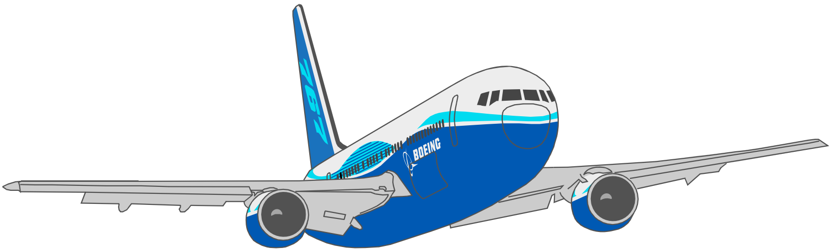

767-300

Flight Crew Operations Manual

GE Capital Corporation

Document Number D632T001-56GEFF
Revision Number: 24
Revision Date: February 20, 2014

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Volume 1

Volume 2

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General

The airplanes listed in the table below are covered in the Flight Crew Operations Manual (FCOM). The numbers are used to distinguish data peculiar to one or more, but not all of the airplanes. Where data applies to all airplanes listed, no reference is made to individual airplane numbers.

Use of the table below permits flight crew correlation of configuration differences by number within an operator’s fleet for airplanes covered in this manual. Configuration data reflects the airplane as delivered configuration and is updated for service bulletin incorporations in conformance with the policy stated in the introduction section of this chapter.

Registry number is supplied by the national regulatory agency. Serial and tabulation numbers are supplied by Boeing.

Revision changes to the table below, and the manual throughout, reflect the new registry number(s). The same changes are applicable to the Model ID table in the QRH.

Registry Number	Serial Number	Tabulation Number
N316LA	30842	VR260
N422LA	35818	VT533
N524LA	35816	VT531
N526LA	35817	VT532

Florida West International Airways also uses this manual to operate the following aircraft:

Registry Number - CC-CZZ

Serial Number - 25756

Tabulation Number - VR251

The following information has been added to this manual to provide flight crewmembers the differences in operating systems and procedures that are required to operate the aircraft listed above:

FWIA Revision - 29 June 6, 2013

1 - Applicable aircraft bulletins.

2 - Addition of systems information related to specific aircraft (by registry number) in the Normal Procedures Section.

3 - System Differences Section added at the end of the Airplane General Chapter in Volume 2 of this manual.

4 - Additional FMC Fail checklist in the QRH.

FWIA Revision - 29 June 6, 2013

General

This Flight Crew Operations Manual (FCOM) has been prepared by The Boeing Company. The purpose of this manual is to:

- provide the operating limitations, procedures, performance, and systems information the flight crew needs to safely and efficiently operate the 767 airplane during all anticipated operations
- serve as a comprehensive reference for use during transition training for the 767 airplane
- serve as a review guide for use in recurrent training and proficiency checks
- provide necessary operational data from the FAA approved airplane flight manual (AFM) to ensure that legal requirements are satisfied
- establish standardized procedures and practices to enhance Boeing operational philosophy and policy.

This manual is prepared for the owner/operator named on the title page specifically for the airplanes listed in the "Model Identification" section. It contains operational procedures and information, which apply only to these airplanes. The manual covers the Boeing delivered configuration of these airplanes. Changes to the delivered configuration are incorporated when covered by contractual revision agreements between the owner/operator and the Boeing Company.

This manual is not suitable for use for any airplanes not listed in the "Model Identification" section. Further, it may not be suitable for airplanes that have been transferred to other owners/operators.

Owners/operators are solely responsible for ensuring the operational documentation they are using is complete and matches the current configuration of the listed airplanes. This includes the accuracy and validity of all information furnished by the owner/operator or any other party. Owners/operators receiving active revision service are responsible to ensure that any modifications to the listed airplanes are properly reflected in the operational procedures and information contained in this manual.

The manual is periodically revised to incorporate pertinent procedural and systems information. Items of a more critical nature will be incorporated in operational bulletins and distributed in a timely manner. In all cases, such revisions and changes must remain compatible with the approved AFM with which the operator must comply. In the event of conflict with the AFM, the AFM shall supersede.

This manual is written under the assumption that the user has had previous multi–engine jet aircraft experience and is familiar with basic jet airplane systems and basic pilot techniques common to airplanes of this type. Therefore, the operations manual does not contain basic flight information that is considered prerequisite training.

Please send all correspondence regarding content or use of this manual, including bulletin status, to the 767 Manager, Flight Technical Data through the Service Requests Application (SR App) on the MyBoeingFleet home page.

Organization

The FCOM is organized in the following manner.

Volume 1 –

- Preface – contains general information regarding the manual’s purpose, structure, and content. It also contains lists of abbreviations, a record of revisions, bulletins, and a list of effective pages.
- Limitations and Normal Procedures chapters cover operational limitations and normal procedures. All operating procedures are based on a thorough analysis of crew activity required to operate the airplane, and reflect the latest knowledge and experience available.
- Supplementary Procedures chapter covers those procedures accomplished as required rather than routinely on each flight.
- Performance Inflight chapter contains performance information necessary for inflight use.

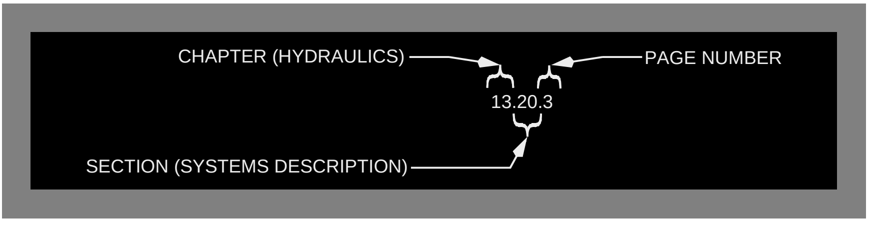
Volume 2 – Chapters 1 through 15 contain general airplane and systems information. These chapters are generally subdivided into sections covering controls and indicators and systems descriptions.

Quick Reference Handbook (QRH) – The QRH covers normal checklists, in–flight performance, non–normal checklists, and non–normal maneuvers.

Page Numbering

The FCOM uses a decimal page numbering system. The page number is divided into three fields; chapter, section, and page. An example of a page number for the hydraulics chapter follows: chapter 13, section 20, page 3.

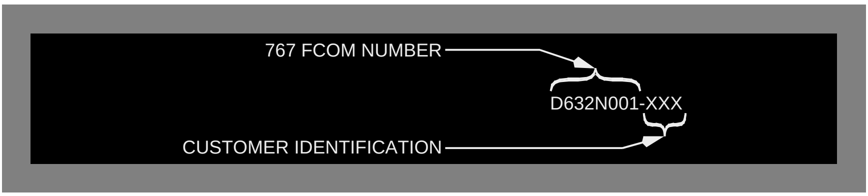
Example Page Number



Page Identification

Each page is identified by a customer document number and a page date. The customer document number is composed of the general 767 FCOM, D632T001–, and is followed by the customer identification. The page date is the date of publication of the manual or the most recent revision date.

Example Page Identification



Warnings, Cautions, and Notes

The following levels of written advisories are used throughout the manual and are not to be confused with EICAS messages, which are separately identified in the text.

WARNING: An operating procedure, technique, etc., that may result in personal injury or loss of life if not carefully followed.

CAUTION: An operating procedure, technique, etc., that may result in damage to equipment if not carefully followed.

Note: An operating procedure, technique, etc., considered essential to emphasize. Information contained in notes may also be safety related.

Flight Crew Operations Manual Configuration

Customer airplane configuration determines the data provided in this manual. The Boeing Company keeps a list of each airplane configuration as it is built and modified through the Service Bulletin process. The FCOM does not reflect customer originated modifications without special contract provisions.

Airplane Effectivities

Differences in airplane configuration are shown by use of airplane effectivities throughout Volumes 1 and 2, and the Quick Reference Handbook
The following rules are used to express airplane effectivities:

1. Airplane effectivities are listed in alpha-numeric order. A range of airplanes is defined by the word “through”, e.g. **N601BC through N605BC** includes all N6xxBC series aircraft in order as listed on the model ID page. A comma in the the range, e.g. **N601BC through N603BC**, **N605BC** indicates that **N604BC** is excluded from the range.

2. Airplane effectivities apply only to the paragraph, illustration, operational note, procedural step, etc. and to subordinate items (if any).

   Example (with subordinate items):

   N601BC through N604BC

   Right radio tuning panel..Set
   Verify that the OFF light is extinguished.

   First officer’s audio control panel..Set

   In this example, the effectivity N601BC through N604BC applies to the first procedural step and further indented (subordinate) step only. The effectivity does not include the next equivalently indented step.

   The first step (Right radio tuning panel) is effective for airplanes N601BC through N604BC, the second step (First officer’s audio control panel) is effective for all airplanes:

   Example (without subordinate items):

   N601BC through N602BC
   Thrust reversers inoperative.

   Autobrake system inoperative.

   In this example, the effectivity N601BC through N602BC applies to the first operational note only. The effectivity does not apply to the next equivalently indented operational note.

   The first operational note (Thrust reverser inoperative.) is effective for airplanes N601BC through N602BC only, the next operational note Autobrake ...) is effective for all airplanes.

3. When airplane effectivities are stated immediately below a checklist title, the entire checklist applies to the listed airplanes only. In the following example, the OIL FILTER checklist is applicable to N601BC through N603BC only:

OIL FILTER

N601BC through N603BC

4. When Boeing has been notified airplanes are to be modified by service bulletin (SB), the effectivity statement will include ‘Add’ and ‘Delete’ versions, as appropriate, in parentheses. Depending upon the modification, there may not be both an ‘Add’ and an ‘Delete’ version.

   The text before the semicolon in the parentheses lists the range of airplanes being modified. The text after the semicolon indicates the ‘before’ or ‘after’ version and briefly describes what the SB does. The following examples illustrate this:

   Example (‘Add’ version):

   (SB Adds N604BC when Dual Oil Filters are installed)
   The engine may be operated normally.

   "SB Adds N604BC" means the incorporation of the SB (i.e. installation of Dual Oil Filters in this example) is scheduled to begin for airplane N604BC. The words "SB Adds, when Dual Oil Filters are installed" indicate the associated operational note (The engine may be operated normally.) applies to N604BC when the SB has been incorporated.

   Example (‘Deletes’ version):

   (SB Deletes N604BC when Dual Oil Filters are installed)
   The engine must be operated at idle thrust.

   For airplane N604BC the SB (i.e. installation of Dual Oil Filters in this example) has not been incorporated. The associated operational note (The engine must be operated at idle thrust) applies N604BC.

   "SB Deletes N604BC" means the incorporation of the SB (i.e. installation of Dual Oil Filters in this example) is scheduled to begin for airplane N604BC. The words "The engine must be operated at idle thrust " will apply to N604BC until the SB has been incorporated.

General

The following abbreviations may be found throughout the manual. Some abbreviations may also appear in lowercase letters. Abbreviations having very limited use are explained in the chapter where they are used.

A	
ABV	Above
AC	Alternating Current
ACARS	Aircraft Communications Addressing and Reporting System
ACP	Audio Control Panel
ACT	Active
ADC	Air Data Computer
ADF	Automatic Direction Finder
ADI	Attitude Director Indicator
ADIRS	Air Data Inertial Reference System
ADIRU	Air Data Inertial Reference Unit
AFDS	Autopilot Flight Director System
AFM	Airplane Flight Manual (FAA approved)
A/G	Air/Ground
AGL	Above Ground Level
AIL	Aileron
ALT	Altitude
ALTN	Alternate
AM	Amplitude Modulation
AMI	Airline Modifiable Information
ANP	Actual Navigational Performance
ANT	Antenna
AOA	Angle of Attack
AOC	Airline Operational Communication Data Link
A/P	Autopilot
APL	Airplane
APP	Approach
APU	Auxiliary Power Unit
ARINC	Aeronautical Radio, Incorporated
ARPT	Airport
ARR	Arrival
ASA	Autoland Status Annunciator
ASYM	Asymmetry
A/T	Autothrottle
ATA	Actual Time of Arrival
ATC	Air Traffic Control
ATT	Attitude

AUTO–THROT	Autothrottle
AUTO	Automatic
AUX	Auxiliary
AVAIL	Available
B	
BARO	Barometric
BAT	Battery
B/CRS	Back Course
BFO	Beat Frequency Oscillator
BKR	Breaker
BLD	Bleed
BLW	Below
BRG	Bearing
BRT	Bright
BTL	Bottle
C	
C	Captain Celsius Center Cool
CANC	Cancel
CAP	Capture
CAPT	Captain
CB	Circuit Breaker
CDU	Control Display Unit
CG	Center of Gravity
CHR	Chronograph
CKT	Circuit
CL	Close
CLB	Climb
CLR	Clear
CMD	Command
CO	Company
COMM	Communication
COMP	Comparator
COMPT	Compartment
CON	Continuous
CONFIG	Configuration
CONT	Control
COOL	Cooling
CRS	Course
CRT	Cathode Ray Tube
CRZ	Cruise
CTL	Control
CTR	Center
CWS	Control Wheel Steering
D	
DA(H)	Decision Altitude (Height)
DC	Direct Current
DCU	Display Concentrator Unit
DDG	Dispatch Deviations Guide
DEL	Delete
DEP	Departure
DEPR	Depressurize
DES	Descent
DH	Decision Height
DIFF	Differential
DISC	Disconnect

DISCH	Discharge
DK	Deck
DME	Distance Measuring Equipment
DN	Down
DSPL	Display
E	
E/D	End of Descent
E/E	Electrical/Electronic
EEC	Electronic Engine Control
EFI	Electronic Flight Instruments
EFIS	Electronic Flight Instrument System
EGT	Exhaust Gas Temperature
EICAS	Engine Indication and Crew Alerting System
ELEC	Electrical
ELEV	Elevator
EMER	Emergency
ENG	Engine
ENT	Entry
EO	Engine Out
EPR	Engine Pressure Ratio
EQPT or EQUIP	Equipment
ETOPS	Extended Range Operation with Twin Engine Airplanes
EVAC	Evacuation
EXEC	Execute
EXT	Extend or External
F	
F	Fahrenheit
FADEC	Full Authority Digital Engine Control
FCC	Flight Control Computer
FCOM	Flight Crew Operations Manual
FD, F/D or FLT DIR	Flight Director
FF	Fuel Flow
FILT	Filter
FL CH or FLCH	Flight Level Change
FLT	Flight
FMA	Flight Mode Annunciations
FMC	Flight Management Computer
FMS	Flight Management System
F/O or F O	First Officer
FPA	Flight Path Angle
FPV	Flight Path Vector
FPM	Feet Per Minute
FREQ	Frequency
F/S	Fast/Slow
FT	Feet
FWD	Forward
FWSOV	Fire Wall Shut Off Valve
G	
GA	Go–Around
GEN	Generator

GMT	Greenwich Mean Time
GND	Ground
GPS	Global Positioning System
GPWS	Ground Proximity Warning System
G/S	Glide Slope
GS	Ground Speed
H	
HDG	Heading
HF	High Frequency
HI	High
HLD	Hold
HPSOV	High Pressure Shut Off Valve
HSI	Horizontal Situation Indicator
HYD	Hydraulic
I	
IAS	Indicated Airspeed
IDENT	Identification
IGN	Ignition
IGS	Instrument Guidance System
IND LTS	Indicator Lights
INIT	Initialization
INSTR	Instrument
ILS	Instrument Landing System
INBD	Inboard
IND	Indicator
INOP	Inoperative

INT or INTPH	Interphone
INTC	Intercept
ISFD	Integrated Standby Flight Display
IRS	Inertial Reference System
ISA	International Standard Atmosphere
ISLN	Isolation
K	
K or KTS	Knots
KGS	Kilograms
L	
L	Left
LBS	Pounds
LD	Load
LDA	Localizer-type Directional Aid
LDG	Landing
LE	Leading Edge
LIM	Limit
LKD	Locked
L NAV or LNAV	Lateral Navigation
LOC	Localizer
LT	Light
LWR CTR	Lower Center
LWR DSPLY	Lower Display
M	
M	Mach
MAG	Magnetic

MAN	Manual
MAX	Maximum
MCP	Mode Control Panel
MDA(H)	Minimum Descent Altitude (Height)
MEL	Minimum Equipment List
MIC	Microphone
MFD	Multifunction Display
MIN	Minimum
MLS	Microwave Landing System
MMO	Maximum Mach Operating Speed
MOD	Modify
MSG	Message
MTRS	Meters
N	
N	Normal
NAV	Navigation
ND	Navigation Display
NGS	Nitrogen Generation System
NM	Nautical Miles
NORM	Normal
N1	Low Pressure Rotor Speed
N2	High Pressure Rotor Speed (Pratt & Whitney engines) Intermediate Pressure Rotor Speed (Rolls–Royce engines)
N3	High Pressure Rotor Speed (Rolls–Royce engines)
O	
OAT	Outside Air Temperature
OFST	Offset
OP	Open
OUTBD DSPL	Outboard Display
OVHT	Overheat
OVRD	Override
OVSPD	Overspeed
OXY or O2	Oxygen
P	
PA	Passenger Address
PASS	Passenger
PCP	Pilot Call Panel
PERF	Performance
PES	Pitch Enhancement System
PF	Pilot Flying
PFD	Primary Flight Display
PM	Pilot Monitoring
PNL	Panel
POS	Position
PPOS	Present Position
PRES or PRESS	Pressure
PREV	Previous
P/RST	Push To Reset
PROX	Proximity

PRV	Pressure Regulating Valve
PSI	Pounds Per Square Inch
PTH	Path
PTT	Push To Talk
PTU	Power Transfer Unit
PWR	Power
PWS	Predictive Windshear System
Q	
QFE	Local Station Pressure
QNH	Local Station Pressure Corrected to MSL
QTY	Quantity
R	
R	Right
RA	Radio Altitude Resolution Advisory
RAD	Radio
RAT	Ram Air Turbine
RDMI	Radio Distance Magnetic Indicator
REC	Recorder
RECIR or RECIRC	Recirculation
REF	Reference
REV	Reverse
RF	Refill
RMI	Radio Magnetic Indicator
RNP	Required Navigational Performance
RPM	Revolutions Per Minute
RST	Reset
RNV	Area Navigation (RNAV)
RSVR	Reservoir
R/T	Radio Transmit
RTE	Route
RTO	Rejected Takeoff
RUD	Rudder
RVSM	Reduced Vertical Separation Minimum
S	
SAT	Static Air Temperature Satellite
SB	Service Bulletin
S/C	Step Climb
SDF	Simplified Directional Facility
SEL	Select
SELCAL	Selective Calling
SENS	Sensitivity
SERV	Service
SPD	Speed
SPDBRK	Speedbrake
STAB	Stabilizer
STBY	Standby
SYS	System
T	
T or TRU	True
T or TK or TRK	Track
TA	Traffic Advisory
TAI	Thermal Anti–Ice
TAT	Total Air Temperature

T/C	Top of Climb
TCAS	Traffic Alert and Collision Avoidance System
T/D	Top of Descent
TE	Trailing Edge
TEMP	Temperature
TERR	Terrain
TFC	Traffic
TFR	Transfer
THR	Throttle Thrust
TO or T/O	Takeoff
TO/GA	Takeoff/Go–Around
TURB	Turbine Turbulence
U	
UNLKD	Unlocked
UNSCHD or UNSCHED	Unscheduled
UPR DSPL	Upper Display
USB	Upper Side Band
UTC	Universal Time Coordinated
UTIL	Utility
V	
VA	Design maneuvering Speed
VAL	Valve
VERT	Vertical
VHF	Very High Frequency
VIB	Vibration
VLV	Valve
VMO	Maximum Operating Speed
V NAV or VNAV	Vertical Navigation
VOR	VHF Omnidirectional Range
VR	Rotation Speed
VREF	Reference Speed
VSI	Vertical Speed Indicator
V/S	Vertical Speed
VTK	Vertical Track
V1	Takeoff Decision Speed
V2	Takeoff Safety Speed
W	
W	Warm
WHL	Wheel
WPT	Waypoint
WXR	Weather Radar
X	
X–FEED	Crossfeed
XPDR or XPNDR	Transponder
XTK	Cross Track

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Revision Transmittal Letter

To: All holders of GE Capital Corporation 767 Flight Crew Operations Manual (FCOM), Boeing Document Number D632T001-56GEFF.

Subject: Flight Crew Operations Manual Revision.

CAUTION. Before inserting this FCOM revision check the Bulletin Record, Section 6, against the enclosed Flight Crew Operations Manual Bulletins (OMBs). If all OMBs listed in Section 6 are enclosed, this FCOM has been completely reprinted for customer convenience due to the large number of changed pages.

This revision reflects the most current information available to The Boeing Company 45 days prior to the subject revision date. The following revision highlights explain changes in this revision. The Revision Record page explains the use of revision bars to identify new or revised information.

