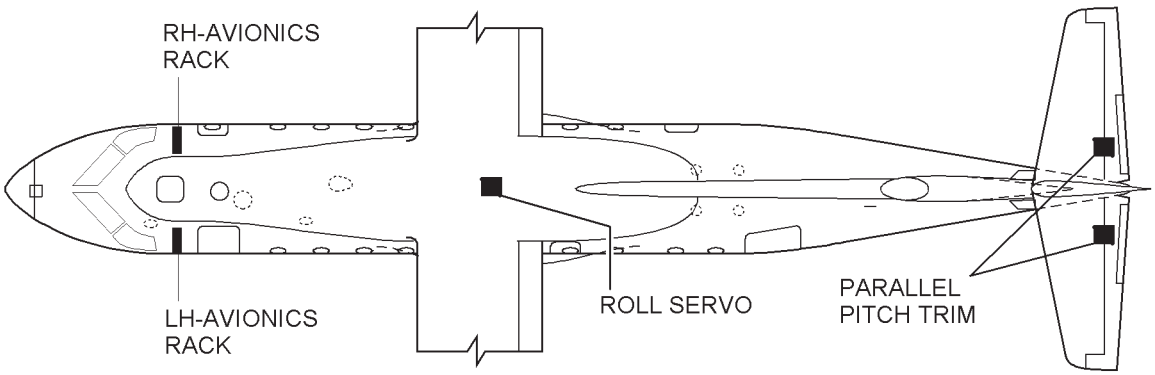
Elevator Trim

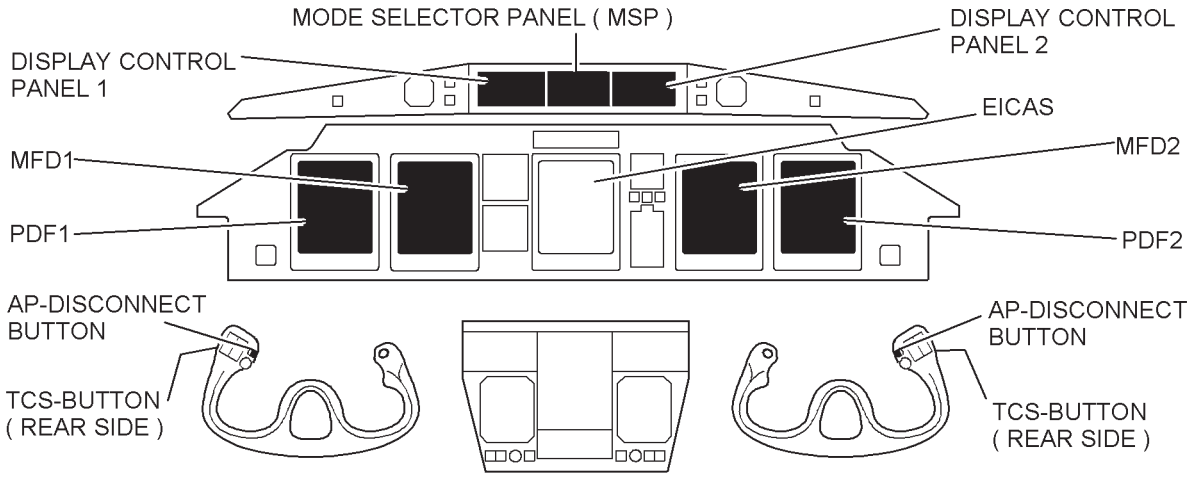
The right elevator trim pointer will only be displayed if the difference between the left and right elevator trim position, known as pitch trim asymmetry, is greater than or equal to two degrees. The left and right pointers will be amber filled whenever the right pointer is displayed. The right elevator trim pointer will be removed and the left elevator trim pointer will revert to its normal color when pitch trim asymmetry is less than or equal to 1.5 degrees. The amber fill for pitch trim asymmetry has priority over the ”takeoff trim green fill”.



EICAS – Auto Flight Indications







EICAS – Flight Guidance System (GP – 300)

MESSAGE (SYNOPTIC) Location (COLOR)	WARN TONE	CONDITION	INHIBIT 1	INHIBIT 2	INHIBIT 3
AIL MISTRIM CAS Field (AMBER)		Airplane is mistrimmed in roll with autopilot engaged.		X	
EICAS Display Ail Trim Arc (GREEN)		Green arrow shows direction of required aileron trim action.			
Flight Control System Page Ail Trim Arc (GREEN)		Green arrow shows direction of required aileron trim action.			
ELEV DISC LOAD HI CAS Field (AMBER)		Force detection rod activated due to auto trim commands with either left or right jammed elevator (in A/P mode).		X	X
EL MISTRIM NOSE DN CAS Field (AMBER)		Airplane is mistrimmed in pitch with autopilot engaged.		X	
EICAS Display 2 Pitch Trim Scale Triangle Marks (Amber)		An additional triangle pointer on the right side o f the pitch trim scale is shown in case of ”pitch trim asymmetry”.			
Flight Control System Page 2 Pitch Trim Scale Triangle Marks (Amber)		An additional triangle pointer on the right side o f the pitch trim scale is shown in case of ”pitch trim asymmetry”.			
EL MISTRIM NOSE UP CAS Field (AMBER)		Airplane is mistrimmed in pitch with autopilot engaged.		X	
EICAS Display 2 Pitch Trim Scale Triangle Marks (Amber)		An additional triangle pointer on the right side o f the pitch trim scale is shown in case of ”pitch trim asymmetry”.			
Flight Control System Page 2 Pitch Trim Scale Triangle Markis (Amber)		An additional triangle pointer on the right side o f the pitch trim scale is shown in case of ”pitch trim asymmetry”.			
EL TRIM FAIL CAS Field (AMBER)		Electrical trim is inoperative or pitch trim system does not support autopilots pitch actuator.		X	
FGC DATA FAIL CAS Field (AMBER)		Flight guidance computer has stopped transmitting ASCB data and is incapable of displaying modes or messages.		X	X
FGC FAIL CAS Field (AMBER)		Flight guidance computer has failed – autopilot disconnected	X	X	X

Message inhibit logic:

1. WOW, Engines off and Electrical Bus Failure refer to section 12–31–17–04
2. Takeoff phase
3. Landing phase

CAS Field and System Messages (Sheet 1 of 3)

MESSAGE (SYNOPTIC) Location (COLOR)	WARN TONE	CONDITION	INHIBIT 1	INHIBIT 2	INHIBIT 3
FGC HDG HLD OFF CAS Field (AMBER)		Flight guidance computer dropped from default HDG HOLD to default wings level mode due to loss of coupled heading data.		X	
FGC LAT MODE OFF CAS Field (AMBER)		Flight guidance computer dropped a lateral mode/basic roll mode (A/P active). A longitudinal NAV signal was interrupted.		X	
FGC VERT MODE OFF CAS Field (AMBER)		Flight guidance computer dropped a vertical mode/basic pitch mode.(A/P in PITCH mode). A lateral NAV signal was interrupted.		X	
YD OFF CAS Field (AMBER)		Yaw damper and autopilot have automatically disconnected.		X	
CAT2 INVALID CAS Field (AMBER)		CAT2 capability lost.			
AP OFF–YD/FD AVAIL CAS Field (BLUE)		Autopilot OFF, yaw damper and flight director are availlable.			
AP/YD OFF–FD AVAIL CAS Field (BLUE)		Autopilot and yaw damper OFF, Flight director is availlable.		X	
CPL DATA INVALID CAS Field (BLUE)		Flight guidance mode selected with invalid sensor.		X	X
FGC ATT/HDG DATA CAS Field (BLUE)		FGC is using single source AHRS data or cannot use AHRS data at all.		X	X
FGC FLCH MISMANAGE CAS Field (BLUE)		Flight guidance FLCH mode mismanage.		X	X
FGC MADC DATA CAS Field (BLUE)		FGC is using single source MADC data or cannot use MADC data at all.		X	X
FGC NAV SOURCE CAS Field (BLUE)		Appropriate NAV source not selected or mode dropped due to change of NAV source.		X	
FGC OVSP PROTECT CAS Field (BLUE)		Flight guidance overspeed protection active only if autopilot actuator is engaged).		X	

Message inhibit logic:

1. WOW, Engines off and Electrical Bus Failure refer to section 12–31–17–04
2. Takeoff phase
3. Landing phase

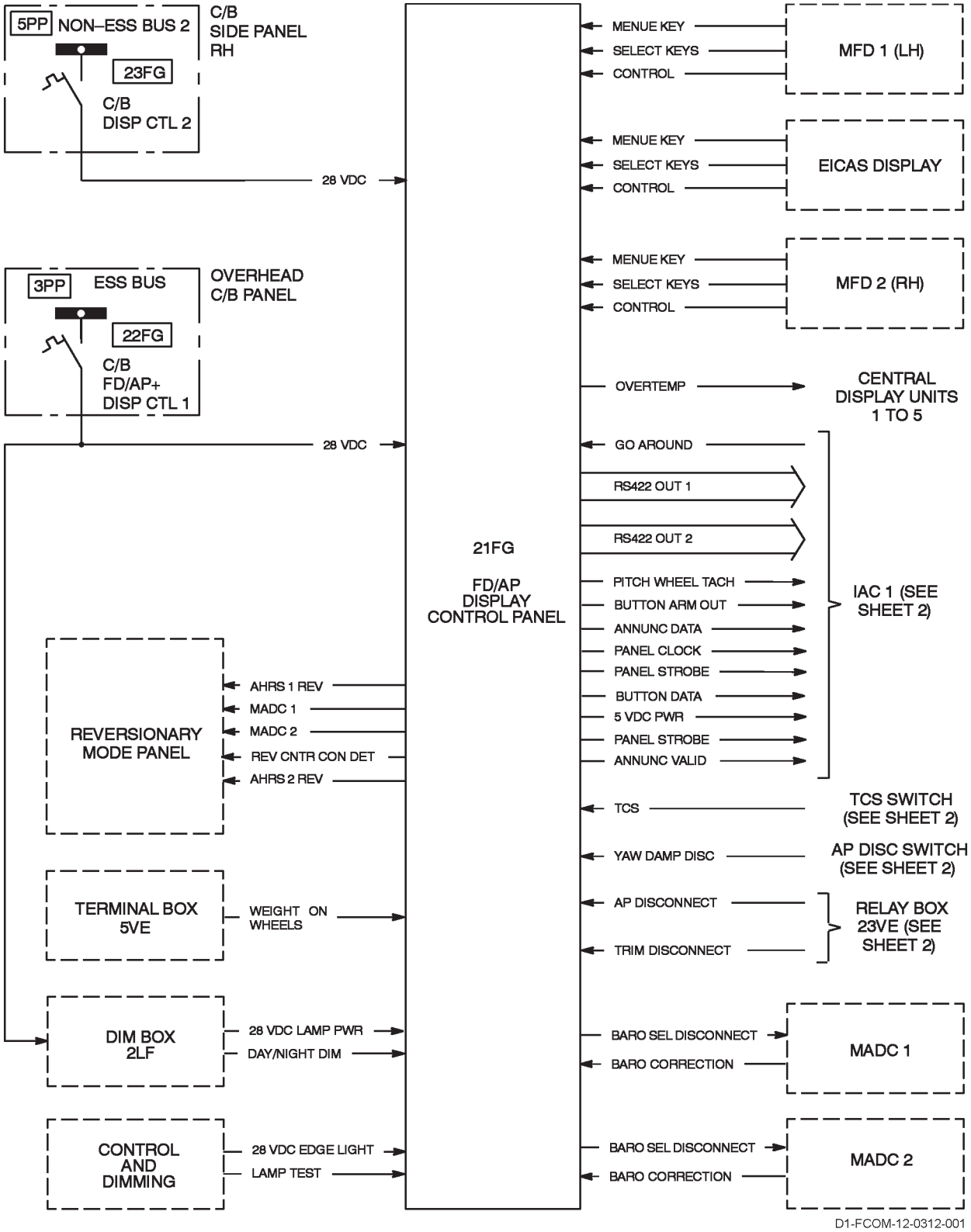
CAS Field and System Messages (Sheet 2 of 3)

MESSAGE (SYNOPTIC) Location (COLOR)	WARN TONE	CONDITION	INHIBIT 1	INHIBIT 2	INHIBIT 3
FGC SERVO PWR OFF CAS Field (BLUE)		No autopilot or yaw damper servo power. Check circuit breakers C5 and C6.		X	
FGC SYSTEM TEST CAS Field (BLUE)		Flight guidance computer in system test.		X	X
NAV MISCMP L or R SEL CAS Field (BLUE)		Flight guidance has selected the left or right sensor during dual sensor approach.		X	X
CAT2 RAD ALT CAS Field (BLUE)		Radio altimeter is failed.			
CAT2 RADIOS CAS Field (BLUE)		VOR/LOC receiver is inoperative.			
CAT2 SG REV CAS Field (BLUE)		Symbol generator reversion is selected.			
CAT2 ADC CAS Field (BLUE)		Air data computer is in reversion or failed.			
CAT2 ATT/HDG CAS Field (BLUE)		Attitude/heading is in reversion or failed.			
CAT2 NOT AVAIL CAS Field (BLUE)		CAT 2 operation not available.			
AP PFD 1 and 2 (RED)	CAVALARY CHARGE	AP automatic or manual disengaged.		X	X

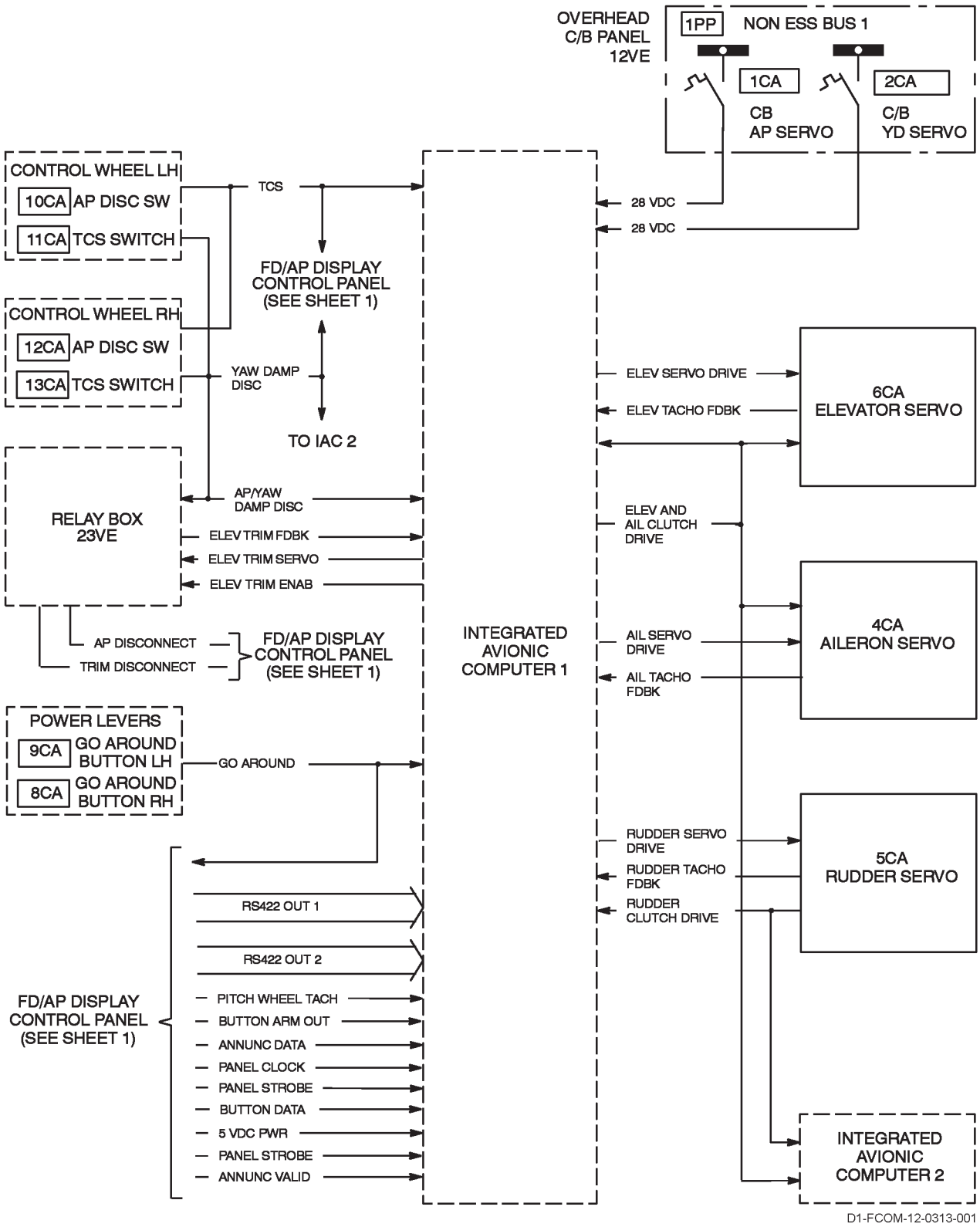
Message inhibit logic:

1. WOW, Engines off and Electrical Bus Failure refer to section 12–31–17–04
2. Takeoff phase
3. Landing phase

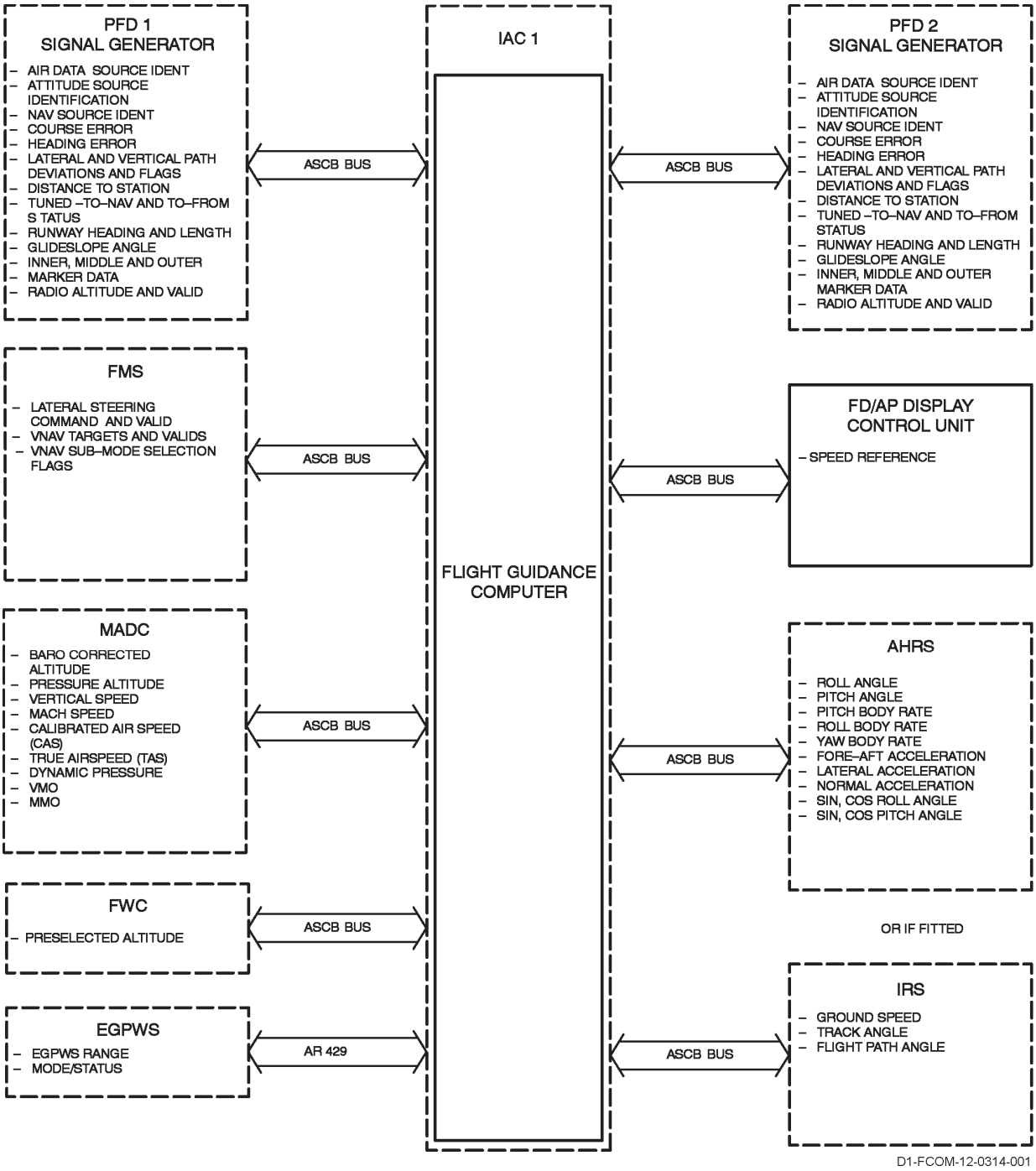
CAS Field and System Messages (Sheet 3 of 3)



AFCS – Signal Flow Diagram (Sheet 1 of 2)



AFCS – Signal Flow Diagram (Sheet 2 of 2)



Flight Guidance Computer – General Data Inputs

FLIGHT GUIDANCE SYSTEM (FGS)

The Flight Guidance System is part of the Primus 2000 integrated avionics system and provides autopilot (AP), flight director (FD) guidance, Yaw damper (YD) and auto–trim functions. The automatic path mode commands are generated by the flight guidance computer in the No. 1 IAC. This guidance computer integrates the attitude and heading reference system, air data information, and EDS electronic display and flight management information into a complete aircraft control system to provide the stabilization and control needed to ensure optimum performance throuhout the aircraft flight regime.
The electonic display system (EDS) provides the pilot with display of attitude, heading, air data, navigation, and engine and crew alerting information.
A central serial communication network provides intersubsystem communications. The network is denoted by the nomenclature avionics standard communications bus (ASCB). This bus structure uses advanced communications techniques and safety design features to provide redundant data exchange within the system.

Flight Guidance System Power–Up Test

The Flight guidance system initiates an automatic power–up test upon application of power. The test takes approximately 60 seconds to complete on the ground (20 seconds in flight).
If a failure is detected in the FGC, the caution message FGC FAIL is displayed. There are no warning (red) messages associated with the FGS.
A failure within the flight guidance computer which prevents operation of the flight director function will result in an FD FAIL annunciation on the PFD.

Flight Guidance System CAUTION/ADVISORY Message

The EICAS displays a variety of messages related to the flight guidance system. All advisory messages are in blue color and all caution messages are in amber color.

AUTOMATIC FLIGHT CONTROL SYSTEM (AFCS)

The PRIMUS 2000 Integrated Avionics System includes a single digital Automatic Flight Control System (AFCS) which consists of:

- Flight Guidance Computer(FGC), Part of the Integrated Avionics Computer (IAC) IC 800
- Mode Selector Panel (MSP), Part of the Guidance Panel Controler (GPC) GP 300
- Servos for Roll, Pitch and YAW (aileron, elevator and rudder)
- Automatic pitch trim system

The AFCS uses available data like speed, vertical speed, altitude, heading, different lateral and longitudinal navigation signals, slip / skid and turn rates, roll / pitch attitude, and aircraft position and processes it for the selected and engaged modes, providing steering signals to the flight director/autopilot (FD/AP) Signal processing is mechanised such that the aircraft can be controlled within the designed passenger comfort and aircraft operational limits of the AFCS, either manually, using flight director command display, or automatically by engaging the autopilot (servos). Dual microprocessor architecture and digital servo monitoring techniques ensure fail–passive operation over the entire aircraft flight envelope. Fail passive operation implies that no failure will result in the aircraft making a large deviation from its position at the time of the failure.
Existence of dual attitude / heading and air data sensors is used to full advantage within the system through sensor voting and management techniques.
The AFCS comprises three major subsystems the flight director, autopilot and yaw damper.

FLIGHT GUIDANCE COMPUTER (FGC)

The Flight Guidance Computer (FGC) is the primary central processing element in the AFCS. It provides flight guidance outputs for display on the primary flight display (PFD) depending on selected and availlable sources and selected modes.

The flight guidance commands are generated by the flight guidance computer (FGC), an integrated part of the IAC No. 1.
The FGC microprocessors are designated the FGC ”A” processor and the FGC ”B” processor. Each of these processors performs different control and computational functions. The ”A” processor performs the outer loop (FD) functions, while the ”B” processor performs the inner loop (autopilot and yaw damper functions). Exchange of status information is made between the two microprocessors.