Revision Record

No.	Revision Date	Date Filed
0	February 8, 2002	
2	February 21, 2003	
4	February 19, 2004	
6	February 23, 2005	
8	February 13, 2006	
10	February 14, 2007	
12	February 18, 2008	
14	February 19, 2009	
16	February 15, 2010	
18	February 18, 2011	
20	February 17, 2012	
22	February 15, 2013	
24	February 20, 2014	

No.	Revision Date	Date Filed
1	August 14, 2002	
3	August 19, 2003	
5	August 23, 2004	
7	August 24, 2005	
9	August 25, 2006	
11	August 17, 2007	
13	August 21, 2008	
15	August 19, 2009	
17	August 16, 2010	
19	August 15, 2011	
21	August 14, 2012	
23	August 16, 2013	

General

The Boeing Company issues FCOM revisions to provide new or revised procedures and information. Formal revisions also incorporate appropriate information from previously issued FCOM bulletins.

The revision date is the approximate date the manual is mailed to the customer and is effective upon receipt.

Formal revisions include a Transmittal Letter, a new Revision Record, Revision Highlights, and a current List of Effective Pages. Use the information on the new Revision Record and List of Effective Pages to verify the FCOM content.

Pages containing revised material have revision bars and highlights associated with the changed text or illustration. Revision bars associated with revised effectivity due to additions, deletions of airplanes or changes to previous registration numbers will not have highlights.

The record should be completed by the person incorporating the revision into the manual.

Filing Instructions

Consult the List of Effective Pages (0.5). Pages identified with an asterisk (*) are either replacement pages or new (original) issue pages. Remove corresponding old pages and replace or add new pages. Remove pages that are marked DELETED; there are no replacement pages for deleted pages.

Be careful when inserting changes not to throw away pages from the manual that are not replaced. The List of Effective Pages determines the correct content of the manual.

Revision Highlights

Highlights have page numbers; section and paragraph titles are provided.

This section (0.4) replaces the existing section 0.4 in your manual.

Throughout the manual, airplane effectivity may be updated to reflect coverage as listed on the Preface - Model Identification page, or to show service bulletin airplane effectivity. Highlights are not supplied.

This manual is published from a database; the text and illustrations are marked with configuration information. Occasionally, because the editors rearrange the database markers, or mark items with configuration information due to the addition of new database content, some customers may receive revision bars on content that appears to be unchanged. Pages may also be republished without revision bars due to slight changes in the flow of the document.

Chapter 0 - Preface

Section 2 - Introduction

General

0.2.2 - Revised Boeing contact information for questions regarding FCOM/QRH content. Please use the Service Requests Application (SR App) found on the MyBoeingFleet home page.

Chapter NP - Normal Procedures

Section 21 - Amplified Procedures

Preflight Procedure – First Officer

NP.21.19 - Added guidance for verifying the seat is locked following adjustment.

Preflight Procedure – Captain

NP.21.23 - Added guidance for verifying the seat is locked following adjustment.

Chapter SP - Supplementary Procedures

Section 12 - Fuel

Fuel Balancing

SP.12.1 - Revised the title of the checklist to reflect the section where the checklist is located, i.e., the word “Fuel” is at the beginning of the title. This change is also for cross model commonality.

Section 16 - Adverse Weather

Cold Weather Operations

SP.16.3 - Added procedure for starting cold soaked engines when the temperature is below -30 degrees C.

Chapter PI - Performance Inflight

Section TOC - Table of Contents

PI.TOC.1 - Due to publishing system changes, some performance sections have moved, and/or changed to match the configuration of the aircraft(s) covered in the FCOM.

Section 10 - Table of Contents

PI.TOC.10.1 - 767-300W CF6-80C2B6F KG FAA CATC CATD TO1-10% TO2-20% moved from Section 20 to 10.

Section 10 - General

General

PI.10.1 - 767-300W CF6-80C2B6F KG FAA CATC CATD TO1-10% TO2-20% moved from Section 20 to 10.

Section 20 - Table of Contents

PI.TOC.20.1 - 767-300W CF6-80C2B7F KG FAA CATC CATD TO1-10% TO2-20% moved from Section 40 to 20.

Section 20 - General

General

PI.20.1 - 767-300W CF6-80C2B7F KG FAA CATC CATD TO1-10% TO2-20% moved from Section 40 to 20.

Chapter 1 - Airplane General, Emergency Equipment, Doors, Windows

Section 30 - Controls and Indicators

Emergency Locator Transmitter

1.30.22 - Added illustration and callouts for an emergency locator transmitter (ELT) control panel.

1.30.22 - Added illustration and callouts for a remote emergency locator transmitter (ELT) control panel.

1.30.22 - Added illustration for a three position guarded emergency locator transmitter (ELT) control panel with a transmitter on light.

1.30.22 - Added ELT switch "ARMED" description.

1.30.22 - Added ELT switch "RESET" description.

1.30.22 - Added description for the ELT "ON" light.

Section 45 - Emergency Equipment

Miscellaneous Emergency Equipment

1.45.2 - Added systems description for airplanes with emergency locator transmitters (ELT) installed.

1.45.2 - Added ELT description to reflect fleet configuration.

1.45.2 - Added description of EICAS "ELT ON" advisory message.

Section 50 - EICAS Messages

Emergency Locator Transmitter (ELT)

1.50.2 - Added table and condition statement for the EICAS message "ELT ON" for airplanes with a fuselage mounted emergency locator transmitter.

Chapter 4 - Automatic Flight

Section 10 - Controls and Indicators

Autopilot Flight Director Approach Mode Controls

4.10.15 - Edited bullet for grammar/terminology.

4.10.15 - Removed duplicate bullet.

Chapter 5 - Communications

Section 10 - Controls and Indicators

Emergency Locator Transmitter

5.10.21 - Transfered ELT controls and indicators to Chapter 1, Section 30 for cross model consistency.

5.10.21 - Transfered ELT controls and indicators to Chapter 1, Section 30 for cross model consistency.

Section 20 - System Description

Introduction

5.20.1 - Deleted reference to fuselage mounted emergency locator transmitter (ELT).

Fuselage Mounted Emergency Locator Transmitter (ELT)

5.20.5 - Moved ELT system description to Chapter 1, Section 45 for cross model consistency.

Section 50 - EICAS Messages

Satellite Communications (SATCOM)

5.50.1 - Moved table and condition statement for the EICAS message ELT ON to Chapter 1 for cross model consistency.

Chapter 7 - Engines, APU

Section 15 - Controls and Indicators

APU Controls

7.15.1 - Added wording for operational clarification.

Section 30 - APU System Description

APU Shutdown

7.30.2 - Added wording for operational clarification.

Chapter 11 - Flight Management, Navigation

Section 20 - Navigation Systems Description

Global Positioning System (GPS)

11.20.6 - Added paragraph for airplanes with ADS-B installed.

GPS Data

11.20.6 - Added information on GPS EICAS messages.

GPS System Schematic

11.20.7 - Graphic details modified for accuracy.

Mode S

11.20.8 - Added section describing Mode S transponder capabilities.

11.20.8 - Added section with ES/ADS-B transponder information.

Section 43 - FMC Descent and Approach

Holding

11.43.31 - Note edited for clarity.

Hold Page (Existing Hold)

11.43.36 - Paragraph and note edited for clarity.

Chapter 15 - Warning Systems

Section 20 - System Description

Predictive Windshear (PWS)

15.20.25 - Deleted PWS auto enable altitude information no longer applicable to fleet configuration.

15.20.25 - Added PWS auto enable altitude information for airplanes with predictive windshear installed.

Volume 1			V1V2 List of Effective Pages		
Page	Date	FWIA Date	Page	Date	FWIA Date
Title Page 1		31 – 05/05/14	0.5.3		31 – 05/05/14
Title Page 2	ILB		0.5.4		31 – 05/05/14
0.TOC.1	02/20/14		0.5.5		31 – 05/05/14
0.TOC.2	02/20/14		0.5.6		31 – 05/05/14
Model Identification			0.5.7		31 – 05/05/14
0.1.1	08/14/12	29 – 06/06/13	0.5.8		31 – 05/05/14
0.1.2	08/14/12	29 – 06/06/13	0.5.9		31 – 05/05/14
			0.5.10		31 – 05/05/14
Introduction			0.5.11		31 – 05/05/14
0.2.1	02/18/08		0.5.12		31 – 05/05/14
0.2.2	02/20/14		0.5.13		31 – 05/05/14
0.2.3	08/14/12		0.5.14		31 – 05/05/14
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4.10.9	February 18, 2011
4.10.10	February 18, 2011
4.10.11	February 18, 2011
* 4.10.12	February 20, 2014
4.10.13	February 18, 2011
4.10.14	February 18, 2011
* 4.10.15	February 20, 2014
4.10.16	February 18, 2011
4.10.17	February 18, 2011
4.10.18	February 18, 2011
4.10.19	February 18, 2011
4.10.20	February 18, 2011
4.10.21	February 18, 2011
4.10.22	February 18, 2011
4.20.1	February 18, 2011
4.20.2	February 15, 2013
4.20.3	February 18, 2011
4.20.4	August 23, 2004
4.20.5	August 17, 2007
4.20.6	February 18, 2011
4.20.7	February 15, 2013
4.20.8	February 15, 2013
4.20.9	February 15, 2013
4.20.10	February 15, 2013
4.20.11	February 15, 2013
4.20.12	February 15, 2013
4.20.13	February 15, 2013
4.20.14	February 15, 2013
4.20.15	February 15, 2013
4.20.16	February 15, 2013
4.20.17	February 15, 2013
4.20.18	February 15, 2013
4.30.1	February 23, 2005
4.30.2	February 8, 2002
5 Communications (tab)	
* 5.TOC.0.1-4	Deleted
* 5.TOC.1-4	February 20, 2014
5.10.1	February 15, 2013
5.10.2	February 15, 2013
5.10.3	February 15, 2013
5.10.4	February 15, 2013
5.10.5	February 15, 2013
5.10.6	February 15, 2013
5.10.7	February 15, 2013
5.10.8	August 16, 2013
5.10.9	August 16, 2013
5.10.10	August 16, 2013
5.10.11	August 16, 2013
5.10.12	August 16, 2013
5.10.13	August 16, 2013
5.10.14	August 16, 2013
5.10.15	August 16, 2013
5.10.16	August 16, 2013
5.10.17	August 16, 2013
5.10.18	August 16, 2013
5.10.19	August 16, 2013
5.10.20	August 16, 2013
* 5.10.21	February 20, 2014

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5.10.22	August 16, 2013	5.45.9	February 15, 2013
5.10.23	August 16, 2013	5.45.10	February 15, 2013
5.10.24	August 16, 2013	5.45.11	February 15, 2013
* 5.20.1	February 20, 2014	5.45.12	February 15, 2013
* 5.20.2	February 20, 2014	5.45.13	February 15, 2013
5.20.3	February 15, 2013	5.45.14	February 15, 2013
5.20.4	February 15, 2013	5.45.15	February 15, 2013
* 5.20.5	February 20, 2014	5.45.16	February 15, 2013
* 5.20.6	February 20, 2014	5.45.17	February 15, 2013
5.25.1	August 16, 2013	5.45.18	February 15, 2013
5.25.2	February 15, 2013	5.45.19	February 15, 2013
5.25.3	February 15, 2013	5.45.20	February 15, 2013
5.25.4	August 16, 2013	5.45.21	February 15, 2013
5.25.5	February 18, 2011	5.45.22	February 15, 2013
5.25.6	February 15, 2013	5.45.23	February 15, 2013
5.26.1	August 14, 2012	5.45.24	February 15, 2013
5.26.2	February 15, 2013	5.45.25	February 15, 2013
5.26.3	February 15, 2013	5.45.26	February 15, 2013
5.26.4	February 15, 2013	5.45.27	February 15, 2013
5.26.5	February 15, 2013	5.45.28	February 15, 2013
5.26.6	February 15, 2013	5.45.29	February 15, 2013
5.26.7	February 15, 2013	5.45.30	February 15, 2013
5.26.8	February 15, 2013	5.45.31	February 15, 2013
5.26.9	February 15, 2013	5.45.32	February 15, 2013
5.26.10	February 15, 2013	5.45.33	February 15, 2013
5.26.11	February 15, 2013	5.45.34	February 15, 2013
5.26.12	February 15, 2013	5.45.35	February 15, 2013
5.26.13	February 15, 2013	5.45.36	February 15, 2013
5.26.14	February 15, 2013	5.45.37	February 15, 2013
5.26.15	February 15, 2013	5.45.38	February 15, 2013
5.26.16	August 14, 2012	5.45.39	February 15, 2013
5.30.1	February 15, 2013	5.45.40	February 15, 2013
5.30.2	February 8, 2002	* 5.50.1	February 20, 2014
5.40.1	February 18, 2011	* 5.50.2	February 20, 2014
5.40.2	February 18, 2011	* 5.50.3	February 20, 2014
5.40.3	February 15, 2013	* 5.50.4	February 20, 2014
5.40.4	February 15, 2013	**6 Electrical (tab)**	
5.40.5	February 15, 2013		
5.40.6	February 15, 2013	* 6.TOC.0.1-2	Deleted
5.45.1	February 18, 2011	* 6.TOC.1-2	February 20, 2014
5.45.2	February 15, 2013	6.10.1	February 8, 2002
5.45.3	February 15, 2013	6.10.2	February 18, 2011
5.45.4	February 15, 2013	6.10.3	February 15, 2013
5.45.5	February 15, 2013	6.10.4	February 15, 2013
5.45.6	February 15, 2013	6.10.5	February 15, 2013
5.45.7	February 15, 2013	6.10.6	February 15, 2013
5.45.8	February 15, 2013	6.20.1	February 15, 2013

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6.20.2	February 23, 2005
6.20.3	February 23, 2005
6.20.4	August 17, 2007
6.20.5	February 18, 2008
6.20.6	February 18, 2011
6.20.7	February 18, 2011
6.20.8	August 17, 2007
6.20.9	February 18, 2011
6.20.10	February 15, 2013
6.20.11	February 15, 2013
6.20.12	August 14, 2012
6.20.13	August 14, 2012
6.20.14	February 15, 2013
6.20.15	August 14, 2012
6.20.16	August 14, 2012
6.30.1	February 15, 2013
6.30.2	February 15, 2013

7 Engines, APU (tab)

* 7.TOC.0.1-4	Deleted
* 7.TOC.1-4	February 20, 2014
7.12.1	February 13, 2006
7.12.2	February 15, 2013
7.12.3	August 16, 2013
7.12.4	August 15, 2011
7.12.5	February 18, 2011
7.12.6	February 18, 2011
7.12.7	February 18, 2011
7.12.8	February 18, 2011
7.12.9	February 18, 2011
7.12.10	February 18, 2011
7.12.11	February 15, 2013
7.12.12	February 15, 2013
7.12.13	February 15, 2013
7.12.14	February 15, 2013
7.12.15	February 18, 2011
7.12.16	February 18, 2011
7.12.17	February 18, 2011
7.12.18	February 18, 2011
7.12.19	February 18, 2011
7.12.20	February 15, 2013
7.12.21	February 15, 2013
7.12.22	August 16, 2013
* 7.15.1	February 20, 2014
* 7.15.2	February 20, 2014
7.22.1	August 16, 2013
7.22.2	August 16, 2010
7.22.3	August 16, 2013
7.22.4	February 18, 2011
7.22.5	February 18, 2011
7.22.6	February 15, 2013
7.22.7	February 18, 2011
7.22.8	February 15, 2013
7.22.9	February 18, 2011
7.22.10	February 17, 2012
7.22.11	February 18, 2011
7.22.12	February 18, 2011
7.22.13	February 18, 2011
7.22.14	February 18, 2011
7.22.15	February 18, 2011
7.22.16	February 18, 2011
7.22.17	February 15, 2013
7.22.18	February 18, 2011
7.22.19	August 16, 2013
7.22.20	February 18, 2011
7.30.1	February 21, 2003
* 7.30.2	February 20, 2014
7.42.1	February 15, 2013
7.42.2	February 15, 2013
7.42.3	February 15, 2013
7.42.4	February 8, 2002

8 Fire Protection (tab)

* 8.TOC.0.1-2	Deleted
* 8.TOC.1-2	February 20, 2014
8.10.1	August 17, 2007
8.10.2	February 18, 2011
8.10.3	February 18, 2011
8.10.4	February 18, 2011
8.10.5	February 18, 2011
8.10.6	February 18, 2011
8.10.7	February 18, 2011
8.10.8	February 18, 2011
8.10.9	February 18, 2011
8.10.10	February 18, 2011
8.20.1	February 15, 2013
8.20.2	August 17, 2007
8.20.3	February 18, 2011
8.20.4	February 18, 2011
8.20.5	February 18, 2011
8.20.6	February 17, 2012
8.30.1	February 15, 2013
8.30.2	February 15, 2013

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9 Flight Controls (tab)	
* 9.TOC.0.1-2	Deleted
* 9.TOC.1-2	February 20, 2014
9.10.1	August 14, 2002
9.10.2	August 21, 2008
9.10.3	August 24, 2005
9.10.4	August 17, 2007
9.10.5	February 15, 2013
9.10.6	February 15, 2013
9.10.7	February 15, 2013
9.10.8	February 15, 2013
9.10.9	February 18, 2011
9.10.10	February 18, 2011
9.10.11	February 18, 2011
9.10.12	August 17, 2007
9.20.1	February 8, 2002
9.20.2	February 15, 2013
9.20.3	August 24, 2005
9.20.4	February 17, 2012
9.20.5	February 17, 2012
9.20.6	August 16, 2010
9.20.7	August 25, 2006
9.20.8	February 15, 2013
9.20.9	August 14, 2012
9.20.10	August 14, 2012
9.20.11	February 17, 2012
9.20.12	February 17, 2012
9.30.1	February 15, 2013
9.30.2	February 15, 2013
10 Flight Instruments, Displays (tab)	
* 10.TOC.0.1-4	Deleted
* 10.TOC.1-4	February 20, 2014
10.10.1	February 18, 2011
10.10.2	February 18, 2011
10.10.3	August 15, 2011
10.10.4	February 18, 2011
10.10.5	August 15, 2011
10.10.6	February 18, 2011
10.10.7	February 15, 2013
10.10.8	February 15, 2013
10.10.9	February 15, 2013
10.10.10	February 15, 2013
10.10.11	February 15, 2013
10.10.12	February 15, 2013
10.10.13	February 18, 2011
10.10.14	February 18, 2011
10.10.15	February 18, 2011
10.10.16	February 18, 2011
10.10.17	February 18, 2011
10.10.18	February 18, 2011
10.10.19	August 15, 2011
10.10.20	February 18, 2011
10.10.21	August 15, 2011
10.10.22	February 18, 2011
10.10.23	February 18, 2011
10.10.24	February 18, 2011
10.10.25	February 18, 2011
10.10.26	February 18, 2011
10.10.27	February 18, 2011
10.10.28	February 18, 2011
10.10.29	February 15, 2013
10.10.30	February 15, 2013
10.10.31	February 15, 2013
10.10.32	February 18, 2011
10.10.33	February 15, 2013
10.10.34	February 15, 2013
10.10.35	February 15, 2013
10.10.36	February 15, 2013
* 10.10.37	February 20, 2014
* 10.10.38	February 20, 2014
* 10.10.39	February 20, 2014
* 10.10.40	February 20, 2014
10.10.41	February 15, 2013
10.10.42	February 15, 2013
10.10.43	February 15, 2013
10.10.44	February 15, 2013
10.10.45	February 15, 2013
10.10.46	February 15, 2013
10.10.47	February 15, 2013
10.10.48	February 15, 2013
10.10.49	February 15, 2013
10.10.50	February 15, 2013
10.10.51	February 15, 2013
10.10.52	February 15, 2013
10.10.53	February 15, 2013
10.10.54	February 15, 2013
10.10.55	February 15, 2013
10.10.56	February 15, 2013
10.10.57	February 15, 2013
10.10.58	February 15, 2013
10.10.59	February 15, 2013
10.10.60	February 15, 2013

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10.20.1	August 15, 2011
10.20.2	August 15, 2011
10.20.3	February 18, 2011
10.20.4	August 19, 2009
10.20.5	August 19, 2009
10.20.6	August 19, 2009
10.30.1	August 14, 2002
10.30.2	February 18, 2011
10.30.3	February 18, 2011
10.30.4	February 18, 2011
10.30.5	February 18, 2011
10.30.6	February 15, 2013
10.30.7	February 15, 2013
10.30.8	February 15, 2013
10.30.9	February 15, 2013
10.30.10	February 15, 2013
10.30.11	February 15, 2013
10.30.12	February 15, 2013
10.30.13	February 15, 2013
10.30.14	February 15, 2013
10.30.15	February 15, 2013
10.30.16	February 15, 2013
10.40.1	February 15, 2013
10.40.2	February 15, 2013
10.40.3	February 15, 2013
10.40.4	February 15, 2013
10.40.5	February 8, 2002
10.40.6	February 8, 2002
10.50.1	February 23, 2005
10.50.2	February 8, 2002

11 Flight Management, Navigation (tab)

* 11.TOC.0.1-8	Deleted
* 11.TOC.1-8	February 20, 2014
11.10.1	August 16, 2010
11.10.2	August 17, 2007
11.10.3	February 18, 2011
11.10.4	February 15, 2013
11.10.5	February 15, 2013
11.10.6	February 15, 2013
11.10.7	August 23, 2004
11.10.8	August 23, 2004
11.10.9	August 23, 2004
11.10.10	February 18, 2011
11.10.11	February 18, 2011
11.10.12	February 18, 2011
* 11.10.13	February 20, 2014
* 11.10.14	February 20, 2014
11.10.15	February 15, 2013
11.10.16	February 15, 2013
11.10.17	February 18, 2011
11.10.18	February 15, 2013
11.10.19	February 15, 2013
11.10.20	February 15, 2013
11.10.21	February 15, 2013
11.10.22	February 18, 2011
11.20.1	February 15, 2013
11.20.2	February 18, 2011
11.20.3	February 18, 2011
11.20.4	February 15, 2013
11.20.5	February 15, 2013
* 11.20.6	February 20, 2014
* 11.20.7	February 20, 2014
* 11.20.8	February 20, 2014
* 11.20.9	February 20, 2014
11.20.10	February 18, 2011
11.30.1	February 15, 2013
11.30.2	February 15, 2013
11.31.1	February 15, 2013
11.31.2	February 15, 2013
11.31.3	February 17, 2012
11.31.4	February 17, 2012
11.31.5	February 18, 2011
11.31.6	February 15, 2013
11.31.7	February 17, 2012
11.31.8	February 15, 2013
11.31.9	February 15, 2013
11.31.10	February 15, 2013
11.31.11	February 15, 2013
11.31.12	February 15, 2013
11.31.13	February 15, 2013
11.31.14	February 15, 2013
11.31.15	February 15, 2013
11.31.16	February 15, 2013
11.31.17	February 15, 2013
11.31.18	February 15, 2013
11.31.19	February 15, 2013
11.31.20	February 15, 2013
11.31.21	February 15, 2013
11.31.22	February 15, 2013
11.31.23	February 15, 2013
11.31.24	February 15, 2013
11.31.25	February 15, 2013
11.31.26	February 15, 2013

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11.31.27	February 15, 2013	11.40.20	February 15, 2013
11.31.28	February 15, 2013	11.40.21	February 15, 2013
11.31.29	February 15, 2013	11.40.22	February 15, 2013
11.31.30	February 15, 2013	11.40.23	February 15, 2013
11.31.31	February 15, 2013	11.40.24	February 15, 2013
11.31.32	February 15, 2013	11.40.25	February 15, 2013
11.31.33	February 15, 2013	11.40.26	February 15, 2013
11.31.34	February 15, 2013	11.40.27	February 15, 2013
11.31.35	February 15, 2013	11.40.28	February 15, 2013
11.31.36	February 15, 2013	11.40.29	February 15, 2013
11.32.1	August 19, 2009	11.40.30	February 15, 2013
11.32.2	February 15, 2013	11.40.31	February 15, 2013
11.32.3	February 15, 2013	11.40.32	February 15, 2013
11.32.4	August 23, 2004	11.40.33	February 15, 2013
11.33.1	February 18, 2011	11.40.34	February 15, 2013
11.33.2	February 18, 2011	11.40.35	February 15, 2013
11.34.1	February 15, 2013	11.40.36	February 15, 2013
11.34.2	February 15, 2013	11.40.37	February 15, 2013
11.34.3	February 15, 2013	11.40.38	February 15, 2013
11.34.4	February 15, 2013	11.40.39	February 15, 2013
11.34.5	February 15, 2013	11.40.40	February 15, 2013
11.34.6	February 15, 2013	11.40.41	February 15, 2013
11.34.7	February 15, 2013	11.40.42	February 15, 2013
11.34.8	February 15, 2013	11.40.43	February 15, 2013
11.34.9	February 15, 2013	11.40.44	February 15, 2013
11.34.10	February 15, 2013	11.40.45	February 15, 2013
11.34.11	February 15, 2013	11.40.46	February 15, 2013
11.34.12	February 15, 2013	11.40.47	February 15, 2013
11.40.1	February 18, 2011	11.40.48	February 15, 2013
11.40.2	February 17, 2012	11.40.49	February 15, 2013
11.40.3	February 15, 2013	11.40.50	February 15, 2013
11.40.4	February 15, 2013	11.41.1	August 19, 2009
11.40.5	February 15, 2013	11.41.2	February 23, 2005
11.40.6	February 15, 2013	11.41.3	February 18, 2011
11.40.7	February 15, 2013	11.41.4	February 15, 2013
11.40.8	February 15, 2013	11.41.5	February 15, 2013
11.40.9	February 15, 2013	11.41.6	February 15, 2013
11.40.10	February 15, 2013	11.41.7	February 15, 2013
11.40.11	February 15, 2013	11.41.8	February 15, 2013
11.40.12	February 15, 2013	11.41.9	February 15, 2013
11.40.13	February 15, 2013	11.41.10	February 15, 2013
11.40.14	February 15, 2013	11.41.11	February 15, 2013
11.40.15	February 15, 2013	11.41.12	February 23, 2005
11.40.16	February 15, 2013	11.42.1	February 8, 2002
11.40.17	February 15, 2013	11.42.2	February 18, 2011
11.40.18	February 15, 2013	11.42.3	February 18, 2011
11.40.19	February 15, 2013	11.42.4	February 15, 2013

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11.42.5	February 15, 2013	11.42.52	February 15, 2013
11.42.6	February 15, 2013	11.42.53	February 15, 2013
11.42.7	August 15, 2011	11.42.54	February 15, 2013
11.42.8	August 17, 2007	11.43.1	February 15, 2013
11.42.9	August 21, 2008	11.43.2	February 15, 2013
11.42.10	February 19, 2009	11.43.3	February 15, 2013
11.42.11	February 15, 2013	11.43.4	February 15, 2013
11.42.12	February 15, 2013	11.43.5	August 14, 2012
11.42.13	February 15, 2013	11.43.6	August 14, 2012
11.42.14	August 17, 2007	11.43.7	August 14, 2012
11.42.15	February 15, 2013	11.43.8	August 14, 2012
11.42.16	February 15, 2013	11.43.9	August 14, 2012
11.42.17	February 15, 2013	11.43.10	August 14, 2012
11.42.18	February 15, 2013	11.43.11	August 14, 2012
11.42.19	February 15, 2013	11.43.12	August 14, 2012
11.42.20	February 15, 2013	11.43.13	February 15, 2013
11.42.21	February 15, 2013	11.43.14	February 15, 2013
11.42.22	February 15, 2013	11.43.15	February 15, 2013
11.42.23	February 15, 2013	11.43.16	February 15, 2013
11.42.24	February 15, 2013	11.43.17	February 15, 2013
11.42.25	February 15, 2013	11.43.18	February 15, 2013
11.42.26	February 15, 2013	11.43.19	February 15, 2013
11.42.27	February 15, 2013	11.43.20	August 16, 2013
11.42.28	February 15, 2013	11.43.21	February 15, 2013
11.42.29	February 15, 2013	11.43.22	August 16, 2013
11.42.30	February 15, 2013	11.43.23	February 15, 2013
11.42.31	February 15, 2013	11.43.24	August 14, 2012
11.42.32	February 15, 2013	11.43.25	August 16, 2013
11.42.33	February 15, 2013	11.43.26	August 14, 2012
11.42.34	February 15, 2013	11.43.27	August 14, 2012
11.42.35	February 15, 2013	11.43.28	August 14, 2012
11.42.36	February 15, 2013	11.43.29	August 14, 2012
11.42.37	February 15, 2013	11.43.30	August 14, 2012
11.42.38	February 15, 2013	* 11.43.31	February 20, 2014
11.42.39	February 15, 2013	* 11.43.32	February 20, 2014
11.42.40	February 15, 2013	* 11.43.33	February 20, 2014
11.42.41	February 15, 2013	* 11.43.34	February 20, 2014
11.42.42	February 15, 2013	* 11.43.35	February 20, 2014
11.42.43	August 16, 2013	* 11.43.36	February 20, 2014
11.42.44	February 15, 2013	* 11.43.37-38	Deleted
11.42.45	February 15, 2013	11.50.1	February 8, 2002
11.42.46	February 15, 2013	11.50.2	February 8, 2002
11.42.47	February 15, 2013	11.50.3	February 8, 2002
11.42.48	February 15, 2013	11.50.4	February 8, 2002
11.42.49	February 15, 2013	11.50.5	February 8, 2002
11.42.50	February 15, 2013	11.50.6	February 8, 2002
11.42.51	February 15, 2013	11.60.1	February 18, 2011

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11.60.2	February 15, 2013
11.60.3	February 15, 2013
11.60.4	February 15, 2013
11.60.5	February 15, 2013
11.60.6	February 18, 2011
11.60.7	February 18, 2011
11.60.8	February 15, 2013
11.60.9	February 18, 2011
11.60.10	February 18, 2011
12 Fuel (tab)	
* 12.TOC.0.1-2	Deleted
* 12.TOC.1-2	February 20, 2014
12.10.1	February 8, 2002
12.10.2	August 23, 2004
12.10.3	August 23, 2004
12.10.4	August 23, 2004
12.20.1	February 15, 2013
12.20.2	August 16, 2013
12.20.3	February 15, 2013
12.20.4	February 15, 2013
12.20.5	August 24, 2005
12.20.6	August 16, 2013
12.20.7	February 15, 2013
12.20.8	August 24, 2005
12.30.1	August 16, 2013
12.30.2	August 16, 2013
13 Hydraulics (tab)	
* 13.TOC.0.1-2	Deleted
* 13.TOC.1-2	February 20, 2014
13.10.1	August 17, 2007
13.10.2	August 17, 2007
13.10.3	February 8, 2002
13.10.4	February 8, 2002
13.20.1	February 8, 2002
13.20.2	August 14, 2002
13.20.3	February 8, 2002
13.20.4	August 17, 2007
13.20.5	February 17, 2012
13.20.6	February 8, 2002
13.30.1	February 15, 2013
13.30.2	February 8, 2002
14 Landing Gear (tab)	
* 14.TOC.0.1-2	Deleted
* 14.TOC.1-2	February 20, 2014
14.10.1	February 8, 2002
14.10.2	February 8, 2002
14.10.3	February 15, 2013
14.10.4	February 15, 2013
14.10.5	February 15, 2013
14.10.6	February 15, 2013
14.20.1	February 19, 2009
14.20.2	August 15, 2011
14.20.3	February 8, 2002
14.20.4	February 8, 2002
14.20.5	February 8, 2002
14.20.6	February 15, 2013
14.30.1	February 15, 2013
14.30.2	February 15, 2013
15 Warning Systems (tab)	
* 15.TOC.0.1-4	Deleted
* 15.TOC.1-4	February 20, 2014
15.10.1	February 18, 2011
15.10.2	February 8, 2002
15.10.3	February 14, 2007
15.10.4	February 8, 2002
15.10.5	August 16, 2013
15.10.6	August 16, 2013
15.10.7	August 16, 2013
15.10.8	August 16, 2013
15.10.9	August 16, 2013
15.10.10	August 16, 2013
15.10.11	August 16, 2013
15.10.12	August 16, 2013
15.10.13	August 16, 2013
15.10.14	August 16, 2013
15.10.15	August 16, 2013
15.10.16	August 16, 2013
15.10.17	August 16, 2013
15.10.18	August 16, 2013
15.10.19	August 16, 2013
15.10.20	August 16, 2013
15.10.21	August 16, 2013
15.10.22	August 16, 2013
15.10.23	August 16, 2013
15.10.24	August 16, 2013
15.10.25	August 16, 2013
15.10.26	August 16, 2013
15.10.27	August 16, 2013
15.10.28	August 16, 2013
15.10.29	August 16, 2013
15.10.30	August 16, 2013

FAA Approved:

POI: Richard Capon Date: 4/29/2014

15.10.31	August 16, 2013
15.10.32	August 16, 2013
15.20.1	February 15, 2013
15.20.2	February 8, 2002
15.20.3	February 15, 2013
15.20.4	February 15, 2013
15.20.5	February 15, 2013
15.20.6	February 15, 2013
15.20.7	February 15, 2013
15.20.8	February 15, 2013
15.20.9	February 15, 2013
15.20.10	February 15, 2013
15.20.11	February 15, 2013
15.20.12	February 15, 2013
15.20.13	February 18, 2011
15.20.14	August 15, 2011
15.20.15	February 15, 2013
15.20.16	February 15, 2013
15.20.17	August 15, 2011
15.20.18	August 16, 2013
15.20.19	February 15, 2013
15.20.20	February 15, 2013
15.20.21	February 15, 2013
15.20.22	February 15, 2013
15.20.23	February 15, 2013
15.20.24	February 15, 2013
* 15.20.25	February 20, 2014
* 15.20.26	February 20, 2014
* 15.20.27	February 20, 2014
* 15.20.28	February 20, 2014
15.20.29	February 15, 2013
15.20.30	February 15, 2013
15.20.31	February 15, 2013
15.20.32	February 15, 2013
15.20.33	February 15, 2013
15.20.34	February 15, 2013
15.20.35	February 15, 2013
15.20.36	February 15, 2013
15.20.37	February 15, 2013
15.20.38	February 15, 2013
15.30.1	February 15, 2013
15.30.2	February 15, 2013
15.30.3	February 15, 2013
15.30.4	February 18, 2011

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FAA Approved:

POI: Richard Capon Date: 4/29/2014

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General

The Boeing Company issues Flight Crew Operations Manual Bulletins to provide important information to flight crews prior to the next formal revision of the Flight Crew Operations Manual. The transmitted information may be of interest to only specific Operators or may apply to all Operators of this model airplane. Each bulletin will vary.

Bulletins are numbered sequentially for each operator. Each new bulletin is recorded in this record when received and filed as instructed. A bulletin may not apply to all airplane models. In this case, the bulletin specifically identifies the airplane effectivity. When appropriate, the next formal FCOM revision will include an updated bulletin record page.

Bulletin status is defined as follows:

- In Effect (IE) – the bulletin contains pertinent information not otherwise covered in the Flight Crew Operations Manual. The bulletin remains active and should be retained in the manual
- Incorporated (INC) – the bulletin operating information has been incorporated into the Flight Crew Operations Manual. However, the bulletin remains active and should be retained in the manual
- Cancelled (CANC) – the bulletin is no longer active and should be removed from the Flight Crew Operations Manual. All bulletins previously cancelled are no longer listed in the Bulletin Record.

The person filing a new or revised bulletin should amend the Bulletin Record as instructed in the Administrative Information section of the bulletin. When a bulletin includes replacement pages for the Flight Crew Operations Manual or QRH, the included pages should be filed as instructed in the Flight Crew Operations Manual Information section of the bulletin.

Number	Subject	Date	Status
GEFF-4 R1	Fuel System Imbalance Anomaly	July 12, 2004	IE
GEFF-5 R1	Pegasus Flight Management Computer (FMC) Lock-Up Anomaly Due to Data-Bus Communications Failure	October 18, 2005	IE
GEFF-6 R3	Incorrect Turn Direction During a Standard Instrument Departure (SID)	March 11, 2005	IE

Number	Subject	Date	Status
GEFF-9	Performance Predictions Anomaly in Flight Management Computer (FMC) Product Improvement Package (PIP) and Pegasus Software Versions	April 21, 2006	IE
GEFF-11	Pegasus Flight Management Computer (FMC) Departure Routing Anomaly	August 29, 2006	IE
GEFF-12 R1	Uncommanded Auxiliary Power Unit (APU) Shutdown Prior to Engine Start	August 16, 2010	IE
GEFF-13 R1	Honeywell Flight Management Computer (FMC) Anomaly	February 15, 2010	IE
GEFF-14	General Electric (GE) CF6-80C2 Engine Flameout Mitigation	February 20, 2009	IE
GEFF-15	Missing Advisory-Level Message Logic in EICAS Computer P/N S242N701-1001 Operating Program Software (OPS) Version 6	February 15, 2010	IE
GEFF-16	Replacement of STANDBY BUS OFF Quick Reference Handbook (QRH) Checklist.	February 19, 2010	INC
GEFF-17	Uncommanded Turns When LNAV is in Use	October 20, 2010	IE
GEFF-18	FMC Distance to Waypoint Anomaly	November 2, 2012	IE
GEFF-19	Incorrect Turn During Intercept Leg (INTC) in a Standard Instrument Departure (SID)	November 2, 2012	IE

Number	Subject	Date	Status

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Flight Crew Operations Manual Bulletin
for
GE Capital Corporation

The Boeing Company
Seattle, Washington 98124-2207

767

Number: GEFF-4 R1

IssueDate: July 12, 2004

Airplane Effectivity: N316LA (SB Deletes N422LA, N526LA)

Subject: Fuel System Imbalance Anomaly

Reason: To provide information regarding a fuel system imbalance anomaly.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

Boeing has received several operator reports of an imbalance anomaly pertaining to the 767 Fuel System. All operator reports describe simultaneous fuel consumption from the center fuel tank and either the left or right main fuel tank, or simultaneous fuel consumption between the center fuel tank and both left and right main fuel tanks.

Boeing analysis has determined this simultaneous fuel tank consumption anomaly is a result of the center fuel tank pumps not producing adequate pressure to override the main tank fuel pumps. With exception of an empty center fuel tank, the occurrence of the anomaly cannot be accurately predicted for any given flight or any given flight condition.

Boeing is continuing investigation of this anomaly. Several modifications have been made to the center fuel tank override pumps as directed by Federal Aviation Administration (FAA) Airworthiness Directive (AD) 2001-15-08, Amendment 39-12342, effective September 4, 2001, which may be responsible for the imbalance characteristic. FAA AD 2001-15-08 supersedes FAA AD 97-19-15, which is no longer in effect. Therefore, flight crews should be advised of this simultaneous fuel consumption anomaly and provided with recommended operating instructions as temporary corrective action.

The recommended operating instructions contained in this Operations Manual Bulletin have demonstrated in service to both terminate the simultaneous fuel consumption characteristic as well as prevent re-occurrence of the characteristic for the remainder of flight.

There are two means for the flight crew to determine if fuel is simultaneously being consumed from the center fuel tank and either or both main fuel tanks. These are:

1. Flight crew observance of Fuel Quantity Indicating System (FQIS) quantity indicators simultaneously decreasing from the center fuel tank and either or both left and right main fuel tanks without receiving an EICAS fuel system alert; or,
2. Flight crew observance of FQIS quantity indicators simultaneously decreasing from the center fuel tank and either or both left and right main fuel tanks after receiving an EICAS fuel system alert.

Operating Instructions

1. If the flight crew observes FQIS quantity indicators simultaneously decreasing from the center tank and either the left or right main fuel tank without the “FUEL CONFIG” advisory-level EICAS alert displayed and FUEL CONFIG light illuminated, accomplish the FUEL BALANCING supplementary procedure.

   Note: Accomplishing the FUEL BALANCING supplementary procedure allows the center tank fuel pump on the low main fuel tank side to resume override pressure. The left and right main fuel tanks will remain unbalanced at the amount at which the low main fuel tank pumps are selected OFF. When center tank fuel is depleted, the main tanks will begin balancing.

2. If the EICAS advisory-level “FUEL CONFIG” alert displays accompanied by the FUEL CONFIG light, and the flight crew observes FQIS quantity indicators simultaneously decreasing from the center tank and either the left or right main fuel tank, accomplish the FUEL CONFIGURATION non-normal checklist.

   Note: Accomplishing the FUEL CONFIGURATION non-normal checklist allows the center tank fuel pump on the low main fuel tank side to resume override pressure. The left and right main fuel tanks will remain unbalanced at the amount at which the low main fuel tank pumps are selected OFF. When center tank fuel is depleted, the main tanks will begin balancing.

3. If the flight crew observes FQIS quantity indicators simultaneously decreasing from the center tank and both the left and right main fuel tanks without the “LOW FUEL” caution-level EICAS alert displayed, continue normal operation.

   Note: Operator in-service reports have indicated a higher rate of fuel consumption from the center fuel tank being observed in comparison to the rate of fuel consumption from the left and right main fuel tanks. In addition, Boeing analysis has determined that the center fuel tank will empty before the main fuel tank quantities are reduced by an appreciable amount.

4. If the EICAS caution-level “LOW FUEL” alert displays accompanied by the FUEL CONFIG light, accomplish the LOW FUEL non-normal checklist.

   Note: In-service reports have indicated a higher rate of fuel consumption from the center fuel tank in comparison to the rate of fuel consumption from the left and right main fuel tanks. In addition, subsequent Boeing analysis has determined that the center fuel tank will empty before the main fuel tank quantities are reduced by an appreciable amount. Therefore, the “LOW FUEL” alert should be treated with all due vigilance, and the LOW FUEL non-normal checklist accomplished.

5. If the flight crew suspects a fuel leak may exist, accomplish the ENGINE FUEL LEAK non-normal checklist.

   Note: Accomplishing the ENGINE FUEL LEAK non-normal checklist is appropriate if the flight crew suspects or confirms a fuel leak exists. One or more of the following may be evidence of a fuel leak:

   1. Visual observation of fuel spray from strut or engine;
   2. Excessive engine fuel flow;
   3. Total fuel quantity decreasing at an abnormal rate;
   4. “FUEL CONFIG” message on EICAS;
   5. “LOW FUEL” message on EICAS
   6. FUEL DISAGREE – PROG 2 or FUEL QTY ERROR – PROG 2 message on the CDU scratchpad;
   7. INSUFFICIENT FUEL message on the CDU scratchpad.