Flight Director Command Display (FDCD)
The FGC provides pitch and roll commands for display on the Flight Director (FD) command bars. The FD commands can be indicated as single cue or as cross pointer.

Autopilot (AP)
The autopilot function of the AFCS provides pitch and roll attitude control via servo control of ailerons, elevator and aircraft trim system. Data to be used in autopilot computations are processed in a manner consistent with AP flight–safety requirements while also maximizing AP availability.
Autopilot status is displayed above and inside of the ADI sphere on the PDF. When the autopilot is normally or abnormally disengaged, the autopilot audio warning and a flashing red ”AP” is displayed at the upper area of both PFDs. Audio warning can be cancelled one second after the disengage by pushing the AP DISC button.
Whenever the AP is engaged the AP arrows on the MSP will appear.

Yaw Damper
The yaw damper provides Yaw damping and directional control for turn coordination. While the yaw damper can be engaged without the autopilot being engaged, the yaw damper is automatically selected on when the autopilot is selected on. The yaw damper does not have an auto yaw trim capability (like auto pitch trim), therefore the airplane yaw axis must be trimmed (to center the ”ball”) manually.

Servos
The AFCS system interfaces via the AP servos with the flight control system in pitch, roll and yaw axis. The servos are mechanical connected to the primary flight control system.
Inside the servo a mechanical coupled tachgenerator provides a rate feedback signal for monitoring the correct function.
The roll servo is attached to the aileron control system. The roll channel, depending on the selected mode, allows steering of headings, NAV–tracks, and TCS constant bank angles within the limits of the AFCS. The roll channel does not have an auto roll trim capability, however, if the aircraft becomes mistrimmed in the roll axis, an amber caution ”AIL MISTRIM” will be indicated on the CAS field. An aileron mis–trim is indicated by a green arrow inside the aileron trim display arc. The green arrow advises the crew in which direction the aileron trim should be positioned to eliminate the aileron mis–trim condition.
The pitch servo is attached to the elevator control system. The pitch channel, depending on the selected mode, allows the aircraft to climb, descend or maintain altitude within the aircraft control limits of the AFCS. The selected mode will also adjust pitch to compensate for turning flight (lift compensation) or changes in center of gravity. The pitch channel is equipped with an automatic pitch trim system.
The yaw servo is attached to the rudder control system and provides yaw damping and directional control for turn coordination.

Pitch Trim (Automatic Pitch Trim System)

The automatic pitch trim system uses basically the same components as the manual electric pitch trim system. When the AFCS autopilot is engaged, the manual trim switches are disconnected and switched over to the autopilot pitch channel. This AFCS–AP integrated auto pitch trim channel has no engage–disengage display. During this engagement the pitch trim action is a ”follow up” function of the pitch servo (pitch trim is a slave of the pitch servo). The pitch trim actuator is controlled by the pitch trim channel of the AFCS–AP. An electronic device senses the power (amount of voltage in relation to time) to the pitch servo. If this servo power is above a calibrated threshold, the auto pitch trim actuator will be moved in order to reduce the elevator load and will stop when the pitch servo load is zero. In case of an auto trim malfunction manual trim warning messages and/or additional AFCS–AP warnings may appear. The manual trim capability will return if one of the manual pitch trim buttons is activated (or when the AP is disconnected).

FLIGHT GUIDANCE CONTROLLER (GP–300)

The Flight Guidance Controller (GP–300) consists of two Display Control Panels (DCP 1 and DCP 2) and one Mode Selector Panel (MSP) in the center of the GP–300. The integrated MSP–panel provides a single place where flight guidance functions are selected. The autopilot and yaw damper (sevos) engaging is annunciated on the controller and on the PFD. The selection individual Flight Guidance modes is annunciated on the controller and on the PFD. The selection of the Automatic Flight Control System (AFCS) modes and the PFD source for the flight guidance system are also annunciated in both places. The selection of the yaw damper is not annunciated on the PFD.

Display Control Panels (DCPs)

CRS Knobs

When V/L (VOR/LOC mode) is the selected navigation source, the CRS knob allows the setting of the PFD (or MFD) course pointer. When the CRS knob is pushed (Push DIR), the course pointer is centered and points to the selected station if a VOR is the selected navigation source and a valid nav signal is established.

HDG Knobs

The blue heading bug on PFD and MFD is set by the HDG knob. It commands the flight guidance computer to follow the input of either pilots or copilots selected (via MSP CPL–button) command/NAV–side. While in the HDG–mode a lower bank limit of 17° can be selected with the BANK–button on the MSP. When the HDG knob is pushed (push sync) the heading bug is aligned with the present heading. DCP 1 and DCP 2 heading selection and display is not synchronized with pilots and copilots side.

IAS Knob

The blue airspeed bugs selected by the IAS knob are displayed on both PFDs. The IAS knob is located on the DCP1 on the left side of the GP–300. The selected airspeed value is displayed on top of each airspeed tape (LH/RH PFD). The value selected becomes the IAS speed target for use by the FLCH mode of the flight guidance system.

NOTE: 1. IAS power–up default values:
– on ground – amber dashes until knob is rotated
– in flight – previous value.
2. If the V_{MO} becomes less than the selected IAS value, the IAS bug is moved to match the lower V_{MO} value. If V_{MO} later increases, the bug will remain at the lower value.
3. TCS when pressed shifts the speed bug to the present IAS.

ALT Knob

The blue altitude bugs selected by the ALT knob are displayed on both PFDs. The ALT knob is located on the DCP2 on the right side of the GP–300. The selected altitude value is displayed on top of each altitude tape (LH/RH PFD) and an altitude bug is located at the proper position.

NOTE: 1. ALT select is normally in 100–foot increments over the entire range if MDA is not selected by either pilot. If MDA is selected by either pilot or copilot and valid, the bug moves in 10–ft increments up to MDA+1000 ft.

DH/MDA Knobs
Either a radio altimeter DH value or barometric altitude MDA value can be set by the DH/MDA knobs on both DCPs. Settable ranges are:

Value	Range
DH	10 – 2 500 feet
MDA	10 –16 000 feet

The outermost ring (DH/MDA Switch) selects either DH or MDA for setting and display. The respective height reference value is set turning the DH/MDA select knob accordingly. Selecting either position on the DH/MDA switch displays the last set value. Pushing the inner PUSH PRE button, positions the values as follows:

Value	Range
DH	200 feet
DH (CAT II)	100 feet
MDA	1 500 feet

Power–up default values for DH/MDA are:

– on ground amber dashes
– in flight last set value.

BARO IN/hPa Knobs
The Barometric pressure scale in inches of mercury (IN) or hectopascals (hPa) can be set by the BARO IN/hPa knobs on both DCPs. Each outermost ring controls the selection of display format (IN/hPA) and the knob sets the value. Power–up default values are the last entered values. The PUSH STD inner button sets the value to respectively:

– 29.92 inHG
– 1013 hPa (mb)

Metric Altitude Display
Setting the outmost ring to HPA on the BARO IN/hPa knob on one of the two DCPs, the blue altimeter readout in the baro set window , located below the altitude tape, shows the hPa value. Directly below the baro set window, of the respective PDF altitude band, an additional full time digital display of altitude in meters will appear in white colour.

NOTE: Setting the outmost ring back to IN, the readout in meter on the PFD is deleted and the baro set window shows the value in inHG.

FMT Button
The PDF HSI format (in sequence) can be toggled as follows:

– Compass rose (power–up default) display
– Compass arc and no weather display
– Compass arc and weather display.

◆ / ○ Bearing Pointer Selectors

The respective bearing pointer, on the PFDs HSI and on the MFD (when applicable) can be toggled as shown below:

◆	○
VOR 1 (power–up display)	VOR 2 (power–up display)
ADF 1	ADF 1 (ADF 2 INSTALLED)
FMS	FMS
OFF	OFF
repeat	repeat

Navigation Source Select Buttons

The selection of the respective navigation source for navigation display on the PFDs HSI and the compass rose display on the MFD can be selected by the Navigation Source Select Buttons.

- **V/L Button**
  Selects on side VOR/LOC navigation or off side VOR/LOC navigation source. When in FMS mode, allows selection of the preview mode.
- **FMS Button**
  If the FMS has an active flight plan, the FMS navigation and display on MFD can be selected by the FMS button.
- **MLS Button**
  The optional Microwave Landing System can be selected by the MLS button.

MODE SELECTOR PANEL (MSP)

The Mode Selector Panel (MSP) is located in the middle of the Flight Guidance Controler (GP–300), between the left and right Display Control Panels (DCP1 and DCP2).
On the MSP the following modes can be selected:

HDG (Heading)
Commands the flight guidance computer to follow the inputs of the heading bug on the PFD. While in the heading mode a lower bank limit can be selected with the BANK button on the controller.

BANK (Reduced Bank Angle)
Commands the guidance computer to use reduced bank angle (17 °) when in HDG mode.

NAV (Navigation)
Allows the flight guidance computer to arm, capture and track the selected navigation signal sources (VOR, LOC, FMS, LNAV or optional MLS).

APP (Approach)
Allows the AFCS – computer to arm and capture the lateral and vertical deviation signals for ILS (LOC and GS) and VOR (lateral only).

BC (Back Course)
Commands the flight guidance computer to track the localizer back course.

FLCH (Flight Level Change)
Commands the system to climb or descend to an altitude, displayed on the PFD 1 and 2, and set on the DCP 2 Alt knob, with an airspeed, selected by the DCP 1 IAS knob, and displayed by the blue airspeed bug at the indicated airspeed tape. The airspeed bug can also be set to the preset IAS by pushing the TCS button.

VS (Vertical Speed)
Selects the system to maintain the present vertical speed and allows a new vertical speed to be selected (with either the AFCS pitch wheel or by using the TCS button) and maintained. The vertical speed target is displayed on the both PFDs VS indicator (blue pointer). Deselection of VS–mode will revert the AFCS to PIT–mode (basic mode).

Pitch Wheel (Nose up / Nose down)
The pitch wheel commands the AFCS computer to use a rate limited pitch attitude.
The pitch wheel is also used to set vertical speed in the vertical speed modes.
PIT–mode is the AFCS default mode. The PIT–mode can be selected from any vertical mode by deselecting the repective engaged mode and by pushing the lit vertical mode button. When PIT is active the pitch can be modulated directly by moving the pitch wheel. Movement of the wheel cancels ALT HOLD or ALT SEL CAP; however, when captured on the ILS glideslope or MLS glidepath, or in VNAV (VFLCH or VPTH), movement of the pitch wheel has no effect.

ALT (Altitude)
Commands the system to hold the current altitude. ”On” illuminates when the preselected altitude or level is captured.

VNAV (Vertical Navigation)
Commands the system to follow the vertical path or airspeed guidance from the FMS when selected.

AP (Autopilot)
Simultaneously engages the AFCS–autopilot and yaw damper; a second push however, disengages the AFCS–autopilot (roll and pitch servos) only. The yaw damper remains engaged.

YD (Yaw Damper)
Engages the yaw damper only, or disengages the yaw damper and autopilot if engaged before. The single channel, fail passive AFCS–autopilot and/or YD is engaged by the YD or AP button. When AP and/or YD are engaged, the arrows on both sides of AP and/or YD buttons will be illuminated.
Failure of the flight guidance computer will result in the autopilot and yaw damper disengaging.

CPL (PFD Select)
The CPL button alternately selects either the pilot’s or copilot’s PFD, as a source for for lateral and vertical guidance. The digital automatic flight control system (AFCS) power–up logic selects the data displayed on the pilot’s PFD. When the system is transferred to the cross–side PFD, all flight director modes are cancelled and the AFCS is in basic ROL/PIT mode.
Operating modes must be reselected. The pointer on the right or left side of the CPL button will be illuminated to indicate the side being selected. A green FD couple select arrow is displayed on both PFDs.

NOTE: Annunciation of the arm or capture status of the AFCS modes is only annunciated on the PFD.
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STBY (Standby)
Allows all selected AFCS–modes to be cancelled and both PFDs flight director command displays to be extinguished. If the AFCS–autopilot is engaged, it will remain engaged in basic pitch and roll hold modes.

EXTERNAL SWITCHES

TCS Control Button (Touch Control Steering)

A touch control steering button located at the rear of each control wheel (pilots wheel left side, copilots wheel right side) ”synchronizes” the AFCS system to the aircraft attitude in roll and pitch modes to control the values, aligned at the moment of button release within the AFCS limits. In VS–mode, the blue VS–command needle will be additionally synchronised to the present climb/descend rate. As long as the TCS–button is pushed, all AFCS–autopilot servos are disconnected and the airplane can be steered manually. Regardless which AFCS mode is engaged, the blue speed bug will be set to the present air speed when pushing the TCS–button. Disengage the autopilot when it becomes necessary to make manual steering inputs.

G/A Button (Go around mode)

A go around button located at the outer rear side of each thrust lever knob will disconnect both AFCS autopilot servos and switch off all engaged AFCS modes, but engages a roll and pitch go around (G/A) mode with a preadjusted 8° pitch attitude, displayed by the F/D–display.

AP Disconnect Button (Control Wheel)

An autopilot disconnect button located at the front of each control wheel (pilots wheel left side, copilots wheel right side) disconnects both AFCS autopilot servos and yaw damper only, but all other engaged AFCS modes, including the flightdirector command display, remain engaged. When the autopilot is normally or abnormally disengaged a flashing red AP is displayed at the upper area of both PFDs (inside and above of the ADI–sphere) in combination with the autopilot audio warning. After a short delay, when pushing the AP–DISC button again the autopilot audio warning will be silenced and the red ”AP” message in both PFDs will be extinguished.

Autopilot Disengage

The autopilot may also be disengaged by the following:

- Pushing the AP or YD button on the flight guidance controller
- Pushing the G/A button located on the thrust levers
- Activating the normal or STBY elevator trim switches

NOTE:
1. The autopilot and yaw damper is automatically disengaged when either stall warning computer (within DAU) detects a stick shaker condition.
2. The autopilot and yaw damper cannot be engaged on the ground.
3. When the autopilot is normally or abnormaly disengaged, a flashing red AP is displayed at the upper area of both PFDs. It can be removed one second after the disengage by pushing the AP DISC button again.

MODES OF OPERATION

Heading Hold Mode

The basic lateral mode of the AFCS is heading hold. The heading hold mode is defined as:

- Autopilot engaged
- No lateral AFCS mode selected
- Bank angle less than 6º.

If the above conditions are satisfied, the autopilot will roll the airplane to a wings level attitude. When the airplane's bank angle is less than 6º for at least 10 seconds, the heading hold mode is automatically engaged. ROL is displayed in the lateral AFCS annunciation area of the PFD and the MSP STBY button is illuminated.

Roll Hold Mode

The AFCS recognizes the roll hold mode as being operational when:

- No lateral AFCS mode is selected
- The airplane's bank angle is greater than 6º, but less than 35º in the moment of AP engagement
  or
  Touch Control Steering (TCS) was used to initiate the roll maneuver with the autopilot engaged and the previous mode was the heading mode.

When the above conditions are satisfied, the AFCS–AP will maintain the desired bank angle. If TCS is released at bank angles greater than 35º or when the AP is engaged without any lateral AFCS mode selected, the autopilot will roll the airplane to 35º of bank angle and maintain the bank. When the TCS button is used, the AP engage annunciation on the flight guidance controller will extinguish, and TCS annunciation replaces AP on the PFD.

Except for the use of TCS, roll hold is annunciated by the illuminated STBY button on the MSP, and ROL is displayed above the attitude sphere of the PFDs.

Heading Select Mode

The heading select mode is used to intercept and maintain a magnetic heading. The mode is engaged by pushing the HDG button on the MSP. HDG will be annunciated on the PFD. Engaging the heading select mode will reset all previously selected lateral modes.

The heading bug on the HSI is positioned around the compass card at the heading the pilot desires to intercept, using the heading knob of the coupled side (DCP1 or DCP2). The heading select error signal sent to the flight guidance computer is the difference between the actual airplane heading and the selected airplane heading. The flight guidance computer will now generate the proper roll command to intercept and maintain the pilot–selected heading.

The BANK button on the MSP is used to reduce the maximum bank angle from 27º to 17º in the HDG select mode. The heading select mode is cancelled by:

- Pushing the HDG button on MSP
- Selecting go–around or takeoff reference data (on ground only)
- Automatic capture of any other lateral steering mode
- Change in SG (reversion) driving coupled PFD
- Coupling to the cross–side PFD with the flight guidance controller CPL button
- Selecting STBY on the MSP.