6. If fuel jettison operation is required, accomplish the FUEL JETTISON non-normal checklist.

   Note: Accomplishing the FUEL JETTISON non-normal checklist will exclusively isolate the center tank fuel for fuel jettison operation.

As a reminder, Auxiliary Power Unit (APU) operation on the ground or in flight may result in depletion of fuel from the left main fuel tank. Therefore, flight crews should be reminded that a left and right main fuel tank unbalance condition might be a result of APU operation.

Master Minimum Equipment List (MMEL) Item 28-41-1 allows airplane dispatch with an FQIS quantity indicator inoperative if the associated provisos are complied with. Boeing recommends not dispatching an airplane under MMEL Item 28-41-1, if the airplane has been modified by Service Bulletins 767-28-0052 or 767-28-0062, or production equivalents, and center tank fuel is loaded. With a main fuel tank FQIS quantity indicator inoperative, flight crew confusion can result in determining whether the fuel system anomaly described above is occurring or if a suspected engine fuel leak condition exists.

Boeing further recommends if a main fuel tank FQIS quantity indicator failure occurs after dispatch on an airplane modified by Service Bulletin 767-28-0052 or 767-28-0062 with center tank fuel loaded, the flight be terminated by taxiing back to parking or landing at the nearest suitable airport.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin GEFF-4 R1 "In Effect" (IE).

This condition is under investigation. This bulletin will be revised to include Service Bulletin information when available.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

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Flight Crew Operations Manual Bulletin
for
GE Capital Corporation

The Boeing Company
Seattle, Washington 98124-2207

767

Number: GEFF-5 R1

IssueDate: October 18, 2005

Airplane Effectivity: (SB Deletes N316LA)

Subject: Pegasus Flight Management Computer (FMC) Lock-Up Anomaly Due to Data-Bus Communications Failure

Reason: To inform flight crews of a Pegasus-FMC anomaly resulting in the lock up of one or both FMCs and to provide temporary operating instructions for lock-up resolution.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

Boeing has confirmed operator reports of in-service single and dual Pegasus-FMC lock-up events resulting from a data-bus communications anomaly. When the anomaly occurs, one or both FMCs may lock up preventing normal CDU access and control of the FMC(s). This lock-up anomaly and the information and recommended operating instructions contained in this Operations Manual Bulletin are <u>only</u> applicable to Pegasus-FMC software versions.

Operator reports indicate the most common lock-up event involves a single FMC; however, dual FMC lock-up events have also been reported. An FMC lock up is indicated by the continuous display of the "SINGLE FMC OPERATION" scratch-pad message with no response to CDU function or line-select keys and may be accompanied by display of the "L,R FMC FAIL" advisory-level EICAS alert message(s), illumination of the amber FAIL light on the CDU(s), and the amber "MAP" flag on the associated HSI display(s). In some cases, both FMCs may continue to operate normally, but no data communication or data comparison occurs between the master FMC and the spare FMC.

Honeywell is aware of this Pegasus-FMC anomaly. The planned fix to the problem is under investigation.

Operating Instructions

If the "SINGLE FMC OPERATION" scratch-pad message displays on the ground on either CDU, or both FMCs lock up as described above on the ground or in-flight, a single attempt at cycling both FMC circuit breakers can be accomplished, flight conditions permitting, as follows:

Note: If in-flight, Boeing recommends the following procedure be accomplished with an autopilot and the autothrottle engaged due to the requirement of a flight crew member leaving his/her station to achieve access to the overhead circuit breaker panel.

Do not use LNAV or VNAV while attempting the following procedure.

L "FMCS CMPTR" circuit breaker (Location E9). .... PULL

R "FMCS CMPTR" circuit breaker (Location E30) .... PULL

Wait 20 seconds.

L "FMCS CMPTR" circuit breaker (Location E9) .... PUSH

R "FMCS CMPTR" circuit breaker (Location E30) .... PUSH

Wait until MENU page reappears with the "< FMC" prompt at line-select key 1L., then select the prompt by pushing line-select key 1L.

FMC ROUTE .... ENTER

Begin route entry by re-entering ORIGIN airport identifier to ensure previous route is initially deleted.

FMC PERFORMANCE DATA .... ENTER

If normal FMC operation is restored, LNAV and/or VNAV may be engaged, as needed.

The temporary procedural steps provided above should restore normal FMC operation; however, some FMC faults may preclude normal operation. If the above procedure does not restore normal FMC operation, DO NOT accomplish a second attempt as this may result in further systems' degradation.

If the "SINGLE FMC OPERATION" scratch-pad message displays during flight, accomplish the FMC FAIL checklist as published in the Boeing Quick Reference Handbook (QRH), or operator equivalent.

Accomplishing the checklist steps contained in the FMC FAIL checklist will configure the airplane systems for single FMC operation. For Pegasus-FMC equipped airplanes which interface with CDUs equipped with the “MENU” mode-select key, continued ETOPS operation should not be compromised due to the alternate navigation functionality.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin GEFF-5 R1 "In Effect" (IE).

This Operations Manual Bulletin will be revised to include service bulletin information when available.

Boeing Maintenance Tip 767 MT 34-047 is related to this Operations Manual Bulletin.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

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Flight Crew Operations Manual Bulletin
for
GE Capital Corporation

The Boeing Company
Seattle, Washington 98124-2207

767

Number: GEFF-6 R3

IssueDate: March 11, 2005

Airplane Effectivity: (SB Deletes N316LA)

Subject: Incorrect Turn Direction During a Standard Instrument Departure (SID)

Reason: To inform pilots of a Pegasus Flight Management Computer System anomaly.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

An operator has reported cases of the Pegasus-FMC commanding a turn opposite to that expected and displayed on the map during a SID. Each of the reported occurrences involves a SID with a course reversal shortly after takeoff. In these cases, a right turn was correctly displayed on the map but the FMC commanded a left turn when certain criteria existed. Specifically, when the airplane has a steep initial climb, the airplane may reach an altitude constraint with the airplane in a position to immediately sequence the next leg. For example, many SIDs are coded with an initial "runway heading" leg (VA leg type) that climbs to a specified altitude. In some procedures, the SID also has a "heading to an intercept" leg (VI leg type) with an associated turn direction following the VA leg.

When this anomaly occurs, the airplane may reach the specified altitude in a position to immediately sequence the next (VI) leg. Should this simultaneous sequence occur, the VI leg with the turn direction is no longer in the route. Since the turn direction is no longer in the route, the FMC will revert to normal turn logic and command a turn in the shortest direction to the new course. The shortest turn direction may be in the opposite direction from that depicted for the departure. When this anomaly occurs, the map will continue to display the correct magenta path but the airplane may turn in the opposite direction.

The only reported occurrence of this anomaly has been on the RW34 departures at Fukuoka, Japan. However, the software anomaly could cause a similar problem at other airports.

The information and operating instructions contained in this Flight Crew Operations Manual Bulletin are only applicable to Pegasus-FMC software versions.

Operating Instructions

During a SID, should the FD or autopilot begin a turn opposite to that displayed on the map or described in the SID description, use HDG SEL to fly the correct chart course to complete the turn in the correct direction. Following completion of the turn, LNAV may be re-engaged and FD guidance may be followed or the autopilot may be engaged normally.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin GEFF-6 R3 "In Effect" (IE).

This anomaly is corrected by Boeing Service Bulletin 767-34-0471. This Flight Crew Operations Manual Bulletin will be canceled after Boeing is notified that all affected airplanes in the operator’s fleet have been modified.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

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Flight Crew Operations Manual Bulletin
for
GE Capital Corporation

The Boeing Company
Seattle, Washington 98124-2207

767

Number: GEFF-9

IssueDate: April 21, 2006

Airplane Effectivity: (SB Deletes N316LA)

Subject: Performance Predictions Anomaly in Flight Management Computer (FMC) Product Improvement Package (PIP) and Pegasus Software Versions

Reason: To inform flight crews of a performance prediction anomaly on FMC-PIP and Pegasus-FMC software versions.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

Boeing has confirmed operator reports regarding erroneous performance predictions following execution of the ABEAM PTS function on the LEGS page of the FMC-Product Improvement Package (PIP) and Pegasus-FMC software versions. When OAT values have been previously entered in the ALT/OAT field of line-select key 5R on a waypoint WIND page, and the ABEAM PTS function is subsequently selected after a "direct-to" flight plan modification, the OAT value on the WIND page erroneously changes to 0-degrees. After execution, fuel predictions are erroneously recalculated based upon 0-degrees instead of the previously entered value for the respective cruise altitude. Operators have reported display of the INSUFFICIENT FUEL alert-level scratch pad message with the fuel prediction values being much lower than originally planned. Additionally, there are no flight deck annunciations or alerts to indicate an OAT value on the WIND page has erroneously changed.

This Flight Crew Operations Manual Bulletin is only applicable to the FMC-Product Improvement Package (PIP) and Pegasus-FMC software versions. Previous FMC software versions do not include the ABEAM PTS function, the ALT/OAT field entry, or individual waypoint WIND pages, and therefore, are not affected.

Operating Instructions

Following selection and prior to executing the ABEAM PTS function, verify the OAT value on the respective WIND page. If necessary, enter the airplane altitude and the indicated Static Air Temperature (SAT) value from PROGRESS page 2 into the ALT/OAT field for the next route waypoint. This OAT entry will propagate to all down-track waypoints. Following entry of the SAT value into the ALT/OAT field and execution of the route modification, the FMC fuel predictions should be near those obtained from the flight plan.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin GEFF-9 "In Effect" (IE).

The corrective action for the anomaly described in this Flight Crew Operations Manual Bulletin is still under investigation. This bulletin will be revised to include Service Bulletin information when available.

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Flight Crew Operations Manual Bulletin
for
GE Capital Corporation

The Boeing Company
Seattle, Washington 98124-2207

767

Number: GEFF-11

IssueDate: August 29, 2006

Airplane Effectivity: (SB Deletes N316LA)

Subject: Pegasus Flight Management Computer (FMC) Departure Routing Anomaly

Reason: To inform flight crews of a Pegasus-FMC anomaly regarding route discontinuity removal between a selected departure and the active route.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

Boeing has confirmed operator reports of a Pegasus-FMC anomaly related to removal of a route discontinuity between a selected departure and the active route. Boeing engineering has confirmed this software anomaly may occur if a route discontinuity is removed using the RTE page 2 instead of using the RTE LEGS page. Some operator reports indicate the waypoint identifier disappears from the scratch pad when line-selected into the discontinuity boxes, but the RTE page title never indicates the route modification, hence the entry attempt is not successful. And in some cases, a subsequent FMC lockup may result.

Honeywell is aware of this Pegasus-FMC anomaly. The planned fix to the problem is under investigation.

Operating Instructions

To prevent the occurrence of this anomaly, removal of route discontinuities between a selected departure and the active route using the RTE LEGS page instead of RTE page 2 is recommended.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin GEFF-11 "In Effect" (IE).

This Flight Crew Operations Manual Bulletin will be revised to include service bulletin information when available.

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Flight Crew Operations Manual Bulletin
for
GE Capital Corporation

The Boeing Company
Seattle, Washington 98124-2207

767

Number: GEFF-12 R1

IssueDate: August 16, 2010

Airplane Effectivity: All Airplanes

Subject: Uncommanded Auxiliary Power Unit (APU) Shutdown Prior to Engine Start

Reason: To inform flight crews of an uncommanded APU shutdown fault prior to engine start and provide temporary operating instructions.

Revised to include Service Bulletin information.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

Boeing has received operator reports of a fault pertaining to an uncommanded Auxiliary Power Unit (APU) shutdown on the ground prior to engine start. Boeing has confirmed the shutdown fault occurs randomly and is a result of pneumatic air reverse flow when either or both Pack Control Selectors are positioned OFF. The uncommanded APU shutdown occurs when the APU Electronic Control Unit (ECU) is unable to compensate for the pneumatic pressure pulse when either or both pack control valve(s) close. Boeing has confirmed the shutdown fault may occur under the following conditions:

- Both engines shutdown;
- APU running;
- APU Bleed Air switch ON; and,
- A Pack Control selector positioned OFF.

Therefore, flight crew recognition of this fault is primarily noticeable when accomplishing the normal “Before Engine Start” procedure after positioning the Pack Control Selectors OFF in preparation for the initial engine start. If the fault is active and an uncommanded APU shutdown occurs, the APU can be restarted without delay without any required time consideration for cool down.

Boeing has confirmed the fault can only occur upon positioning either or both Pack Control Selectors OFF with the APU as the sole source of pneumatic power. Therefore, exposure to the fault described above is isolated to ground operations and specific to APU bleed air supply for initial engine start.

Operating Instructions

For operators experiencing in-service interruption due to uncommanded APU shutdown prior to engine start, the following temporary operating instructions are recommended:

Prior to positioning the Pack Control Selectors OFF when accomplishing the “Before Start Procedure”, select the APU Bleed Air switch OFF and allow the APU Bleed Air VALVE transition light to momentarily illuminate and extinguish. Then, position the left and right Pack Control Selectors OFF and allow the PACK OFF lights to illuminate. Finally, select the APU Bleed Air switch ON to restore pneumatic air to each engine’s starter, and accomplish a normal engine start.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin GEFF-12 R1 "In Effect" (IE).

This anomaly is corrected by Boeing Service Bulletin 767-21-0230.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

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Flight Crew Operations Manual Bulletin
for
GE Capital Corporation

The Boeing Company
Seattle, Washington 98124-2207

767

Number: GEFF-13 R1

IssueDate: February 15, 2010

Airplane Effectivity: (SB Deletes N316LA)

Subject: Honeywell Flight Management Computer (FMC) Anomaly

Reason: To inform flight crews of a Honeywell FMC anomaly that incorrectly deletes a speed constraint.

Revised to include Service Bulletin information.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

Boeing has confirmed operator reports of a Honeywell FMC anomaly that incorrectly deletes a speed constraint. Some SIDs are designed to limit turn radius to maintain clearance with other traffic or restricted airspace. Some of these procedures also have an AT-OR-ABOVE altitude restriction in conjunction with the speed constraint. Typically, the airplane will be required to limit speed until passing the respective waypoint as well as climb above the altitude constraint. In these procedures, VNAV will incorrectly delete the speed constraint prior to reaching the waypoint if the altitude constraint has been satisfied. When this happens, VNAV will command speed to accelerate to ECON speed (or SEL speed) prior to reaching the constrained waypoint. This anomaly exists on all Boeing 747 / 757 / 767 / 777 airplanes equipped with the Honeywell FMC.

Operating Instructions

To prevent exceeding a speed restriction when accompanied by an AT-OR-ABOVE altitude constraint, use speed intervention (enter speed constraint in the MCP Speed Window) until the constrained waypoint is sequenced. After passing the waypoint, select VNAV as desired.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin GEFF-13 R1 "In Effect" (IE).

This anomaly is corrected by Boeing Service Bulletin 767-34-0566.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

Boeing Commercial Airplanes

Commercial Aviation Services

Attn: 767 Manager, Flight Technical Data

P.O. Box 3707, M/C 20-89

Seattle, Washington, 98124-2207 USA

Telephone: (206) 662-4000

Fax: (206) 662-4743

Flight Crew Operations Manual Bulletin
for
GE Capital Corporation

The Boeing Company
Seattle, Washington 98124-2207

767

Number: GEFF-14

IssueDate: February 20, 2009

Airplane Effectivity: All Airplanes

Subject: General Electric (GE) CF6-80C2 Engine Flameout Mitigation

Reason: To provide flight crews with updated background information on engine flameout events in visible moisture with TAT at or below 10°C in the vicinity of convective weather systems; and to provide revised operating instructions.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

Boeing and General Electric (GE) are investigating several CF6-80C2 engine flameout events which have occurred on various airplane models since 1991. Investigation of weather, flight data, and pilot reports associated with these events suggest the flameout events have occurred at altitudes with Static Air Temperature (SAT) above 0°C in the vicinity of convective weather systems. Boeing and GE believe ice accumulated aft of the fan during a descent or deceleration may have been shed and ingested into the engine when the thrust levers were subsequently advanced.

Boeing and GE investigations conclude the airplanes most likely encountered ice crystals lifted by convective activity prior to the engine flameout. At very cold temperatures near thunderstorms the airplane can encounter visible moisture made up of high concentrations of small ice crystals. These ice crystals do not cause weather radar returns. Flight crews have reported deviating around strong weather radar returns when the flameout events have occurred. Flight crews have also reported rain on the windshield when the outside air temperature was too cold for liquid water to exist. Boeing attributes this to ice crystals that melt upon impact with the heated windshield, giving the appearance of rain. These types of ice crystals do not accumulate on cold aircraft surfaces.

Flight crew reports and airplane data have shown the airplane TAT indication may often erroneously indicate 0°C for a period of time just prior to engine flameout events. This anomalous behavior is due to ice crystals partially blocking the probe and is not a cause for the engine flameout but is confirmation that ice crystals were present.

The Operating Instructions contained in this bulletin use engine anti-ice and wing anti-ice. Increased bleed air extraction from the engine causes the combustor to operate at a higher fuel-to-air ratio. This reduces the probability of flameout. In some engine flameout events, engine anti-ice was previously selected on. Boeing and GE understand that the Operating Instructions contained in this bulletin may not prevent all flameout events. However, increased engine bleed air extraction does provide a large increase in the margin to flameout.

These engine flameout events typically occur when the airplane is leveling off at an intermediate altitude. ATC permitting, make a continuous descent at idle thrust. This decreases the exposure time to the ice crystal condition and a potential engine flameout.

If an engine flameout occurs on an airplane equipped with Full Authority Digital Engine Control (FADEC) engines, the Electronic Engine Control (EEC) attempts to relight the engine when it detects N2 below 50% or a rapid decrease in N2. Engines accelerate to idle very slowly at high altitudes. In some of these events, it has taken 120 seconds or more to reach commanded thrust levels. This may be incorrectly interpreted by the flight crew as an engine that is still flamed out instead of an engine already in the process of relighting. If N2 is steadily increasing and EGT remains within limits, the start is progressing normally. In all events investigated, the affected engines successfully started, including some outside the in-flight start envelope. If N2 is steadily increasing and EGT remains within limits following a single engine flameout, the flight crew need not accomplish the ENGINE FAILURE OR SHUTDOWN followed by the ENGINE IN-FLIGHT START checklist. The DUAL ENGINE FAILURE checklist should be accomplished for dual engine flameout events.

Use of wing anti-ice at altitudes above 22,000 feet has not been included in the Operating Instructions to ensure no adverse impact on airplane systems which use engine bleed air.

Entering the TAI/ON ALT on the DESCENT FORECAST page of the FMC adjusts the VNAV path calculation for approach idle conditions with engine anti-ice ON.

Operating Instructions

When TAT is at or below 10°C in visible moisture with engine thrust reduced for a descent or a speed reduction even with SAT less than -40°C:

CAUTION: Do not use engine or wing anti-ice when TAT is above 10°C.

ENGINE ANTI–ICE switches / selectors .... ON
[Increases bleed air extraction to improve engine flameout margin.]

At or below 22,000 feet:

WING ANTI–ICE switch / selector .... ON
[Increases bleed air extraction to improve engine flameout margin.]

During flight in Instrument Meteorological Conditions (IMC), avoid flying directly over significant amber or red depicted map weather radar regions. Use of the weather radar gain and tilt functions are recommended to assess weather radar return reflectivity.

During airplane descent and ATC permitting, attempt a continuous descent at idle thrust to decrease exposure to ice crystal conditions.

Engine and wing anti-ice may be selected OFF (or AUTO, as installed) when the conditions described above no longer exist and are not required for existing flight conditions.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin GEFF-14 "In Effect" (IE).

This condition is under investigation. This Flight Crew Operations Manual bulletin remains in effect until further notice.

This bulletin supersedes the bulletin titled "Engine Flameout Protection GE CF6-80C2 Engines".

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

Boeing Commercial Airplanes

Commercial Aviation Services

Attn: 767 Manager, Flight Technical Data

P.O. Box 3707, M/C 20-89

Seattle, Washington, 98124-2207 USA

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Flight Crew Operations Manual Bulletin
for
GE Capital Corporation

The Boeing Company
Seattle, Washington 98124-2207

767

Number: GEFF-15

IssueDate: February 15, 2010

Airplane Effectivity: (SB Adds N316LA)

Subject: Missing Advisory-Level Message Logic in EICAS Computer P/N S242N701-1001 Operating Program Software (OPS) Version 6

Reason: To inform flight crews of missing EICAS OPS Version 6 advisory-level message logic and to provide temporary operating instructions with OPS Version 6 installed.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

Boeing and Rockwell Collins have confirmed the EICAS advisory-level "L ENG FUEL FILT" alert message is not available on airplanes installed with EICAS computer P/N S242N701-1001 with Operating Program Software (OPS) Version 6. This software version is installed by incorporation of Boeing Service Bulletin 767-31-0236, or production equivalent.