VOR (NAV) Mode ARM

The VOR mode provides for automatic intercept, capture and tracking of a selected VOR radial, utilizing the VOR navigation source displayed on the coupled side PFD. Prior to engaging the mode, the pilot would perform the following:

- Tune the NAV receiver to the desired VOR frequency
- Push the V/L button on the flight guidance controller to select VOR as the navigation source
- Set the course pointer on the PFD for the desired course (radial) toward or away from the station
- Set the heading bug on the PFD for the desired intercept for the selected course.

With the airplane outside of the normal capture range of the VOR signal (typically the deviation bar on the PFD is greater than two dots), the pilot selects the NAV button on the guidance panel. At this time, the PFD annunciates HDG in green and VOR in white. The flight guidance computer is now armed to capture the VOR signal and is generating a roll command to fly the heading select mode as previously discussed to intercept the selected VOR radial.

VOR (NAV) Mode CAPTURE/TRACK

Upon VOR radial capture the system automatically drops the heading select mode and switches to the VOR capture phase.
The following is observed on the PFD:

- the white VOR message extinguishes
- the green active lateral guidance (HDG) is replaced by green VOR annunciation flashing for 5 seconds, then remaining steady

The system is now in the capture phase of operation. The AFCS computer generates the proper roll command to intercept and track the selected VOR radial.

When the course select pointer was set on the coupled side PFD using the course knob on the DCP1 or DCP2, the course select error signal was established. This signal represents the difference between the actual aircraft heading and the desired aircraft course. The course error signal is then sent from the NAV source to the AFCS computer.

The radio deviation signal is routed from the navigation receiver to the flight guidance computer, where the signal is lateral gain programmed. The lateral gain programming is performed as a function of DME distance to the station and barometric altitude. This gain programming adjusts for the airplane either coming toward or moving away from the VOR station. The DME compensation approximates ground range to the station for more accurate gain programming and helps to calculate over station sensing (OSS).
When flying a VOR intercept, the optimum intercept angle should be less than 45º.

As the airplane approaches the VOR station, it will enter a zone of unstable radio signal. This zone of confusion radiates upward from the station in the shape of a truncated cone. In this area, the radio signal becomes highly erratic and it is desirable to remove it from the roll command. The over station sensor monitors for entry into the zone of confusion and removes radio deviation from the roll command.

When over the VOR station, the system will accept and follow a course change of up to 90º.

The VOR mode is cancelled by:
- Changing VOR frequency
- Pushing the NAV button on the MSP
- Selecting the heading select mode, APP mode
- Changing navigation sources on the DCP1 or DCP2 for the coupled PFD
- Selecting go–around or takeoff reference data (on ground only)
- Selecting standby (STBY) on the MSP
- Coupling to the cross–side PFD on the MSP CPL button
- Change in SG (reversion) driving the coupled PFD.

VOR Approach (VOR APP) Mode
The VOR approach mode provides for intercept, capture and tracking of a selected VOR radial when using the VOR as an approach reference for landing.

The VOR approach mode is set up and flown exactly like the VOR mode:

- Tune the NAV receiver to the desired VOR frequency
- Push the V/L button on the flight guidance controller to select VOR as the navigation source
- Select the APP button on the MSP
- Arm and capture annunciations on the PFD will be ”VOR” in white and green respectively
- MDA altitude bug is set on the PFD altitude tape when MDA is selected on display controller
- Selected gains in the flight guidance computer are changed to optimize system performance in the VOR APP mode.

FMS – LNAV

Should the pilot select the FMS on the display controller for the coupled PFD, the NAV mode is flown as previously described under VOR mode, with the following differences:

- Instead of using course error and radio deviation, a composite lateral steering command is utilized from the FMS.
- When the NAV button on the MSP is pushed and FMS is selected on DCP1 or DCP2 as the navigation source, LNAV will annunciate on the PFD. Depending on the circumstances, the FGC may first arm, then capture LNAV. Capture is annunciated with LNAV in green. Once captured, the FGC/AFCS will track the active FMS stored flight plan. The LNAV mode is cancelled by:

- Pushing the NAV button on the MSP
- Selecting go–around or take off reference data (on ground only)
- Selecting another navigation source on the DCP1 or DCP 2 for the coupled PFD
- Selecting the heading select mode on the MSP
- Selecting standby (STBY) on the MSP
- Coupling to the cross–side PFD with the CPL button on the MSP
- Changing the SG (reversion) which is driving the coupled PFD.

Localizer Approach Mode (APP)

The localizer approach mode (APP) provides for automatic intercept, capture, and tracking of the front course localizer beam to line up on the centerline of the runway in use. Prior to mode engagement, the pilot would perform the following:

- Tune the navigation receiver to the published front course localizer frequency for the RWY in use
- Push the V/L button on the DCP1 or DCP2 to select ILS as the navigation source
- Set the course pointer on the PFD for the inbound runway heading
- Set the heading bug on the PFD to the desired heading for a localizer intercept
- Select MDA on the DCP1 or DCP2 DH/MDA knob (outer ring) and dial the minimum descent altitude bug on the PFD altimeter and on the DH/MDA display with the DH/MDA knob.

The PFD lateral deviation bar now displays the relative position of the airplane to the center of the localizer beam and the desired inbound course. With the heading bug set for course intercept, the heading select mode is used to perform the intercept. Outside the capture range of the localizer signal, pushing the APP button on the MSP will cause the PFD to annunciate:

- HDG in green
- LOC in white.

The airplane is now flying the selected heading intercept and the AFCS is armed for automatic localizer beam capture.

With the airplane approaching the selected intercept course, the Lateral Beam Sensor (LBS) is monitoring localizer beam deviation, beam rate, and TAS. At the computed time, the LBS will trip and capture the localizer signal. The flight guidance computer now drops the heading select mode and generates the proper roll command to bank the airplane toward localizer beam center. When the LBS trips, the following is observed on the PFD:

– The green HDG annunciation extinguishes
– The white LOC message extinguishes
– The green LOC message is annunciated.

The flight guidance computer now generates the proper roll command to bank the airplane to capture and track the selected localizer signal.

NOTE: When flying a localizer intercept, the optimum intercept angle is 45º.

The distance to localizer calculation of the FGC computer is based on the distance–to–station (DME) information if the DME is valid and co–located with the localizer transmitter. If the DME information is not available, the distance to localizer will be estimated based on radio altitude, true airspeed, glideslope deviation (if valid), and an assumed flight path angle of 3°. If, in addition to an invalid DME, the radio altitude is invalid, the altitude will be estimated to be 1 500 feet above runway until start of descent is detected by the Flight Guidance Computer.

The localizer mode is cancelled by:

– Pushing the NAV button on the MSP
– Selecting go–around or takeoff reference data (on ground only)
– Selecting the heading select mode on the MSP
– Selecting the back course lateral steering mode on the MSP
– Coupling the cross–side PFD with the MSP CPL button
– Selecting standby (STBY) on the MSP
– Changing navigation sources on the DCP1 or DCP 2 or changing localizer frequency
– Changing the SG (reversion) which is driving the coupled PFD.

Back Course Mode (BC)

The back course mode provides for automatic intercept, capture, and tracking of the back course localizer signal. When flying a back course localizer approach, glideslope capture is automatically inhibited.

The back course mode is set up and flown exactly like a front course localizer approach, with the following differences:

- On the MSP, the BC button is pushed
- With the airplane outside the normal localizer capture limits, the PFD will annunciate BC in white and HDG in green
- At back course capture, the PFD will annunciate BC in green.

When the back course mode was selected on the MSP, logic in the flight guidance computer was established to internally reverse the polarity of the course error and localizer signals.

At back course capture, the flight guidance computer will generate a roll command to smoothly capture and track the back course localizer signal.

The back course mode is cancelled by:

- Pushing STBY
- HDG, NAV, APP or BC button on the MSP
- Selecting the go–around modes or takeoff reference data (on ground only)
- Coupling to the cross–side PFD on the MSP CPL button
- Changing the SG (reversion) which is driving the coupled PFD
- Changing navigation sources on the DCP 1 or DCP 2.

Instrument Landing System Approach Mode (ILS)
The approach mode (APP) provides for automatic intercept, capture and tracking of the front course localizer and glideslope signals of the flight guidance system. This allows the FGS to fly a fully coupled ILS approach. The mode is interlocked, so that glideslope capture is inhibited, until localizer capture has occurred.

The approach mode is set up and flown as follows:

- The navigation receiver is tuned to the published ILS frequency for the active runway
- Push the V/L button on the flight guidance controller to select ILS as the navigation source
- Select on the DCP1 or DCP2 DH/MDA knob outer ring DH or MDA. Set the decision height or the minimum descent altitude value for the relevant PFD with the DH/MDA–inner–knob
- The course pointer and heading bug are set on the active PFD for localizer intercept
- The APP mode is selected on the MSP.

With the localizer captured, and outside the normal glideslope capture limits, the PFD will indicate the following mode messages at this time:

- LOC in green
- GS in white
- any other vertical mode (ALT, VS, PIT) in green if selected by the pilot.

Dual Approach Track Mode
The dual approach track mode provides a more accurate instrument approach because it monitors and averages both navigation sources.

When AFCS is in the dual approach track mode the couple arrow above the PFD will point in both directions and both sides of the CPL button on the MSP will be illuminated.

The dual approach track mode is automatically activated when the conditions below are given:

- Both RMU navigation receivers tuned to the same frequency and are receiving valid signals
- Both PFD’s operating from different symbol generators
- Both PFD’s displaying their dedicated approach NAV source (LH LOC, GS1, RH LOC, GS2).

ILS Approach Glideslope Intercept (G/S)
At glideslope capture, the flight guidance computer drops any other vertical mode that was in use, and automatically generates a pitch command to smoothly track the glideslope beam.

At this time, the PFD will display:

– LOC in green
– GS in green.

Glideslope deviation is routed from the navigation receiver to the flight guidance computer. Gain programming is performed on the glideslope signal to compensate for the airplane closing on the glideslope antenna, and beam convergence caused by the range and directional properties of the glideslope antenna.
The approach mode is cancelled by:

– Pushing the NAV or APP buttons on the MSP
– Selecting go–around, standby (STBY), or takeoff reference data (on ground only)
– Selecting any other lateral or vertical mode on the MSP
– Changing navigation sources on the DCP1 or DCP2, or changing localizer frequencies on the RMU
– Coupling to the cross–side PFD on the MSP CPL button
– SG reversionary selection of the SG which is driving the coupled PFD.

Preview Navigation Source
The preview NAV source is annunciated in white on the upper left of the HSI compass. Available preview sources are VOR1, VOR2, LOC1, LOC2 (ILS), and MLS as an option.

Preview Course Pointer / Lateral Deviation Indicator
When the FMS is the displayed navigation source on the PFD (or when the FGS is in HDG mode), and the onside VOR, LOC or optional MLS is tuned to a station, VOR, LOC, or MLS course can be previewed on either HSI compass (and on the MFD compass display) by pushing either the V/L or MLS button of the DCP1 or DCP2.
To preview a VOR, LOC (ILS) or MLS course follow this procedure:
– Select the FMS as the displayed navigation source for the FGS selected onside PFD. The FGS can be engaged on the MSP by the selected modes NAV, HDG or even ROL
– Push either the V/L or MLS button of the MSP and the preview course pointer is displayed in dim white on the MFD
– Tune the onside VOR, LOC (ILS) or MLS to a valid station. When a vertical source is selected, the vertical deviation preview scale is also displayed. The preview station identifier is displayed directly below the NAV source annunciator. The distance to the preview station is displayed in the NAV source distance readout.
– Turn CRS knob on the DCP1 or DCP2 to select the desired preview course on the MFD. The desired track (DTK) readout is replaced by the selected preview course. The DTK readout is restored 15 seconds after the CRS knob is turned
– Push the FMS button on the DCP1 or DCP2, if you want to remove the preview course information.

NAV / APP (LOC/ILS), BC Preselect (Arming)
Once the preview feature has been avtivated, the FGS will allow an automatic transition to the navigation source being previewed. The previewed sources can be VOR, LOC (ILS), BC or optional MLS.

FMS Transition to ILS:
- After completion of all of the above push either the APP, BC or MLS on the MSP to arm the transition of the FGS from FMS to the previous onside prepared LOC, VOR or MLS. The knob will illuminate and the PFD will now annunciate the FGS arm modes appropriate for the previewed source, transition is now armed.
- The FGS will continue tracking the FMS, HDG or ROL attitude mode until the previewed sources lateral deviation has reached its typical capture value.
- At transition capture, the FGS automatically replaces the FMS display and also replaces NAV, HDG or ROL modes with the previewed navigation source. It captures and tracks the lateral navigation signal.
- If appropriate the ILS glideslope (or MLS glidepath) will be captured at the proper intercept point.
- The approach is then completed as previously described for the appropriate navigation source.

Pitch Hold Mode (PIT)
The pitch hold mode (PIT) is a basic FGS–AFCS vertical mode and is annunciated in the upper right area of the PFD. PIT is not a button on the MSP and will appear on the PFD if no other vertical guidance mode is selected. PIT is the AFCS pitch channel default mode. Pushing the MSP STBY button during AFCS–AP operation, will disengage all present AFCS modes and will activate the AFCS default mode (ROL–PIT), however the AFCS autopilot and yaw damper remain engaged. The AFCS–AP pitch attitude then will be controlled by the TCS button on the MSP pitch wheel. In ROL–PIT default mode the AFCS–AP will continue to control the aircraft but the flight director command display is removed. When selecting a new mode on the MSP, the flight director command display will return, regardless if the AFCS–AP is engaged or not.

Pitch Hold Mode (PIT) with AFCS–AP engaged
Operation of pitch hold mode with AP engaged is described as follows:

- If not vertical AFCS modes are active (AFCS in PIT default mode), the AP will hold the pitch attitude existing at AP engagement. The FD command display will be in view on both PFDs if a lateral AFCS mode is active. The FD command display can be extinguished, if the AFCS is in the ROL–PIT default mode, by pushing the MSP STBY button and the AP remains engaged.
- When the PIT mode is active, the pitch attitude reference can be changed by depressing the TCS button on the control wheel and simultaneously changing the airplanes pitch attitude by steering the control column. The AFCS–AP will retain the pitch attitude existing at the moment TCS was released.
- The pitch attitude reference is most easily changed through the use of the pitch wheel which is located on the MSP. The pitch wheel function is inhibited in MSP FLCH and APR modes, but it can be used if no vertical modes are active (PIT) or in ALT hold mode (movement of the pitch wheel will cancel the ALT hold mode and change over to the VS mode).

Pitch Hold Mode (PIT) with AFCS–AP not engaged
Operation of pitch hold mode with AP not engaged is described as follows:

- Selection of an AFCS lateral mode with no active vertical mode results in the appearing of the FD command display in view (both PFDs). This FD command display represents the airplane pitch attitude at the moment the lateral mode was selected. The reference also can be changed by depressing the TCS button which will cause the pitch command to synchronize the AFCS to the present airplane attitude.
- The pitch hold mode (PIT) is cancelled by manual selection of modes on the MSP, or automatically by interception of an ALT or G/S AFCS vertical mode.

Vertical Speed Hold Mode (VS)
The vertical speed hold mode is used to maintain the airplane at a selected vertical speed reference. The vertical speed target is displayed on both PFDs above the vertical speed display. At the same time a blue command needle appears on the vertical speed display on both PFDs.

Engaging and using the VS hold mode:

- Moving the PITCH wheel on the MSP cancels the AFCS mode altitude hold (ALT) or altitude select capture. However when captured on the ILS glideslope (or MLS glidepath), in VNAV (VFCH or VPTH) or FLCH pitch wheel movement has no effect.
- Pushing the VS button on the MSP commands the AFCS to maintain the present vertical speed and allows a new vertical speed to be selected using the MSP pitch wheel.
- Depressing the TCS button on the control wheel (AFCS in VS mode) and maneuvering the airplane to a new vertical speed reference and then releasing the TCS button, is an other way to reset a new vertical speed target. Actual airplane vertical speed is still displayed on the vertical speed indicator.

When the vertical speed mode is engaged, the following occurs:

- VS in green is annunciated on both PFDs above the attitude sphere.
- Both PFDs display the vertical speed target value above the vertical speed scale in ft/min. At the same time a blue command needle appears in both PFDs vertical speed scales with the same vertical speed value as the display readout shows.
- When VS is selected all previously selected vertical modes will be disengaged.