Each engine fuel system is equipped with a filter to remove contaminants and a pressure relief valve to allow bypass of an obstructed filter element. A pressure differential switch provides EICAS alerting of filter element obstruction prior to pressure relief valve actuation and filter bypass. Contaminants in the fuel system may result in erratic engine operation and flameout.

The EICAS advisory-level "L ENG FUEL FILT" alert message indicates an impending fuel filter bypass condition exists on the left engine. In addition, a status-level "L ENG FUEL FILT" message shows on the EICAS Status page. The STATUS Cue indication appears anytime a new status message exists with the EICAS Status page not displayed.

Boeing has been notified by the Federal Aviation Administration (FAA) Aircraft Certification Office (ACO) that an Immediate Adopted Rule (IAR) is being drafted, which will result in imminent issuance of an Airworthiness Directive (AD) regarding this missing advisory-level message.

Operating Instructions

In the interim period with EICAS OPS Version 6 installed, the following temporary operating instructions are provided:

If the STATUS Cue shows anytime on the ground after engine start or during flight, select the Status Page on the secondary EICAS display, and verify the "L ENG FUEL FILT" message is not shown. If the "L ENG FUEL FILT" message is not shown on the Status Page, the secondary engine parameters may be reselected on the secondary EICAS display, or the display may be blanked. If the "L ENG FUEL FILT" message is shown on the Status Page, accomplish the ENGINE FUEL FILTER non-normal checklist as published in the Boeing Quick Reference Handbook (QRH). If on the ground, check the Dispatch Deviations Guide (DDG), or operator equivalent.

In the unlikely event the status-level "L ENG FUEL FILT" and advisory-level "R ENG FUEL FILT" messages are simultaneously shown, an impending fuel filter bypass condition exists on both engines. With both messages shown, airplane fuel system contamination may be present and may result in erratic engine operation and flameout.

Further flight crew action in response to either or both the "L ENG FUEL FILT" status-level message and the "R ENG FUEL FILT" advisory-level messages being shown are not established by Boeing or the FAA. Any further flight crew action should be determined by individual operator policy.

Boeing policy on flight crew use of status-level messages has not changed. After engine start, any condition having adverse effect on safe continuation of the flight appears as an EICAS alert message (Warning, Caution, or Advisory). If other status-level messages are shown as a consequence of complying with these temporary operating instructions, the flight crew should respond in accordance with the appropriate operator policy.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin GEFF-15 "In Effect" (IE).

On airplanes with EICAS OPS Version 6 installed, the effects of this Flight Crew Operations Manual Bulletin are immediately corrected by:

- Incorporation of EICAS OPS Version 5 by either of the following applicable actions:
    - On airplanes of cumulative line (C/L) number 881 or prior, installation of Boeing Service Bulletin 767-31-0180;

    or

    - On airplanes of C/L number 882 and greater, installation per Airplane Maintenance Manual (AMM) 31-41-02/201.

    or

- Incorporation of EICAS OPS Version 7 by Boeing Service Bulletin 767-31-0267.

This Flight Crew Operations Manual Bulletin will be "Cancelled" (CANC) upon operator notification to Boeing that all affected airplanes covered in this Flight Crew Operations Manual have been modified replacing EICAS OPS Version 6.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

Boeing Commercial Airplanes

Commercial Aviation Services

Attn: 767 Manager, Flight Technical Data

P.O. Box 3707, M/C 20-89

Seattle, Washington, 98124-2207 USA

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Flight Crew Operations Manual Bulletin
for
GE Capital Corporation

The Boeing Company
Seattle, Washington 98124-2207

767

Number: GEFF-16

IssueDate: February 19, 2010

Airplane Effectivity: All Airplanes

Subject: Replacement of STANDBY BUS OFF Quick Reference Handbook (QRH) Checklist.

Reason: To provide a revised "STANDBY BUS OFF" procedure (Chapter NNC - Section 6) for the Quick Reference Handbook (QRH).

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

An electrical system failure event was recently confirmed by Boeing, the National Transportation Safety Board (NTSB), and the Federal Aviation Administration (FAA) regarding the partial loss of the DC-powered electrical bus system on a 757 airplane. The information provided by this Flight Crew Operations Manual Bulletin (FCOMB) is related to FAA Safety Alert Flight Operations (SAFO) 09001, Subject: Effects of Electrical Faults Resulting in Main Battery Depletion, Dated: January 13, 2009.

The failure event resulted in the loss of all equipment solely powered by the main airplane battery even though power to both AC buses was available. Boeing and the FAA have determined interim corrective action is needed for all 767 airplanes to mitigate the occurrence of this specific failure event.

During normal operation with the Standby Power selector in the AUTO position, the AC buses supply power to the battery and standby DC buses through a transformer rectifier unit and to the standby AC bus. The main battery charger, powered by the ground service bus, provides DC power to the hot battery bus. If the Standby Power selector is in the BAT position, the battery charger is disabled and the main battery becomes the sole source of electrical power to all equipment powered from the hot battery bus, the battery bus, the standby DC bus, and the standby AC bus. On some airplanes, the APU battery is paralleled to the main battery, which provides increased time these buses can be powered with the Standby Power selector in the BAT position.

The Quick Reference Handbook (QRH) replacement pages provided by this FCOMB provide a revised STANDBY BUS OFF checklist. This STANDBY BUS OFF checklist contains the recommend flight crew guidance in the event the STANDBY BUS OFF advisory-level alert message is shown on EICAS.

Boeing will be issuing Service Bulletin 767-24-0200 during or before 3rd-quarter 2010. This service bulletin will be applicable to all 767 variant airplanes delivered prior to March 2010 and will provide an FAA-approved retrofit kit of parts to bypass the battery-charger cutout with the Standby Power selector in the BAT position during flight. All airplanes delivered during or after March 2010 will have a production revision incorporated to provide the identical battery-charger-cutout configuration provided by the service bulletin.

The QRH replacement pages provided by this FCOMB are valid for use on airplane configurations both unmodified and modified by this service bulletin in a mixed-fleet configuration. When an operator reports to Boeing that all 767 airplanes have been modified by Service Bulletin 767-24-0200, a final revised STANDBY BUS OFF checklist will be issued to the operator's Boeing-published QRH that is compatible to a pure-fleet, SB-modified 767 configuration. This eliminates FAA and Boeing concerns of two STANDBY BUS OFF checklists being contained within an operators QRH, or operator equivalent, and the flight crew potential of erroneously accomplishing a STANDBY BUS OFF checklist not compatible with the airplane wiring configuration.

<u>IMPORTANT</u>: All operators are reminded to properly report all Service Bulletin incorporation to Boeing in a timely manner. This will ensure proper manual pages are provided commensurate with the reported airplane fleet configuration.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin GEFF-16 "Incorporated" (INC).

This affects of this Flight Crew Operations Manual Bulletin (FCOMB) are further modified by pure-fleet incorporation within an operator's fleet of Boeing Service Bulletin 767-24-0200. This Flight Crew Operations Manual Bulletin will be "CANCELLED" (CANC) upon operator notification to Boeing that all affected airplanes covered in this Flight Crew Operations Manual have been modified by Boeing Service Bulletin 767-24-0200.

Please send all correspondence regarding Operations Manual Bulletin status to the following address:

Boeing Commercial Airplanes

Commercial Aviation Services

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Seattle, Washington, 98124-2207 USA

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Flight Crew Operations Manual Bulletin
for
GE Capital Corporation

The Boeing Company
Seattle, Washington 98124-2207

767

Number: GEFF-17

IssueDate: October 20, 2010

Airplane Effectivity: All Airplanes

Subject: Uncommanded Turns When LNAV is in Use

Reason: To inform flight crews of the possibility of the airplane turning prior to the active waypoint when LNAV is in use.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

Boeing has received several reports of uncommanded turns when LNAV is in use. This condition has been reported on 757, 767, 747-400 and 777 airplanes. When an uncommanded turn occurs, the TO (active) waypoint was observed on the FMC CDU to have prematurely sequenced. In some cases, the ND correctly showed the TO waypoint in front of the airplane, but the waypoint symbol's color was white (indicating inactive) instead of magenta (indicating active). No inputs to the FMC were reported to have been in progress at the time of the turns. The condition was usually resolved by performing a DIRECT TO to the waypoint that had prematurely sequenced.

Boeing has been unable to identify the cause of this uncommanded turn condition. Attempts to duplicate it in the lab have so far been unsuccessful.

Operating Instructions

Should an uncommanded turn occur when using LNAV, select HDG SEL to follow the flight plan, then perform a DIRECT TO to the waypoint that had prematurely sequenced. Reengage LNAV as desired.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin GEFF-17 "In Effect" (IE).

This condition is under investigation. This bulletin remains in effect until further notice.

This bulletin will be revised to include information about the service bulletin that resolves the condition when that information becomes available.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

Boeing Commercial Airplanes

Commercial Aviation Services

Attn: 767 Manager, Flight Technical Data

P.O. Box 3707, M/C 20-89

Seattle, Washington, 98124-2207 USA

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Flight Crew Operations Manual Bulletin
for
GE Capital Corporation

The Boeing Company
Seattle, Washington 98124-2207

767

Number: GEFF-18

IssueDate: November 2, 2012

Airplane Effectivity: All Airplanes

Subject: FMC Distance to Waypoint Anomaly

Reason: To inform flight crews of an erroneous distance to waypoint anomaly and subsequent fly-over instead of fly-by waypoint in the route.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

A customer reported an erroneous distance was shown for a flight plan waypoint after a departure procedure was added to the flight plan. This also results in LNAV overflying the waypoint in which the distance is incorrect. This anomaly occurs when moving a waypoint into the first line of the first LEGS page after the flight plan has been activated. Subsequently selecting a SID where the last waypoint of the SID is the same waypoint as the first waypoint of the enroute flight plan results in an incorrect distance to the waypoint following the last waypoint of the SID.

Here is an example of the problem:

ZSSS is the origin. Enter the following fixes on the LEGS page:

JTN..NXD..TOL..ELNEX

Activate and execute the route. Select NXD to the scratchpad and place it into the first line.

Execute this mod.

The distance between NXD and TOL is shown correctly as 78 NM. Select runway 36 with the NXD02X SID. The last waypoint of the SID procedure is NXD. Now the distance between NXD and TOL is incorrectly shown as 121 NM. LNAV will fly-over instead of fly-by waypoint TOL.

Operating Instructions

If a flight plan leg appears to have an incorrect distance, push the line select key next to the waypoint with the incorrect distance twice and execute. Verify the distance is correct.

To prevent this anomaly from occurring, follow the Boeing Normal Procedures for entering Route, Runways and SIDs, included below for review.

RTE page:

1. Enter the route
2. Enter the FLIGHT NUMBER
3. Activate and execute the route

Note: Do not perform a DIRECT TO to the first waypoint.

Departure page:

1. Select the runway and departure routing
2. Execute the runway and departure routing

Verify the route is correct on the RTE page. Check the LEGS page as needed to ensure compliance with the flight plan.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin GEFF-18 "In Effect" (IE).

This condition is under investigation. This Flight Crew Operations Manual Bulletin remains in effect until further notice and will be revised to include service bulletin information when available.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

Boeing Commercial Airplanes
Commercial Aviation Services
Attn: 767 Manager, Flight Technical Data
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Flight Crew Operations Manual Bulletin
for
GE Capital Corporation

The Boeing Company
Seattle, Washington 98124-2207

767

Number: GEFF-19

IssueDate: November 2, 2012

Airplane Effectivity: All Airplanes

Subject: Incorrect Turn During Intercept Leg (INTC) in a Standard Instrument Departure (SID)

Reason: To inform flight crews of a Pegasus Flight Management Computer anomaly.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

A Previous bulletin was issued for a similar problem. Pegasus version 09 was expected to correct this anomaly but it did not.

An operator has reported cases of the Pegasus-FMC commanding a turn opposite to that expected and shown on the map during a SID. Each of the reported cases involves a SID with a 270 degree turn after takeoff. In these cases a left turn was correctly shown on the map for the leg.

When this anomaly occurs, the airplane initially starts to turn in the correct direction but then the FMC loses the turn direction, reverts to normal turn logic and commands a turn in the shortest direction to the new course. The shortest turn direction may be in the opposite direction from that shown for the departure. The active leg at the time was a VI or heading to (INTC) leg.

The only reported occurrences of this anomaly have been on runway 16L and 16R departures at Haneda airport, Tokyo, Japan. However, the software anomaly could cause a similar problem at other airports.

The information and operating instructions contained in this Flight Crew Operations Manual Bulletin are only applicable to Pegasus-FMC software.

Operating Instructions

During a SID, should the FD or autopilot begin in a turn opposite to that shown on the map or described in the SID description, use HDG SEL to fly the correct chart course to complete the turn in the correct direction. Following completion of the turn, LNAV may be re-engaged and FD guidance may be followed or the autopilot may be engaged.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin GEFF-19 "In Effect" (IE).

This condition is under investigation. This Flight Crew Operations Manual Bulletin remains in effect until further notice and will be revised to include service bulletin information when available.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

Boeing Commercial Airplanes

Commercial Aviation Services

Attn: 767 Manager, Flight Technical Data

P.O. Box 3707, M/C 20-89

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Differences, CC-CZZ — Chapter 0
FCOM Bulletins

Number	Subject	Date	Status
LANF-3 R2	FMC Holding Pattern Anomaly	July 6, 2001	IE
LANF-4 R3	Center Tank Fuel Pumps	April 9, 2004	CANC
LANF-5 R1	Consecutive Conditional Altitude Waypoints Map Anomaly	October 31, 2000	IE
LANF-6 R1	VNAV Descent to Holding Altitude	April 1, 2002	IE
LANF-7 R1	Cabin Pressurization Control System (CPCS) Anomaly	May 31, 2001	IE

Flight Crew Operations Manual Bulletin for LAN Cargo S.A.

The Boeing Company
Seattle, Washington 98124-2207

767

Number: LANF-3 R2
IssueDate: July 6, 2001

Airplane Effectivity: (SB Deletes CC-CZZ)

Subject: FMC Holding Pattern Anomaly

Reason: To inform flight crews of incorrect FMC holding pattern size when flying without LNAV engaged.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

The FMC calculates holding pattern size based on the target holding airspeed, current winds and altitude when crossing the holding fix, and FAA/ICAO holding protected airspace limits. The FMC updates holding pattern size, as required, each time the airplane crosses the holding fix. However, current FMC software prevents pattern size update if LNAV was not engaged on the previous crossing of the holding fix. If a holding pattern has been modified after crossing the holding fix without LNAV engaged, the FMC will not update the holding pattern size when the fix is crossed again. The airplane must cross the holding fix twice with LNAV engaged for FMC holding pattern update to occur. This does not affect holding pattern size for initial holding pattern entry.

The anomaly can occur when descending in holding or modifying a holding pattern. In one reported event, the flight crew created a holding pattern in the FMC at an initial approach fix and entered the holding pattern using HDG SEL. Upon receiving ATC clearance, the flight crew began a descent and engaged LNAV. Before crossing the holding fix twice with LNAV engaged, the flight crew descended to an altitude where the original holding pattern size no longer met protected airspace criteria. A GPWS warning was generated from nearby terrain. This terrain alert would have been avoided had a holding pattern update occurred.

The anomaly does not exist with PEGASUS FMC, P/N S242T102-455.

Operating Instructions

When possible, enter and fly FMC holding patterns with LNAV engaged. Holding pattern size will be updated, as required, each time the airplane crosses the holding fix and the airplane will remain within FAA/ICAO hold protected airspace. Cross check lateral and vertical navigation for proper operation.

If 1) climbing or descending in, or 2) modifying, a holding pattern without LNAV engaged, fly the holding pattern in HDG SEL and use time/distance techniques. Under these conditions, use the FMC holding pattern for reference only since pattern size is not updated when the holding fix is crossed.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin LANF-3 R2 "In Effect" (IE).

This anomaly is corrected by Boeing Service Bulletin 767-34-0291 or 767-34-0301 or 767-34-0302 or 767-34-0303 or 767-34-0304. Refer to individual Service Bulletin for applicability.

This Operations Manual Bulletin will be canceled after Boeing is notified that all affected airplanes in the operators fleet have been modified.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

Mailing Address:	Manager, Flight Training and Technical Data 767 Model Boeing Commercial Airplane Group P.O. Box 3707 M/C 20-89 Seattle, WA 98124-2207 USA
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BOEING

Flight Crew Operations Manual Bulletin for LAN Cargo S.A.

The Boeing Company
Seattle, Washington 98124-2207

767

Number: LANF-4 R3
IssueDate: April 9, 2004

Airplane Effectivity: CC-CZZ

Subject: Center Tank Fuel Pumps

Reason: This bulletin informs flight crews of the potential for fuel pump damage that could create a potential ignition source and provides additional information and alternate operating instructions for flight crews. This bulletin provides Federal Aviation Administration (FAA)-approved alternate flight crew operations procedures granted under the provisions of FAA Letter 140S-04-03: "Alternative Method of Compliance (AMOC) to Airworthiness Directive 2001-15-08," dated March 1, 2004.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

Airworthiness Directive (AD) 2001-15-08

An operator removed a center tank fuel pump and found a damaged inlet diffuser assembly. Diffuser assembly damage may cause metal-to-metal contact, creating a potential ignition source. Ignition of fuel vapors may occur if the damaged pump is not fully immersed in fuel. Approximately 500 kilograms (1000 pounds) of fuel is required to ensure the center tank pumps remain completely immersed in fuel.

Pump damage may be accompanied by tripping of the fuel pump circuit breakers.

Center tank pump inlet diffuser damage has been the subject of FAA Airworthiness Directives. The AD's required inspection and replacement of affected fuel pumps, and incorporation of pump improvements per Boeing Service Bulletin SB 767-28-0046. The damaged pump in a reported event had the equivalent of this Service Bulletin incorporated.

Selecting the center tank fuel pumps off before the center tank fuel quantity falls below 500 kilograms (1000 pounds) or at the first indication of low pump pressure, whichever occurs first, ensures that fuel vapors will not come in contact with a potentially damaged fuel pump. The first indication of fuel pump low pressure is the brief, intermittent illumination of the pump PRESS light before the tank quantity indicates zero. EICAS delays the CTR L or R FUEL PUMP messages until the PRESS lights illuminate continuously.

The FUEL CONFIG Light illuminates and the FUEL CONFIG advisory message appears when the center tank fuel pump switches are OFF with greater than 500 kilograms (1200 pounds) in the center tank. Flight crews may experience the FUEL CONFIG light and EICAS message appearing after the center tank fuel pump switches are selected OFF.

A scavenge system (as installed), operating with fuel pressure from the main (wing) tank pumps, will operate automatically to transfer any remaining fuel in the center tank to the main tanks. Fuel transfer begins when the main tanks are approximately half empty.

If the center tank fuel pumps are on during takeoff, a minimum of 2,300 kilograms (5000 pounds) must be in the center tank when the entry doors are closed with the airplane readied for initial taxi. This quantity should reduce the need for flight crews to select center tank pump switches off below 10,000 feet.

If one center tank fuel pump fails with ample fuel in the center tank, the failed pump should be selected OFF. The crossfeed valve(s) should be opened to prevent a fuel unbalance. The remaining center tank pump can remain ON until the center tank fuel quantity approaches 500 kilograms (1000 pounds).

There are no changes to the Fuel Jettison (as installed) or the Low Fuel Non-normal Procedures.

The following Boeing All Operators telegraphic messages were issued on this subject:

- M-7240-97-1126, dated July 22, 1997
- M-7240-97-1259, dated August 14, 1997
- M-7240-97-1486, dated September 18, 1997.

Alternative Method of Compliance (AMOC) to AD 2001-15-08

Boeing submitted request for AMOC to the Seattle Aircraft Certification Office (SACO) and Aircraft Evaluation Group (AEG) of the FAA Northwest Region Branch. The FAA has approved all provisions of the Boeing requested AMOC, per FAA Letter 140S-04-3, "Alternative Method of Compliance to Airworthiness Directive 2001-15-08," dated March 1, 2004. The Operating Instructions section of this Operations Manual Bulletin delineates the alternate flight crew operating procedures to those contained in AD 2001-15-08.

IMPORTANT: Operator adoption of the alternate flight crew operations procedures granted under the AMOC is contingent upon operator notification of the AMOC requirements and operational approval from the Principal Operations Inspector (POI). Since most airplanes affected by this Operations Manual Bulletin are not operated under United States registry, the FAA-approved AMOC has no authority. Final approval for all airplanes operated under foreign government registry must be granted by the appropriate government regulatory authority.

Operating Instructions

Airworthiness Directive (AD) 2001-15-08

If the center tank fuel pumps are on during takeoff, a minimum of 2,300 kilograms (5000 pounds) must be in the center tank when the entry doors are closed with the airplane readied for initial taxi.

As the center tank approaches empty during normal use, select both center tank fuel pump switches OFF with the first occurrence of any of the following:

- at or before center tank fuel quantity reaches 500 kilograms (1000 pounds), or
- either center tank fuel pump PRESS lights illuminate, or
- either the CTR L or R FUEL PUMP EICAS advisory messages are displayed.

If the Fuel Jettison Non-normal Procedure is being used to empty the center tank, complete the jettison procedure and select the center tank fuel pump switches to OFF when the CTR L or R FUEL PUMP EICAS messages are observed or as soon as either of the center tank fuel pump PRESS lights illuminate.

If a center tank fuel pump fails with ample fuel in the center tank, accomplish the FUEL PUMP Non-normal Procedure.

Alternative Method of Compliance (AMOC) to AD 2001-15-08

The intent of the following alternate operating procedures is to provide identical 767 center tank fuel pump operating procedures to those recently mandated by FAA AD on the 757 airplane. The following are 767 alternate flight crew operating procedures approved by FAA AMOC:

1. Center tank fuel operation. The center tank fuel pump switches must be selected ON if center tank fuel quantity is 5,000 pounds (2,300 kilograms) or greater with the airplane readied for initial taxi.

   Both center tank fuel pump switches must be OFF for takeoff and initial climb if center tank fuel is less than 5,000 pounds (2,300 kilograms) with the airplane readied for initial taxi. Both center tank fuel pumps should be selected ON above 10,000 feet MSL or after the pitch attitude has been reduced to begin acceleration to climb speed, if more than 1,000 pounds (500 kilograms) of fuel remains in the center tank.

Both center tank fuel pump switches must be selected OFF when center tank fuel quantity reaches approximately 1,000 pounds (500 kilograms). For airplanes not equipped with a center tank scavenge system, this 1,000 pounds (500 kilograms) of fuel may only be used in a low fuel situation.

Note: In cruise flight, center tank fuel may be reduced to approximately 800 pounds (400 kilograms) as necessary to extinguish the amber FUEL CONFIG light and "FUEL CONFIG" alert message on EICAS. This will allow the fuel configuration alert to activate for a fuel imbalance condition.

2. Non-normal checklist considerations. The amber FUEL CONFIG light will illuminate and the "FUEL CONFIG" alert message will display on EICAS with approximately 1,200 pounds (600 kilograms) of fuel quantity in the center tank and the center tank fuel pump switches are selected OFF. Do not accomplish the FUEL CONFIGURATION non-normal checklist prior to or during takeoff with less than 5,000 pounds (2,300 kilograms) of fuel in the center tank, unless an imbalance is noticed between the main tanks.

   If the amber FUEL CONFIG light illuminates and the "LOW FUEL" alert message displays on EICAS, accomplish the LOW FUEL non-normal checklist, as published. All center tank fuel may be used regardless of the amount of fuel remaining in the center tank.

   If a center fuel tank pump amber PRESS light illuminates and the "CTR L,R FUEL PUMP" alert message displays on EICAS with fuel in the center tank, accomplish the FUEL PUMP non-normal checklist, as published. A fuel pump failure should be assumed in this situation.

   If fuel jettison operation is required, accomplish the FUEL JETTISON non-normal checklist, as published. All center tank fuel is available for jettison operations, as allowed under AD 2001-15-08.

3. Increase in certified Maximum Zero Fuel Weight (MZFW). Provided the affects of airplane center-of-gravity (CG) are verified to be within allowable limits, the zero fuel weight of the airplane plus the weight of fuel in the center tank may exceed the certified MZFW up to a value of 5,000 pounds (2,300 kilograms). This MZFW increase is to allow for center tank fuel, which cannot be used during takeoff and initial climb. The magnitude of the increase in zero fuel weight is not to exceed the weight of loaded fuel in the center tank and is only permitted when operating under the Airplane Flight Manual (AFM) revisions mandated by AD 2001-15-08.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin LANF-4 R3 "In Effect" (IE).

This condition is corrected by Boeing Service Bulletin 767-28-0062. This bulletin will be cancelled after Boeing is notified that all affected airplanes in your fleet have been modified.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

Mailing Address:	Manager, Flight Training and Technical Data 767 Model Boeing Commercial Airplane Group P.O. Box 3707 M/C 20-89 Seattle, WA 98124-2207 USA
Fax:	(206) 662-7812
Telex:	32-9430 Station 627
SITA:	SEABO7X

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BOEING

Flight Crew Operations Manual Bulletin for LAN Cargo S.A.

The Boeing Company
Seattle, Washington 98124-2207

767

Number: LANF-5 R1

IssueDate: October 31, 2000

Airplane Effectivity: (SB Deletes CC-CZZ)

Subject: Consecutive Conditional Altitude Waypoints Map Anomaly

Reason: To inform flight crews of an HSI Map display anomaly associated with routes containing two consecutive conditional altitude waypoints.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

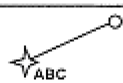
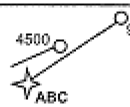
Background Information

During flight test, a Boeing flight crew experienced an HSI Map display anomaly. Simulator and lab tests show that when two consecutive conditional altitude waypoints exist in a procedure, the Map display of the magenta line does not reflect the intended path on the active leg for the conditional altitude waypoint. The displayed magenta line may erroneously indicate a turn prior to the airplane satisfying the required altitude for the turn. Conditional altitude waypoints are depicted as a small circle along with the altitude on the HSI Map display and their location depends on the airplane satisfying the altitude associated with the leg.

Consecutive conditional altitude waypoints may appear in Standard Instrument Departures (SID) and Missed Approach procedures and are automatically entered into the route when a procedure is selected from the FMC DEPARTURES or ARRIVALS page. Procedures which use this combination of two consecutive altitude waypoints usually require a climb to a specified altitude followed by a small turn to intercept a VOR radial while climbing to a higher altitude. Approximately 400 procedures worldwide are affected by this anomaly.

Honeywell and Boeing are investigating this anomaly.

The typical HSI Map display and corresponding RTE LEGS page display for conditional altitude waypoints are shown below:

Description	ND Map Display	CDU LEGS Page Display
Constant Heading to an Altitude	 4500	070° HDG (4500)
Constant Course to an Altitude	 4500	070° TRK (4500)
Outbound Radial to an Altitude	 9700 ABC	070° (9700)
Consecutive Course to an Altitude Followed by Outbound Radial to an Altitude	 4500 9700 ABC	070° TRK (4500) 063° (9700)

Operating Instructions

When flying a SID or missed approach procedure containing consecutive conditional altitude waypoints, the active route shown on the HSI Map is incorrect; however, LNAV guidance is reliable and may be flown using either the flight director or autopilot. Monitor LNAV progress and insure all altitudes and turn points are consistent with the procedure and available raw data.

Three different vendors (Jeppesen, Swissair and Racal) supply navigation data bases for the FMC. Currently affected procedures for each vendor's navigation data base are contained in the original bulletin and are not reissued with this bulletin. To determine which vendor supplies your data base, check the Navigation Data Line on the FMC IDENT page. The navigation data base identifier begins with a three letter code. Use the Navigation Data Base vs. Vendor Reference Table (A) to determine the vendor associated with the three letter navigation data base identifier. Then locate the vendor tables (B1, B2 and B3) to determine the affected procedures.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin LANF-5 R1 "In Effect" (IE).

This anomaly is corrected by Boeing Service Bulletin 767-34-0291 or 767-34-0301 or 767-34-0302 or 767-34-0303 or 767-34-0304. Refer to individual Service Bulletin for applicability.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

Mailing Address:	Manager, Flight Training and Technical Data 767 Model Boeing Commercial Airplane Group P.O. Box 3707 M/C 20-89 Seattle, WA 98124-2207 USA
Fax:	(206) 662-7812
Telex:	32-9430 Station 627
SITA:	SEABO7X

Operations Manual Bulletin Attachment
Consecutive Conditional Altitude Waypoints Map Anomaly

Table A
Navigation Data Base vs. Vendor Reference Table

Nav. ID	Vendor	Nav. ID	Vendor	Nav. ID	Vendor	Nav. ID	Vendor*
AA7	J	BA1	J	CI4	J	ET2	J
AC1	J	BB2	S	CI5	J	ET3	J
AC3	J	BE0	J	CJ1	J	ET4	J
AC4	J	BE3	J	CM2	J	ET6	J
AE1	S	BE4	J	CM3	J	EZ1	S
AE2	S	BE6	J	CO1	J	EZ2	S
AE3	S	BE7	J	CP1	J	FA1	J
AF4	S	BE8	J	CP4	J	FA2	J
AH3	J	BE9	J	CP9	J	FI1	J
AH6	J	BI1	J	CV1	S	FS1	J
AI4	J	BI6	J	CX4	J	FX1	J
AJ1	J	BI7	J	CZ5	J	GA5	S
AM1	J	BK1	J	CZ6	J	GB1	J
AM6	J	BK1	J	DL1	J	GB2	J
AN6	A	BO1	J	DL2	J	GD1	J
AR1	J	BO4	J	DL3	J	GF1	J
AR5	J	BR1	J	DL3	J	GF2	J
AT1	J	BR2	J	DL4	J	GF5	J
AT2	J	BY1	R	DL5	J	GG1	J
AT4	J	BY2	R	DP1	J	GS1	J
AV1	J	BY3	R	DP5	J	HE4	J
AW1	J	BY4	R	DP8	J	HP5	J
AW2	J	BY6	R	EE1	J	HV2	S
AY1	J	CA2	J	EK2	S	HV5	S
AY8	J	CA4	J	ER1	J	HV6	S
AZ8	S	CB2	J	ET1	J	HY6	S
AZ8	S	CB2	J	ET1	J	HY6	S

*J = Jeppesen (Table B1) S = Swissair (Table B2) R = Racal (Table B3)

Operations Manual Bulletin Attachment
Consecutive Conditional Altitude Waypoints Map Anomaly

Table A
Navigation Data Base vs. Vendor Reference Table

Nav. ID	Vendor	Nav. ID	Vendor	Nav. ID	Vendor	Nav. ID	Vendor*
IB1	S	LA2	J	MS5	J	PT4	R
IB3	S	LA6	J	MS6	J	PT5	R
IL5	J	LH4	S	MT1	J	PT6	R
IL6	J	LH5	S	MU1	J	QF1	J
JD7	J	LO1	J	MX1	J	QF4	J
JD9	J	LO6	J	MX4	J	QN2	J
JG4	J	LU1	S	NG6	J	QN3	J
JK1	S	LU3	S	NH1	J	QQ2	J
JK3	S	LU4	S	NH2	J	RA1	J
JL1	J	LU5	S	NH4	J	RG1	J
JL2	J	LU6	S	NH6	J	RG2	J
JL4	J	LU7	S	NS1	J	RS6	J
JL6	J	LY2	J	NS2	J	SA4	J
KE2	J	LY3	J	NS3	J	SA6	J
KE4	J	LY7	J	NU1	J	SE1	J
KF1	J	MA6	J	NW1	J	SI1	J
KF2	J	MD0	J	NW4	J	SK4	S
KF3	J	MD1	J	OZ1	J	SK5	S
KF4	J	MD2	J	OZ2	J	SK6	S
KL4	S	MD3	J	OZ4	J	SN7	S
KL5	S	MH1	S	PA1	S	SQ4	J
KL7	S	MH4	J	PL1	J	SR4	S
KT1	J	MJ1	J	PL2	J	SR5	S
KT2	J	MK1	J	PR4	J	ST1	J
KT6	J	MP2	S	PT1	J	SU6	J
KU6	S	MP5	S	PT2	J	SV5	J
LA1	J	MS1	J	PT3	J	TA1	J

*J = Jeppesen (Table B1) S = Swissair (Table B2) R = Racal (Table B3)

Operations Manual Bulletin Attachment
Consecutive Conditional Altitude Waypoints Map Anomaly

Table A
Navigation Data Base vs. Vendor Reference Table

Nav. ID	Vendor	Nav. ID	Vendor	Nav. ID	Vendor	Nav. ID	Vendor*
TA5	J	UK3	R	WE1	J		
TE4	J	UK6	S	WO2	J		
TE6	J	UN1	S	XG1	J		
TE7	J	UN2	S	XO2	S		
TG5	S	UN5	S	XO5	J		
TK2	J	UP1	J	XY1	S		
TQ2	S	UP3	J	YK1	J		
TQ3	S	UP5	J	YN1	J		
TR1	J	UP6	J	YX1	J		
TR2	J	US5	J	ZB1	R		
TR3	J	US6	J	ZB2	R		
TS1	J	UX1	J	ZB3	R		
TS2	J	UX2	J	ZB4	R		
TW1	J	UX3	J	ZO1	J		
TW2	J	VE1	J				
TW3	J	VE2	S				
TW4	J	VO1	S				
TZ1	J	VO3	S				
TZ2	J	VP1	S				
TZ3	J	VR1	J				
TZ4	J	VS4	S				
UA1	J	VZ1	J				
UA2	J	VZ2	J				
UA4	J	VZ4	J				
UC1	J	VZ5	J				
UD1	J	VZ6	J				

*J = Jeppesen (Table B1) S = Swissair (Table B2) R = Racal (Table B3)

Operations Manual Bulletin Attachment
Consecutive Conditional Altitude Waypoints Map Anomaly

Table B1
Jeppesen Navigation Data Base - Standard Instrument Departures

ICAO ID	Airport	Departure	Runway
EDFH	Hahn, Germany	RUWE1E	RW03
EHAM	Amsterdam,Schipol, Netherlands	EO01L	RW01L
EHAM	Amsterdam,Schipol, Netherlands	EO09L	RW09L
EHAM	Amsterdam,Schipol, Netherlands	EO27L	RW27L
ENBO	Bodo, Norway	GLOM2B	RW26
ENBO	Bodo, Norway	STOB1B	RW26
ENDU	Bardufoss, Norway	BDF2	RW11
ENDU	Bardufoss, Norway	LAVN2A	RW11
ENDU	Bardufoss, Norway	TULD2A	RW11
ENZV	Stavanger/Sola, Norway	BANK1D	RW29
ENZV	Stavanger/Sola, Norway	DOGI1D	RW11
ENZV	Stavanger/Sola, Norway	DOLF1D	RW29
ENZV	Stavanger/Sola, Norway	FUND1D	RW29
ENZV	Stavanger/Sola, Norway	GRAM1D	RW11
ENZV	Stavanger/Sola, Norway	LUCK1D	RW29
ENZV	Stavanger/Sola, Norway	MADY1D	RW11
ENZV	Stavanger/Sola, Norway	OKLA1D	RW11
ENZV	Stavanger/Sola, Norway	SIRD1D	RW11
ENZV	Stavanger/Sola, Norway	STON1D	RW29
ESNN	Sundsvall-Harnosand, Sweden	LUE1C	RW34
ESNN	Sundsvall-Harnosand, Sweden	STEW2C	RW34
FACT	Cape Town, South Africa	OKTE2B	RW19
FACT	Cape Town, South Africa	PARI2B	RW19
GCFV	Fuerteventura, Canary Is	KORA1R	RW19
GCFV	Fuerteventura, Canary Is	LPC2R	RW19
GCFV	Fuerteventura, Canary Is	LT1R	RW19
GCFV	Fuerteventura, Canary Is	SAMA1R	RW19
GCFV	Fuerteventura, Canary Is	TFN1R	RW19

Operations Manual Bulletin Attachment
Consecutive Conditional Altitude Waypoints Map Anomaly

Table B1
Jeppesen Navigation Data Base - Standard Instrument Departures

ICAO ID	Airport	Departure	Runway
GCFV	Fuerteventura, Canary Is	TFS2R	RW19
GCFV	Fuerteventura, Canary Is	VAST1R	RW19
KBZN	Boseman/Gallatin, MT	BZN365	RW30
KBZN	Boseman/Gallatin, MT	BZN86S	RW30
KBZN	Boseman/Gallatin, MT	BZN86W	RW30
KCGZ	Casa-Grande, AZ	UCZKJ1	RW05
KHLN	Helena, MT	HLN2	RW05
KHLN	Helena, MT	HLN2	RW09
KINW	Winslow, AZ	HLN1	RW29
KLAX	Los Angeles, CA	BEVAN1	ALL
KMSO	Missoula, MT	MSOEAS	RW29
KPHX	Phoenix/Sky Harbor, AZ	MISSY2	RW26B
KSJC	San Jose, CA	SUNOL5	RW12
KSTS	Santa Rosa/Sonoma Co, CA	STS5	RW01
KSTS	Santa Rosa/Sonoma Co, CA	STS5	RW14
KSTS	Santa Rosa/Sonoma Co, CA	STS5	RW19
KSTS	Santa Rosa/Sonoma Co, CA	STS5	RW32
LEAS	Asturias, Spain	ARPO1B	RW11
LEAS	Asturias, Spain	LURI1B	RW11
LEAS	Asturias, Spain	MUSI1B	RW11
LEAS	Asturias, Spain	RATP1B	RW11
LEIB	Ibza, Spain	MHN1E	RW24
LEIB	Ibza, Spain	MJV1E	RW24
LEPA	Palma de Mallorca, Spain	MEBU1A	RW24
LEPA	Palma de Mallorca, Spain	MHN1A	RW24
LEPA	Palma de Mallorca, Spain	MJV1B	RW06
LEPA	Palma de Mallorca, Spain	OSGA1A	RW24
LFMI	Istres/Le Tube, France	LUC6D	RW15

Operations Manual Bulletin Attachment
Consecutive Conditional Altitude Waypoints Map Anomaly

Table B1
Jeppesen Navigation Data Base - Standard Instrument Departures

ICAO ID	Airport	Departure	Runway
LGAT	Athens, Greece	FALC1F	RW15
LGAT	Athens, Greece	KOR1F	RW15
LGAT	Athens, Greece	KRS1F	RW15
LGAT	Athens, Greece	TNG1F	RW15
LGAT	Athens, Greece	VILI1F	RW15
LGKL	Kalamata, Greece	KLM1V	RW17
LGKL	Kalamata, Greece	KLM1Y	RW17
LGKP	Karpathos, Greece	KRC1A	RW30
LGKP	Karpathos, Greece	KRC1B	RW12
LGKV	Kavala/Megas Alexandros, Greece	ALX3A	RW05
LGKV	Kavala/Megas Alexandros, Greece	ALX3B	RW23
LGKV	Kavala/Megas Alexandros, Greece	LMO3A	RW05
LGKV	Kavala/Megas Alexandros, Greece	LMO3B	RW23
LGKV	Kavala/Megas Alexandros, Greece	PERE3A	RW05
LGKV	Kavala/Megas Alexandros, Greece	RODO1A	RW05
LGKV	Kavala/Megas Alexandros, Greece	RODO1B	RW23
LGMK	Mikonos, Greece	RIPL1A	RW34
LGMK	Mikonos, Greece	RIPL1B	RW16
LGMT	Mitilini, Greece	LSV1A	RW33
LGRX	Araxos, Greece	ALAK1M	RW36
LGRX	Araxos, Greece	ARGU1M	RW36
LGRX	Araxos, Greece	IXON1M	RW36
LGRX	Araxos, Greece	KESA1M	RW36
LGRX	Araxos, Greece	KOR1M	RW36
LGRX	Araxos, Greece	KRK1M	RW36
LGRX	Araxos, Greece	TRL1M	RW36
LGSR	Santorini, Greece	ASTI1E	RW16
LGSR	Santorini, Greece	ATLA1B	RW34

Operations Manual Bulletin Attachment
Consecutive Conditional Altitude Waypoints Map Anomaly

Table B1
Jeppesen Navigation Data Base - Standard Instrument Departures

ICAO ID	Airport	Departure	Runway
LGSR	Santorini, Greece	ATLA1C	RW16
LGSR	Santorini, Greece	MIL1E	RW34
LGSR	Santorini, Greece	MIL1F	RW34
LGSR	Santorini, Greece	MIL1G	RW16
LGSR	Santorini, Greece	MIL1H	RW16
LGTG	Tanagra, Greece	AGH1C	RW28
LGTG	Tanagra, Greece	AGH1D	RW10
LGTG	Tanagra, Greece	ATH1C	RW28
LGTG	Tanagra, Greece	ATH1D	RW10
LGTG	Tanagra, Greece	IXON1C	RW28
LGTG	Tanagra, Greece	IXON1D	RW10
LGTG	Tanagra, Greece	OLID1C	RW28
LGTG	Tanagra, Greece	OLID1D	RW10
LGTG	Tanagra, Greece	SKL1F	RW28
LGTG	Tanagra, Greece	SKL1G	RW10
LGTS	Thessaloniki/Makedonia, Greece	ARNA1E	RW28
LGTS	Thessaloniki/Makedonia, Greece	FSK1E	RW28
LGTS	Thessaloniki/Makedonia, Greece	LAMB1E	RW28
LGTS	Thessaloniki/Makedonia, Greece	LOPO1E	RW28
LGTS	Thessaloniki/Makedonia, Greece	SKL1E	RW28
LGTS	Thessaloniki/Makedonia, Greece	TSL1F	RW28
LIBC	Crotone, Italy	CDC5A	RW35
LIBC	Crotone, Italy	CDC5B	RW17
LIMP	Parma, Italy	PAR5V	RW02
LIPZ	Venezia/Tessera, Italy	CHI5H	RW22
LIPZ	Venezia/Tessera, Italy	RON5H	RW22
LIPZ	Venezia/Tessera, Italy	ROTA5H	RW22
LIRQ	Florence, Italy	PIS5A	RW23