The vertical speed mode can be cancelled by:

- Intercepting and capturing G/S or ALT mode
- Pushing the VS button on MSP engaging PIT default mode
- Selecting another vertical mode
- Selecting go–around standby (STBY) or takeoff reference data (on ground only)
- Coupling to the cross–side PFD
- SG reversionary selection of the SG which was driving the coupled PFD.

NOTE: Airplane overspeed protection is also provided in this mode, except in default pitch mode.

Flight Level Change Mode (FLCH)

The FLCH mode is set up to change flight level, at the selected airspeed, from present altitude to the preselected altitude. In FLCH mode the aircraft tries to prevent flying away from the preselected altitude target. For example, Power Lever retard during a climb toward a preselected altitude target will cause the system to try to maintain a positive vertical speed and, therefore, will result in deceleration rather than descent, even after the vertical speed reaches zero.

When VNAV is engaged, activation of the FLCH button on the MSP engages the VNAV submode FLCH and overrides all active AFCS pitch modes. In FLCH mode airspeed (IAS) reference is a blue bug on the airspeed tape of both PFDs. The IAS airspeed target will be selected by the DCP1 airspeed knob, or by pushing and holding the control wheel TCS button allowing the pilot to maneuver the airplane without disengaging the FLCH mode. When the TCS button is released, the airspeed target is now the current (IAS) airspeed.

Although the FLCH mode, in the long term, tracks the reference airspeed, short–term emphasis is on vertical speed. This minimizes vertical speed excursions due to disturbances or large airspeed changes thus improving the passenger comfort.

The FLCH mode is annunciated on the PFD by a green FLCH above the attitude sphere.

The FLCH mode is cancelled by:

- Intercepting and capturing G/S or ALT mode
- Pushing the FLCH button on the MSP
- Selecting any other vertical mode, or capturing preselected altitude
- Selecting go–around mode
- Coupling to the cross–side PFD
- Selecting standby mode
- SG reversionary selection of the SG which was driving the coupled PFD
- Moving the pitch wheel on the MSP
- Failure of the coupled ADC.

<u>NOTE</u>:
1. The AFCS will not fly to an airspeed reference outside the normal airplane flight envelope. The AFCS limits the commanded airspeed to the maximum speed (V_{MO} or M_{MO}) of the airplane. This applies regardless of the selected AFCS mode.
2. The change in AFCS operation (i.e., speed limit) is annunciated by turning the IAS speed bug and digits amber or V/S needle and digits amber depending on the selected AFCS mode.
3. If the FLCH mode requirements cannot be fulfilled because of power lever mismanagement a FLCH mismanage advisory is posted on EICAS.

Altitude Preselect Mode (ASEL)

The altitude preselect mode is used in conjunction with another vertical mode to enable the pilot to automatically capture, level off and hold the altitude he has set with the altitude select (ALT) knob on the DCP 2 and shown on each PFD. The altitude preselect mode provides for capturing and leveling off at the altitude, while the other vertical mode is used to fly to the desired altitude. To fly the altitude preselect mode, the pilot will perform the following:

- Set the desired altitude in the PFD altitude preselect window
- Initiate the required climb or descent to the new altitude (altitude select is now armed)
- Engage another vertical mode, such as VS or FLCH on the MSP.

At this time, the PFD would display the following mode messages:

- ASEL in white
- The other vertical mode in green.

The airplane is now flying toward the preselected altitude using one vertical mode, while ASEL is armed to automatically capture the desired altitude.

When the altitude select capture detector trips, the altitude select mode is captured and the other active vertical mode is dropped. At this time, the PFD will display ASEL in green.

In the event that the altitude select mode is engaged late (that is, the airplane has already gone through the selected altitude but is still ± 250 ft), the capture detector will trip immediately and initiate the flare maneuver to capture the selected altitude.

The AFCS will remain in the ASEL capture mode until the following conditions exist simultaneously:

- ASEL CAP
- Altitude error less than 25 ft
- Climb or Descend rate less than 5 ft/sec.

Now the AFCS automatically switches to altitude hold (ALT) mode.

NOTE: Changing the selected altitude on the DCP 2 while in the capture phase will cause the active ASEL mode to be cancelled and resume the vertical mode prior altitude capture.

Altitude Hold Mode

The altitude hold mode is a vertical AFCS mode, used to maintain a barometric altitude reference. To fly altitude hold mode, the pilot will perform the following:

– Be in any lateral AFCS mode
– Push the ALT button on the MSP.

At this time, the green ALT annunciator is displayed on the PFD while altitude hold is active. The vertical channel of the AFCS will maintain the barometric altitude at the time of mode engagement. The reference altitude may be changed by using TCS to maneuver to a new altitude and then releasing the TCS button. Selecting the ALT mode on will cancel any other previously selected vertical mode.

The ALT hold mode is cancelled by:

– Moving the pitch wheel on the MSP
– Pushing the ALT button on the MSP
– Selecting any other vertical mode or capturing the selected altitude
– Selecting go–around, standby (STBY) on the MSP or takeoff reference data (on ground only)
– Coupling to the cross–side PFD
– SG (symbol generator) reversionary selection of the SG which was driving the coupled PFD
– Failure of the coupled ADC.

Vertical Navigation Mode (VNAV)

Activation of the VNAV button on the MSP selects the vertical navigation mode and overrides all active pitch AFCS modes. In the VNAV mode, the FGS tracks the vertical flight profile of the FMS with the following submodes possible.

NOTE: The FMS works with the AFCS so that any vertical navigation mode will never be commanded past the alert altitude as displayed in the PFD altitude select window.

VERTICAL NAVIGATION SUBMODES

Vertical Flight Level Change (VFLCH)

VFLCH operates identically to FLCH except that the target speed and altitude delivered from the FMS are used for climb or descent. VFLCH will also engage if VALT is engaged and the FMS initiates a climb or descent. A third possible way to enter VFLCH mode is when VALT or VPTH arm is engaged or armed and the FLCH button on the MSP is pushed. The FMS FLCH mode is annunciated on the PFD by a green VFLCH.

Vertical Altitude Select (VASL)

VASL operates identically to ALT SEL. Disengage the AP when it becomes necessary to make manual steering inputs. ASL will arm when VFLCH or VPTH is engaged. When the mode captures, VASL in green will be displayed on the PFD.

Vertical Altitude Hold Mode (VALT)

VALT operates identically to ALT. VALT will engage automatically after VASL has captured the target altitude. VALT will also engage whenever the VNAV button is activated on the MSP and the airplane is within 250 ft of the FMS target altitude. The FMS ALT mode is annunciated on the PFD by a green VALT.The VALT mode must be selected (as an arming mode) prior intercepting a VPATH automatically or manually.

Vertical Path Mode (VPTH)

VPTH mode (only when AFCS in NAV mode) is used to fly a fixed flight path angle to a vertical waypoint during descent.
VPTH mode will capture and engage:

- Automatically whenever the FMS initiates the FMS preselected descent path which can occure while the AFCS is in VALT or VFLCH mode.The desired altitude or flight level at the target waypoint is displayed in large character numbers on the FMS–CDU.
- Manually when FMS is the navigation source, the MSP NAV mode is engaged, and the desired altitude or flight level at the target waypoint is displayed in large character numbers on the FMS–CDU. The VPTH mode will be engaged and intercept the AFCS vertical path after pushing the FMS–CDU buttons: ”DIRECT TO” and Waypoint ALT/LEVEL (RH side).
- The AFCS will not start descent before a lower altitude or flight level (ALT/FL) is selected and displayed on the PFDs. This selected ALT/FL will be captured and maintained by the AFCS. It has priority over the FMS based ALT/FL during descent or climb in every vertical AFCS mode.

When the mode VPTH is captured, VPTH in green color will be displayed on the PFD.

Go–Around Mode with Wings Level (GA)

The go–around mode is normally used to transition from an approach to a climb out condition when a missed approach is executed. The pilot selects go–around by pushing the GA button located on either outboard Thrust Lever handle. With go–around selected, all AFCS modes are cancelled, and the autopilot and yaw damper are disengaged. The lateral mode is wings level, the vertical mode is 8° pitch up on the PFD.
In GA mode a vertically, 8° climb angle is presented by the AFCS on the PFD.
The go–around mode is annunciated on the PFD with GA in green color and is cancelled by selecting another pitch mode or by pushing the TCS or STBY buttons.