Operations Manual Bulletin Attachment
Consecutive Conditional Altitude Waypoints Map Anomaly

Table B1
Jeppesen Navigation Data Base - Standard Instrument Departures

ICAO ID	Airport	Departure	Runway
LSGC	Les Eplatures, Switzerland	FRI1B	RW24
LSGC	Les Eplatures, Switzerland	HOC1A	RW24
LSGC	Les Eplatures, Switzerland	HOC1B	RW24
LSGC	Les Eplatures, Switzerland	SPR1B	RW24
LSZG	Grenchen, Switzerland	SHU2T	RW25
LSZG	Grenchen, Switzerland	WIL2T	RW25
MGGT	Guatemala/La Aurora, Guatemala	SJOB	RW01
MGGT	Guatemala/La Aurora, Guatemala	PALEN	RW01
MKJP	Kingston/Norman Manley, Jamaica	MLY1	RW12
MUCU	Santiago de Cuba/Antonio Maceo, Cuba	CAOBA2	RW09
NFNA	Nausori, Fiji	ALFA	RW10
NFNA	Nausori, Fiji	BRAVO	RW10
NFNA	Nausori, Fiji	BRAVO	RW28
NFNA	Nausori, Fiji	CHARLI	RW10
NSFA	Apia/Faleolo, Samoa	ALFA	RW26
NTAA	Tahiti, Tahiti	EMIR1A	RW04
NTAA	Tahiti, Tahiti	KAIN1A	RW04
NTAA	Tahiti, Tahiti	METU1A	RW04
OIAW	Ahwaz, Iran	GABK1B	RW30
OIAW	Ahwaz, Iran	GABK1H	RW12
OIAW	Ahwaz, Iran	MIS1B	RW30
OIAW	Ahwaz, Iran	MIS1H	RW12
OIBB	Bushehr, Iran	KUGV1A	RW31
OIBB	Bushehr, Iran	KUGV1B	RW13
OIBB	Bushehr, Iran	KUGV1C	RW31
OICC	Kermanshah, iran	RULI1D	RW11
OIGG	Rasht, Iran	RALG1A	RW27
OIGG	Rasht, Iran	RALG1B	RW09

Operations Manual Bulletin Attachment
Consecutive Conditional Altitude Waypoints Map Anomaly

Table B1
Jeppesen Navigation Data Base - Standard Instrument Departures

ICAO ID	Airport	Departure	Runway
OIGG	Rasht, Iran	RART1A	RW27
OIGG	Rasht, Iran	RART1B	RW09
OIKB	Bandar Abbass, Iran	TAVN2A	RW03
OIKK	Kerman, Iran	ALGU2B	RW34
OIKK	Kerman, Iran	ALGU2D	RW34
OIKK	Kerman, Iran	ALGU2E	RW34
OIKK	Kerman, Iran	ALGU3A	RW34
OIKK	Kerman, Iran	ALGU3C	RW16
OIKK	Kerman, Iran	ALKE2C	RW34
OIKK	Kerman, Iran	ALKE3A	RW34
OIKK	Kerman, Iran	ALKE3B	RW16
OIKK	Kerman, Iran	ALKU2D	RW34
OIKK	Kerman, Iran	ALKU2E	RW16
OIKK	Kerman, Iran	ALKU3A	RW34
OIKK	Kerman, Iran	ALKU3B	RW16
OIKK	Kerman, Iran	ALKU3C	RW16
OIKK	Kerman, Iran	ALME2D	RW34
OIKK	Kerman, Iran	ALME3A	RW34
OIKK	Kerman, Iran	ALME3C	RW16
OIKK	Kerman, Iran	ALMI2A	RW34
OIKK	Kerman, Iran	ALMI2B	RW16
OIKK	Kerman, Iran	ALMI2C	RW16
OIKK	Kerman, Iran	ALMI2D	RW34
OIKK	Kerman, Iran	ALMO1A	RW34
OIKK	Kerman, Iran	ALMO2B	RW34
OIKK	Kerman, Iran	ALMO2C	RW16
OIKK	Kerman, Iran	ALMO2D	RW34
OIKK	Kerman, Iran	ALMO2E	RW34

Operations Manual Bulletin Attachment
Consecutive Conditional Altitude Waypoints Map Anomaly

Table B1
Jeppesen Navigation Data Base - Standard Instrument Departures

ICAO ID	Airport	Departure	Runway
OIMM	Mashhad, Iran	METK2A	RW13
OIMM	Mashhad, Iran	METK2B	RW31
OIMM	Mashhad, Iran	METK2C	RW31
OIMM	Mashhad, Iran	MIDM1A	RW13
OIMM	Mashhad, Iran	MIDM1B	RW31
OIMM	Mashhad, Iran	NOTS2A	RW13
OIMM	Mashhad, Iran	NOTS2B	RW13
OIMM	Mashhad, Iran	NOTS2C	RW31
OIMM	Mashhad, Iran	RAMI2A	RW13
OIMM	Mashhad, Iran	RAMI2B	RW31
OISS	Shiraz, Iran	KISE1B	RW11
OITR	Uromiyeh, Iran	BONA1B	RW21
OITR	Uromiyeh, Iran	ZAJ1B	RW21
OITT	Tabriz, Iran	RUDA1B	RW12
OITT	Tabriz, Iran	RUDA1D	RW12
OIZH	Zaheadan, Iran	DANO2B	RW17
OLBA	Beirut, Lebanon	KAD1C	RW18
OLBA	Beirut, Lebanon	KAD1C	RW21
RJCH	Hakodate, Japan	HWE2R	RW12
RJCN	Nakashibetsu, Japan	NSE2R	RW26
RJFE	Fukue, Japan	FUER1	RW21
RJFE	Fukue, Japan	JB2	RW03
RJFE	Fukue, Japan	OLE2	RW03
RJFY	Kanoya, Japan	EASTRE	RW08
RJFY	Kanoya, Japan	WESTRE	RW26
RJKA	Amami, Japan	AME1R	RW03
RJKA	Amami, Japan	AME1R	RW21
RJOB	Okayama, Japan	OKC2	RW07

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Consecutive Conditional Altitude Waypoints Map Anomaly

Table B1
Jeppesen Navigation Data Base - Standard Instrument Departures

ICAO ID	Airport	Departure	Runway
RJOB	Okayama, Japan	OYE2R	RW07
RJOB	Okayama, Japan	WASYU1	RW07
RJOC	Izumo, Japan	OIE2	RW07
RJOC	Izumo, Japan	TRE4	RW07
RJOC	Izumo, Japan	XZE1R	RW07
RJOC	Izumo, Japan	XZE3E	RW07
RJOW	Iwami, Japan	IME1R	RW29
RJSA	Aomori, Japan	MRE1R	RW06
RJSA	Aomori, Japan	MRE1R	RW24
RJSF	Fukushima, Japan	GTC1	RW19
RJSF	Fukushima, Japan	SDE1	RW19
RJSF	Fukushima, Japan	YTE1	RW19
RJSY	Shonai, Japan	YSE1R	RW27
RJTH	Hachliojima, Japan	HCE1R	RW25
RJTH	Hachliojima, Japan	HCE2W	RW25
RJTO	Oshma, Japan	MJ1	RW21
RJTO	Oshma, Japan	SPENS2	RW03
RKJY	Yeosu, Korea	GOSB1A	RW17
RKJY	Yeosu, Korea	NIKE1A	RW17
ROAH	Naha, Japan	NHC2SR	RW18
RPMD	Davao/Francisco Bangoy, Phillipines	SID1B	RW23
RPMD	Davao/Francisco Bangoy, Phillipines	SID2	RW23
RPMD	Davao/Francisco Bangoy, Phillipines	SID3	RW23
RPMD	Davao/Francisco Bangoy, Phillipines	SID4	RW23
RPMZ	Zamboanga, Phillipines	SID1	RW09
RPMZ	Zamboanga, Phillipines	SID1	RW27
RPMZ	Zamboanga, Phillipines	SID2	RW09
RPMZ	Zamboanga, Phillipines	SID2	RW27

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Consecutive Conditional Altitude Waypoints Map Anomaly

Table B1
Jeppesen Navigation Data Base - Standard Instrument Departures

ICAO ID	Airport	Departure	Runway
RPMZ	Zamboanga, Phillipines	SID7	RW09
RPMZ	Zamboanga, Phillipines	SID7	RW27
RPVM	Lapu-Lapu/Mactan, Phillipines	SID15	RW04
RPVM	Lapu-Lapu/Mactan, Phillipines	SID15A	RW04
RPVM	Lapu-Lapu/Mactan, Phillipines	SID16	RW04
SCFA	Antofagasta, Chile	ANCLA2	RW18
SCFA	Antofagasta, Chile	ANCLA3	RW19
SCFA	Antofagasta, Chile	COLOSB	RW18
SCFA	Antofagasta, Chile	COLOSC	RW19
SCFA	Antofagasta, Chile	MOREK1	RW18
SCFA	Antofagasta, Chile	MOREK2	RW19
SCIE	Concepcion/Carriel, Chile	CORNL4	RW20
SCSE	La Serena/La Florida, Chile	LILEN1	RW29
SVCS	Charallave/Oscar Machado Zuoloaga, Venezuela	3NOL10	RW10
ZYTL	Dalian, China	D15T	RW28

Operations Manual Bulletin Attachment
Consecutive Conditional Altitude Waypoints Map Anomaly

Table B1
Jeppesen Navigation Data Base - Approaches/Missed Approaches

ICAO ID	Airport	Approach
CYDN	Dauphin, Manitoba, Canada	VOR14
CYXE	Saskatoon, Sask., Canada	VOR33
CYYB	North Bay, Ontario, Canada	VOR18
ENAT	Alta, Norway	ILS12
ENBO	Bodo, Norway	ILS08
ENKB	Kristiansund/Kvernberget, Norway	VOR25
FADN	Durban/Louis Botha, South Africa	VOR23
FYWH	Windhoek/Lughawe, Nambia	VOR26
GCRR	Arrecife/Lanzarote, Canary Is.	ILS04
KAHN	Athens/Ben Epps, GA	VOR02
KALW	Walla Walla, WA	VOR02
KBKE	Baker, OR	VOR12
KBLH	Blythe, CA	VOR26
KBOI	Boise, ID	VOR10R
KBOI	Boise, ID	ILS10R
KBPI	Big Piney/Marbleton, WY	VOR31
KCEC	Crescent City, CA	VOR11
KCEC	Crescent City, CA	ILS11
KCEC	Crescent City, CA	VOR11
KCMA	Camarillo, CA	VOR26
KCOE	Coeur D'alene, ID	VOR01
KCOE	Coeur D'alene, ID	ILS05
KDLF	Del Rio, TX	VOR13C
KDLF	Del Rio, TX	VOR31C
KDRO	Durango/La Plata Co., CO	VOR02
KDRO	Durango/La Plata Co., CO	ILS02
KEEO	Meeker, CO	RNV03
KFLG	Flagstaff, Puliam, AZ	VOR21

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Consecutive Conditional Altitude Waypoints Map Anomaly

Table B1
Jeppesen Navigation Data Base - Approaches/Missed Approaches

ICAO ID	Airport	Approach
KGFK	Grand Forks, ND	VOR17R
KGFK	Grand Forks, ND	VOR35L
KHVR	Havre City-Co, MT	VOR07
KHYS	Hays, KS	VOR16
KHYS	Hays, KS	VOR34
KHYS	Hays, KS	VOR16
KHYS	Hays, KS	VOR34
KIGM	Kingman, AZ	VOR21
KJAC	Jackson Hole, WY	ILS18
KLMT	Klamath Falls, OR	VOR32
KLMT	Klamath Falls, OR	ILS32
KNGP	Corpus Christi, TX	VOR13R
KNQX	Key West, FL	VOR07
KONA	Winona Muni/Max Conrad, MN	VOR29
KOTH	North Bend Muni, OR	VOR04
KPMD	Palmdale, CA	VOR25
KPMD	Palmdale, CA	ILS25
KPNE	North Philadelphia, PA	VOR24
KPUC	Price/Carbon Co, UT	VOR36
KRWL	Rawlins Muni, WY	VOR22
KSBM	Sheboygan Co, WI	VOR03
KSBY	Salisbury/Wicomico Co., MD	ILS32
KSBY	Salisbury/Wicomico Co., MD	VOR14
KSBY	Salisbury/Wicomico Co., MD	VOR32
KSVC	Silver City/Grant Co, NM	LOC26
KSVN	Savannah/Hunter, GA	VOR28
KTMA	Tifton, GA	VOR27
KTMA	Tifton, GA	VOR33

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Consecutive Conditional Altitude Waypoints Map Anomaly

Table B1
Jeppesen Navigation Data Base - Approaches/Missed Approaches

ICAO ID	Airport	Approach
KTRM	Palm Springs Thermal, CA	VOR30
KTVF	Thief River Falls, MN	VOR31
KTWF	Twin Falls/Sun Valley, ID	VOR07
LEBL	Barcelona, Spain	VOR02
LEBL	Barcelona, Spain	ILS07
LGKO	Marathon/Kotroni, Greece	VOR15
LGKO	Marathon/Kotroni, Greece	VOR33
LIPE	Bologna/Borgo Panigale, Italy	VOR12
LIPE	Bologna/Borgo Panigale, Italy	ILS12
LTAQ	Samsun, Turkey	VOR21
MDBH	Barahona, Dominican Republic	VOR12
MDBH	Barahona, Dominican Republic	VOR30
MDPP	Puerto Plata, Dominican Republic	VOR26
MDSD	Santo Domingo/De Las Americas, Dominican Republic	VOR17
MDSD	Santo Domingo/De Las Americas, Dominican Republic	VOR35
MHTG	Tegucigalpa/Toncontin, Honduras	VOR01
MPDA	David/Enrique Malek, Panama	VOR04
MPTO	Panama/Tocumen, Panama	VOR03L
MUCU	Santiago de Cuba/Antonio Maceo, Cuba	ILS09
MUCU	Santiago de Cuba/Antonio Maceo, Cuba	LOC09
NCRG	Avarua/Rarotonga, Cook Is.	ILS08
NCRG	Avarua/Rarotonga, Cook Is.	ILS26
NSFA	Faleolo, Samoa	ILS08
NZNR	Napier, New Zealand	VOR16
OEBH	Bisha, Saudi Arabia	ILS18
OEDR	Dhahran, Saudi Arabia	VOR34L
OEDR	Dhahran, Saudi Arabia	ILS34L

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Consecutive Conditional Altitude Waypoints Map Anomaly

Table B1
Jeppesen Navigation Data Base - Approaches/Missed Approaches

ICAO ID	Airport	Approach
OIBJ	Jam Tohid, Iran	VOR11
OIBJ	Jam Tohid, Iran	ILS11
OIFM	Esfahan, Iran	VOR26L
OIFM	Esfahan, Iran	VOR26R
PABI	Delta Junction, AK	VOR18
PAMC	McGrath, AK	VOR16
PAYA	Yakutat, AK	VOR11
PAYA	Yakutat, AK	VOR29
PHTO	Hilo, Hawaii	ILS26
RJBD	Nanki-Shirahama, Japan	VOR15
RJBD	Nanki-Shirahama, Japan	LOC15
RJCB	Obhiro, Japan	ILS35
RJCH	Hakodate, Japan	VOR12
RJCH	Hakodate, Japan	ILS12
RJCH	Hakodate, Japan	LOC12
RJCM	Memanbetsu, Japan	ILS18
RJDC	Yamaguchi-Ubi/Honshu Is., Japan	VOR07
RJDT	Tsushima, Japan	LOC32
RJDT	Tsushima, Japan	VOR32
RJFK	Kagoshima, Japan	VOR34
RJFK	Kagoshima, Japan	ILS34
RJKB	Okierabu, Japan	VOR22
RJKN	Tokunoshima Is., Japan	VOR01
RJNT	Toyama, Japan	LOC20
RJOB	Okayama, Japan	ILS07
RJOM	Matsuyama, Japan	ILS14
RJOR	Tottori, Japan	ILS10
RJOS	Tokushima, Japan	VOR29

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Consecutive Conditional Altitude Waypoints Map Anomaly

Table B1
Jeppesen Navigation Data Base - Approaches/Missed Approaches

ICAO ID	Airport	Approach
RJSF	Fukushima, Japan	ILS01
RJSF	Fukushima, Japan	VOR01
RJSF	Fukushima, Japan	VOR19
RJSN	Nigata, Japan	VOR10
RJSN	Nigata, Japan	VOR28
RJSN	Nigata, Japan	ILS28
RJSY	Shonai, Japan	VOR27
RJSY	Shonai, Japan	VOR09
RKPK	Kimhae, Korea	VOR36
ROMY	Miyako, Japan	ILS22
ROMY	Miyako, Japan	VOR04
ROMY	Miyako, Japan	VOR22
RORY	Yoron, Japan	VOR14
RORY	Yoron, Japan	VOR32
RPLL	Manila, Phillipines	VOR06
RPLL	Manila, Phillipines	ILS06
RPMD	Davao/Francisco Bangoy, Phillipines	VOR23
RPMD	Davao/Francisco Bangoy, Phillipines	VOR05
RPVA	Tacloban/Daniel Z. Romualdez, Phillipines	VOR36
RPVB	Bacolod Negros Occidental, Phillipines	VOR04
SBFL	Florianopolis/Hercilioluz, Brazil	VOR32
SBUP	Castilho/Urubupunga, Brazil	VOR29
SLVR	Viru Viru, Bolivia	ILS33
SPIM	Lima-Callao, Peru	VOR33
TGPY	Point Salines, GranaVORa	VOR10
VAGO	Goa, India	VOR08
VOMM	Madras, India	VOR12
VOMM	Madras, India	VOR30

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Consecutive Conditional Altitude Waypoints Map Anomaly

Table B1 Jeppesen Navigation Data Base - Approaches/Missed Approaches		
ICAO ID	**Airport**	**Approach**
VTBU	Rayong/Utapao, Thailand	VOR18
VTSB	Surat Thani, Thailand	VOR22
VTUW	Nakon Phanom, Thailand	VOR15
WAAU	Kendari/Wolter Monginsidi, Indonesia	VOR26
WAMM	Manado/Sam Ratulangi, India	ILS36
WAPP	Ambon/Patimura, Indonesia	ILS04
WRLL	Balikpapan/Sepinggan, Indonesia	ILS25
YMAY	Albury, Australia	VOR07
ZGNN	Nanning/Wuxu, China	VOR23

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Table B2
Swissair Navigation Data Base - Standard Instrument Departures

Origin Airport	Airport Name	FMC-CDU Departure	FMC-CDU Runway
EDFH	Hahn, Germany	RUWE1E	RW03
GCFV	Fuerteventura, Canary Is	KORA1R	RW19
GCFV	Fuerteventura, Canary Is	LPC1R	RW19
GCFV	Fuerteventura, Canary Is	LPC2R	RW19
GCFV	Fuerteventura, Canary Is	LT1R	RW19
GCFV	Fuerteventura, Canary Is	SAMA1R	RW19
GCFV	Fuerteventura, Canary Is	TFN1R	RW19
GCFV	Fuerteventura, Canary Is	TFS2R	RW19
GCFV	Fuerteventura, Canary Is	VAST1R	RW19
HKJK	Nairobi/Jomo Kenyatta, Kenya	LADANC	RW06
KHLN	Helena, MT	HLN2	RW05
KHLN	Helena, MT	HLN2	RW09
KSJC	San Jose, CA	ALTAM6	RW12
KSJC	San Jose, CA	SUNOL5	RW12
LEAS	Asturias, Spain	ARPO1A	RW29
LEAS	Asturias, Spain	ARPO1B	RW11
LEAS	Asturias, Spain	LURI1A	RW29
LEAS	Asturias, Spain	LURI1B	RW11
LEAS	Asturias, Spain	MUSI1A	RW29
LEAS	Asturias, Spain	MUSI1B	RW11
LEAS	Asturias, Spain	RATP1A	RW29
LEAS	Asturias, Spain	RATP1B	RW11
LEIB	Ibza, Spain	EO24	RW24
LEIB	Ibza, Spain	MHN1E	RW24
LEIB	Ibza, Spain	MJV1E	RW24
LEPA	Palma de Mallorca, Spain	MEBU1A	RW24
LEPA	Palma de Mallorca, Spain	MHN1A	RW24

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Table B2
Swissair Navigation Data Base - Standard Instrument Departures

Origin Airport	Airport Name	FMC-CDU Departure	FMC-CDU Runway
LEPA	Palma de Mallorca, Spain	MJV1B	RW06
LEPA	Palma de Mallorca, Spain	OSGA1A	RW24
LGAT	Athens, Greece	KEA1D	RW33
LGAT	Athens, Greece	KRS1D	RW33
LGAT	Athens, Greece	TNG1D	RW33
LGAT	Athens, Greece	VILI1F	RW15
LGSK	Skiathos, Greece	AGH1A	RW20
LGSK	Skiathos, Greece	AGH1B	RW02
LGSK	Skiathos, Greece	KORS1A	RW20
LGSK	Skiathos, Greece	KORS1B	RW02
LGSK	Skiathos, Greece	TNG1A	RW20
LGSK	Skiathos, Greece	TNG1B	RW02
LGSK	Skiathos, Greece	TSL1A	RW20
LGSK	Skiathos, Greece	TSL1B	RW02
LGTG	Tanagra, Greece	AGH1C	RW28
LGTG	Tanagra, Greece	AGH1D	RW10
LGTG	Tanagra, Greece	ATH1C	RW28
LGTG	Tanagra, Greece	ATH1D	RW10
LGTG	Tanagra, Greece	IXON1C	RW28
LGTG	Tanagra, Greece	IXON1D	RW10
LGTG	Tanagra, Greece	OLID1C	RW28
LGTG	Tanagra, Greece	OLID1D	RW10
LGTG	Tanagra, Greece	SKL1F	RW28
LGTG	Tanagra, Greece	SKL1G	RW10
LGTS	Thessaloniki/Makedonia, Greece	EO28	RW28
LGTS	Thessaloniki/Makedonia, Greece	EO34	RW34
LGTS	Thessaloniki/Makedonia, Greece	TSL1F	RW28
LIBC	Crotone, Italy	CDC5A	RW35

Operations Manual Bulletin Attachment
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Table B2
Swissair Navigation Data Base - Standard Instrument Departures

Origin Airport	Airport Name	FMC-CDU Departure	FMC-CDU Runway
LIBC	Crotone, Italy	CDC5B	RW17
LIPZ	Venezia/Tessera, Italy	CHI5H	RW22
LIPZ	Venezia/Tessera, Italy	RON5H	RW22
LIPZ	Venezia/Tessera, Italy	ROTA5H	RW22
LIRQ	Florence, Italy	PIS5A	RW23
LLBG	Tel Aviv/D. Ben Gurion, Israel	IRM2E	RW26
LLBG	Tel Aviv/D. Ben Gurion, Israel	IRM2F	RW30
LLBG	Tel Aviv/D. Ben Gurion, Israel	NAT3E	RW26
LLBG	Tel Aviv/D. Ben Gurion, Israel	SALA2E	RW26
LLBG	Tel Aviv/D. Ben Gurion, Israel	SALA2F	RW30
LLBG	Tel Aviv/D. Ben Gurion, Israel	SOLI3E	RW26
LLBG	Tel Aviv/D. Ben Gurion, Israel	TALM2E	RW26
MGGT	Guatemala/La Aurora, Guatemala	SJOB	RW01
MKJP	Kingston/Norman Manley, Jamaica	ENEKA3	RW30
MKJP	Kingston/Norman Manley, Jamaica	LETUM3	RW30
MKJP	Kingston/Norman Manley, Jamaica	NORAN3	RW30
MKJP	Kingston/Norman Manley, Jamaica	OSTER3	RW30
MKJP	Kingston/Norman Manley, Jamaica	OZARK3	RW30
MKJP	Kingston/Norman Manley, Jamaica	TIGON1	RW30
MUCU	Santiago de Cuba/Antonio Maceo, Cuba	CAOBA2	RW09
MUCU	Santiago de Cuba/Antonio Maceo, Cuba	SANTO3	RW09

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Consecutive Conditional Altitude Waypoints Map Anomaly

Table B2
Swissair Navigation Data Base - Standard Instrument Departures

Origin Airport	Airport Name	FMC-CDU Departure	FMC-CDU Runway
MUCU	Santiago de Cuba/Antonio Maceo, Cuba	SANTO3	RW27
NSFA	Apia/Faleolo, Samoa	ALFA	RW08
NSFA	Apia/Faleolo, Samoa	BRAVO	RW08
NSFA	Apia/Faleolo, Samoa	SALA	RW08
NSFA	Apia/Faleolo, Samoa	TELE	RW08
NSFA	Apia/Faleolo, Samoa	VASA	RW08
OIBB	Bushehr, Iran	KUGV1A	RW31
OIBB	Bushehr, Iran	KUGV1B	RW13
OIBB	Bushehr, Iran	KUGV1C	RW31
OIBB	Bushehr, Iran	KUGV1D	RW13
OICC	Kermanshah, iran	RULI1D	RW11
OIFM	Esfahan, Iran	LABT1A	RW26
OIFM	Esfahan, Iran	LADA1A	RW26
OIFM	Esfahan, Iran	LADA2C	RW26
OIFM	Esfahan, Iran	LADA2D	RW08
OIFM	Esfahan, Iran	LADL1A	RW26
OIFM	Esfahan, Iran	LADL2C	RW26
OIFM	Esfahan, Iran	LADL2D	RW08
OIFM	Esfahan, Iran	LARB1A	RW26
OIGG	Rasht, Iran	RALG1A	RW27
OIGG	Rasht, Iran	RALG1B	RW09
OIGG	Rasht, Iran	RART1A	RW27
OIGG	Rasht, Iran	RART1B	RW09
OIKB	Bandar Abbass, Iran	MOBO1B	RW21
OIKB	Bandar Abbass, Iran	MOBO2C	RW03
OIKB	Bandar Abbass, Iran	TAVN2A	RW03
OIKB	Bandar Abbass, Iran	TAVN2E	RW03

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Consecutive Conditional Altitude Waypoints Map Anomaly

Table B2
Swissair Navigation Data Base - Standard Instrument Departures

Origin Airport	Airport Name	FMC-CDU Departure	FMC-CDU Runway
OIKK	Kerman, Iran	ALGU2B	RW34
OIKK	Kerman, Iran	ALGU2D	RW34
OIKK	Kerman, Iran	ALGU2E	RW34
OIKK	Kerman, Iran	ALGU2F	RW16
OIKK	Kerman, Iran	ALGU3A	RW34
OIKK	Kerman, Iran	ALGU3C	RW16
OIKK	Kerman, Iran	ALKE2C	RW34
OIKK	Kerman, Iran	ALKE2D	RW16
OIKK	Kerman, Iran	ALKE3A	RW34
OIKK	Kerman, Iran	ALKE3B	RW16
OIKK	Kerman, Iran	ALKU2D	RW34
OIKK	Kerman, Iran	ALKU2E	RW16
OIKK	Kerman, Iran	ALKU2F	RW16
OIKK	Kerman, Iran	ALKU3A	RW34
OIKK	Kerman, Iran	ALKU3B	RW16
OIKK	Kerman, Iran	ALKU3C	RW16
OIKK	Kerman, Iran	ALME2D	RW34
OIKK	Kerman, Iran	ALME2F	RW16
OIKK	Kerman, Iran	ALME3A	RW34
OIKK	Kerman, Iran	ALME3C	RW16
OIKK	Kerman, Iran	ALMI2A	RW34
OIKK	Kerman, Iran	ALMI2B	RW16
OIKK	Kerman, Iran	ALMI2C	RW16
OIKK	Kerman, Iran	ALMI2D	RW34
OIKK	Kerman, Iran	ALMI2E	RW16
OIKK	Kerman, Iran	ALMI2F	RW16
OIKK	Kerman, Iran	ALMO1A	RW34
OIKK	Kerman, Iran	ALMO2B	RW34

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Table B2
Swissair Navigation Data Base - Standard Instrument Departures

Origin Airport	Airport Name	FMC-CDU Departure	FMC-CDU Runway
OIKK	Kerman, Iran	ALMO2C	RW16
OIKK	Kerman, Iran	ALMO2D	RW34
OIKK	Kerman, Iran	ALMO2E	RW34
OIKK	Kerman, Iran	ALMO2F	RW16
OIMM	Mashhad, Iran	METK2A	RW13
OIMM	Mashhad, Iran	METK2B	RW31
OIMM	Mashhad, Iran	METK2C	RW31
OIMM	Mashhad, Iran	MIDM1A	RW13
OIMM	Mashhad, Iran	MIDM1B	RW31
OIMM	Mashhad, Iran	NOTS2A	RW13
OIMM	Mashhad, Iran	NOTS2B	RW13
OIMM	Mashhad, Iran	NOTS2C	RW31
OIMM	Mashhad, Iran	RAMI2A	RW13
OIMM	Mashhad, Iran	RAMI2B	RW31
OITR	Uromiyeh, Iran	ZAJ1B	RW21
OITT	Tabriz, Iran	RUDA1B	RW12
OITT	Tabriz, Iran	RUDA1D	RW12
OIZH	Zaheadan, Iran	DANO2B	RW17
OIYY	Yazd, Iran	BOMI1D	RW13
OIYY	Yazd, Iran	BONE1D	RW13
OIYY	Yazd, Iran	BONI1D	RW13
OIYY	Yazd, Iran	BONO1D	RW13
OIZH	Zahedan, Iran	DANO2B	RW17
OLBA	Beirut, Lebanon	KAD1C	RW18
OLBA	Beirut, Lebanon	KAD1C	RW21
OLBA	Beirut, Lebanon	KAD1D	RW03
OLBA	Beirut, Lebanon	KAD1D	RW36
ROAH	Naha, Japan	NHC2SR	RW18

Operations Manual Bulletin Attachment
Consecutive Conditional Altitude Waypoints Map Anomaly

Table B2
Swissair Navigation Data Base - Standard Instrument Departures

Origin Airport	Airport Name	FMC-CDU Departure	FMC-CDU Runway
RPVB	Bacolod Negros Occidental, Phil-lipines	SID 2	RW22
RPVM	Lapu-Lapu/Mactan, Phillipines	SID15	RW04
RPVM	Lapu-Lapu/Mactan, Phillipines	SID15A	RW04
RPVM	Lapu-Lapu/Mactan, Phillipines	SID16	RW04
SCIE	Concepcion/Carriel, Chile	CO4TCO	RW20
SCIE	Concepcion/Carriel, Chile	CO4VLD	RW20

Operations Manual Bulletin Attachment
Consecutive Conditional Altitude Waypoints Map Anomaly

Table B2
Swissair Navigation Data Base - Approaches/Missed Approaches

Destination Airport	Airport Name	Approach
EGPB	Sumburgh, UK	ILS27
ENBR	Fergen/Flesland, Norway	ILS35
FCBB	Brazzaville/Maya-Maya, Congo	ILS06
FMCH	Moroni/Hahaia, Comores	ILS02
GCRR	Arrecife/Lanzarote, Canary Is.	ILS04
HAAB	Addis Ababa/Bole, Ethiopia	ILS25
HAAB	Addis Ababa/Bole, Ethiopia	VOR25
HADR	Dire Dawa/Abba Tenna Dejazmatch Yilma, Ethopia	VOR15
HESH	Sharm-El-Shiekh, Egypt	ILS04
KMKC	Kansas City/Downtown, KS	ILS03
KPMD	Palmdale, CA	ILS25
LEAM	Almeria, Spain	NDB08
LEBL	Barcelona, Spain	VOR02
LEBL	Barcelona, Spain	ILS07
LEBL	Barcelona, Spain	ILS25
LFLC	Clermont-Ferrand/Aulnat, France	ILS26
LGKO	Marathon/Kotroni, Greece	VOR15
LGKO	Marathon/Kotroni, Greece	VOR33
LIPE	Bologna/Borgo Panigale, Italy	ILS12
LIRZ	Perugia, Italy	VOR01
LPLA	Lajes-Terceira, Is, Portugal	ILS15
LTCG	Trabzon, Turkey	ILS11
MUCU	Santiago de Cuba/Antonio Maceo, Cuba	ILS09
NWWW	Noumea/La Tontouta, New Caledonia	ILS11
OEDR	Dhahran, Saudi Arabia	ILS34L
OIBJ	Jam Tohid, Iran	VOR11

Operations Manual Bulletin Attachment
Consecutive Conditional Altitude Waypoints Map Anomaly

Table B2
Swissair Navigation Data Base - Approaches/Missed Approaches

Destination Airport	Airport Name	Approach
OIBJ	Jam Tohid, Iran	ILS11
OINR	Ramsar, Iran	NDB31
PAYA	Yakutat, AK	VOR02
RJCH	Hakodate, Japan	ILS12
RJCH	Hakodate, Japan	LOC12
RJFK	Kagoshima, Japan	ILS34
RJNK	Kanazawa/Komatsu, Japan	ILS06
RJNN	Najoya, Japan	VOR34
RJNN	Najoya, Japan	ILS34
RJSA	Aomori, Japan	ILS24
RJSN	Nigata, Japan	ILS28
RJSS	Sendai, Japan	ILS27
RKPK	Kimhae, Korea	ILS36
RKPK	Kimhae, Korea	LOC36
ROAH	Naha, Japan	VOR18
RPLL	Manila/Ninoy Aquino, Phillipines	VOR06
RPVB	Bacolod Negros Occidental, Phillipines	VOR04
VOMM	Madras, India	VOR25
VTUW	Nakon Phanom, Thailand	VOR15
WAPP	Ambon/Patimura, Indonesia	ILS04

Operations Manual Bulletin Attachment
Consecutive Conditional Altitude Waypoints Map Anomaly

Table B3 Racal Navigation Data Base - Standard Instrument Departures			
Origin Airport	Airport Name	FMC-CDU Departure	FMC-CDU Runway
ESNN	Sundsvall-Harnosand, Sweden	LUE1C	RW34
FACT	Cape Town, South Africa	OKTE2B	RW19
FACT	Cape Town, South Africa	PARI2B	RW19
GCFV	Fuerteventura, Canary Is	KORA1R	RW19
GCFV	Fuerteventura, Canary Is	LPC2R	RW19
GCFV	Fuerteventura, Canary Is	LT1R	RW19
GCFV	Fuerteventura, Canary Is	SAMA1R	RW19
GCFV	Fuerteventura, Canary Is	TFN1R	RW19
GCFV	Fuerteventura, Canary Is	TFS2R	RW19
GCFV	Fuerteventura, Canary Is	VAST1R	RW19
LEIB	Ibza, Spain	MHN1E	RW24
LEIB	Ibza, Spain	MJV1E	RW24
LEPA	Palma de Mallorca, Spain	MEBU1A	RW24
LEPA	Palma de Mallorca, Spain	MHN1A	RW24
LEPA	Palma de Mallorca, Spain	MJV1B	RW06
LEPA	Palma de Mallorca, Spain	OSGA1A	RW24
LGMT	Mitilini, Greece	LSV1A	RW33
LIMP	Parma, Italy	PAR5V	RW02
LIMP	Parma, Italy	PAR5Y	RW20
MGGT	Guatemala/La Aurora, Guatemala	PALEN	RW01
MKJP	Kingston/Norman Manley, Jamaica	ENEKA3	RW30
MKJP	Kingston/Norman Manley, Jamaica	MLY1	RW12
MKJP	Kingston/Norman Manley, Jamaica	NORAN3	RW30
MKJP	Kingston/Norman Manley, Jamaica	TIGON1	RW30

Operations Manual Bulletin Attachment
Consecutive Conditional Altitude Waypoints Map Anomaly

Table B3
Racal Navigation Data Base - Standard Instrument Departures

Origin Airport	Airport Name	FMC-CDU Departure	FMC-CDU Runway
MUCU	Santiago de Cuba/Antonio Maceo, Cuba	CAOBA2	RW09
MUCU	Santiago de Cuba/Antonio Maceo, Cuba	SANTO3	RW09
MUCU	Santiago de Cuba/Antonio Maceo, Cuba	SANTO3	RW27
OLBA	Beirut, Lebanon	KAD1C	RW18
OLBA	Beirut, Lebanon	KAD1C	RW21

Operations Manual Bulletin Attachment
Consecutive Conditional Altitude Waypoints Map Anomaly

Table B3
Racal Navigation Data Base - Approaches/Missed Approache

Destination Airport	Airport Name	Approach
DTTX	Sfax/El Maou, Tunisia	VOR15
DTTX	Sfax/El Maou, Tunisia	VOR33
EGPE	Inverness, UK	VOR06
EGPE	Inverness, UK	VOR24
ENBO	Bodo, Norway	ILS08
GCRR	Arrecife/Lanzarote, Canary Is.	VOR04
HEAX	Alexandria, Egypt	VOR04
HEAX	Alexandria, Egypt	VOR36
KDRO	Durango/La Plata Co., CO	ILS02
LIPE	Bologna/Borgo Panigale, Italy	VOR12
LTCG	Trabzon, Turkey	VOR11
MDPP	Puerto Plata, Dominican Republic	VOR26
MDSD	Santo Domingo/De Las Americas, Dominican Republic	VOR35
NSFA	Faleolo, Samoa	ILS08
NWWW	Noumea/La Tontouta, New Caledonia	ILS11
OEDR	Dhahran, Saudi Arabia	ILS34L
RJCH	Hakodate, Japan	ILS12
RJOM	Matsuyama, Japan	ILS14
RPLL	Manila, Phillipines	ILS06
SLVR	Viru Viru, Bolivia	ILS33
SPIM	Lima-Callao, Peru	VOR33
TFFF	Forte-de-France/Le Lamentin Martinque, France	VOR27
WMKL	Pulau/Langkawi, Malaysia	VOR03

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Flight Crew Operations Manual Bulletin for LAN Cargo S.A.

The Boeing Company
Seattle, Washington 98124-2207

767

Number: LANF-6 R1

IssueDate: April 1, 2002

Airplane Effectivity: **(SB Deletes CC-CZZ)**

Subject: VNAV Descent to Holding Altitude

Reason: This bulletin provides information for flight crews regarding an FMC anomaly.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

An operator has reported incidents of VNAV incorrectly allowing descent through the selected MCP altitude. This may occur while descending enroute to a holding pattern. When a VNAV descent is in progress and an altitude constraint is entered in 1R on the HOLD page, the altitude constraint will be displayed in large font on the respective HOLD AT line on the LEGS page. This condition results in the altitude constraint being placed on the HOLD, not necessarily on the waypoint. In some cases, VNAV may allow the airplane to descend below the constraint / HOLD altitude, even if the MCP window is set at the HOLD altitude.

A corresponding anomaly does not exist while the airplane is in a climb. While performing a VNAV climb to a holding pattern, the airplane will not climb through the MCP altitude.

This anomaly has been verified by Boeing and exists in the 200K, 700K, 1-Meg Non PIP FMCs. The anomaly will not occur on those FMCs which incorporate the VNAV ALT mode.

The pilot can identify the applicable FMC by reference to Line 5 on the IDENT page. The applicable FMC will show DRAG FACTOR on Line 5L and F-F Factor (fuel flow factor) on Line 5R.

For information purposes, the non-applicable FMCs will show DRAG/FF (drag and fuel flow factor) on Line 5L and CO DATA on Line 5R (PIP FMC) or OPC on Line 5L and DRAG/FF on Line 5R (PEGASUS). The installed CDU does not provide a reliable indication of the installed FMC because some airplanes have been retrofitted with PIP or PEGASUS FMCs while retaining the basic CDU.

Operating Instructions

When directed to descend and hold at a specified altitude at a waypoint in the route, enter the altitude constraint on the LEGS page. This can be done prior to or after creating the HOLD but must be done on the LEGS page.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin LANF-6 R1 "In Effect" (IE).

This anomaly will be corrected by Boeing Service Bulletin 767-34-0301 or 767-34-0302 or 767-34-0303. Refer to individual Service Bulletin for applicability.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

Mailing Address:	Manager, Flight Training and Technical Data 767 Model Boeing Commercial Airplane Group P.O. Box 3707 M/C 20-89 Seattle, WA 98124-2207 USA
Fax:	(206) 662-7812
Telex:	32-9430 Station 627
SITA:	SEABO7X

BOEING

Flight Crew Operations Manual Bulletin for LAN Cargo S.A.

The Boeing Company
Seattle, Washington 98124-2207

767

Number: LANF-7 R1

IssueDate: May 31, 2001

Airplane Effectivity: **(SB Deletes CC-CZY, CC-CZZ, PR-ABB)**

Subject: Cabin Pressurization Control System (CPCS) Anomaly

Reason: To inform flight crews of a Cabin Pressurization Control System anomaly.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

An anomaly has been discovered with the Cabin Pressurization Control System (CPCS). A recent software change in the CPCS may result in the outflow valve closing and the airplane pressurizing on the ground. In some cases, this has resulted in the inability to open the passenger entry doors.

Boeing has discovered this anomaly was introduced in a recent software change in the Cabin Pressurization Controllers (CPC). Specifically, airplane pressurization can occur after an electrical power transfer is accomplished. This includes, but is not limited to, electrical power transfers as a result of normal engine start and shutdown operations.

The affected Honeywell CPC software is:

2117388-11

2117388-12 and,

2117388-13.

Operating Instructions

The following highlighted procedural steps should be executed as shown below immediately after the "Fuel Control switches" step as published in the Normal Procedures section of The Boeing Company Operations Manual, Volume I:

FUEL CONTROL switches - - - - - - - - - - - - - - - - - - - CUT OFF C

Verify ENG VALVE and SPAR VALVE lights extinguished.

CABIN ALTITUDE MODE SELECTOR - - - - - - - - - - - - MAN F/O

If outflow valve not fully open:

CABIN ALTITUDE MANUAL CONTROL - - - - - - - - CLIMB F/O

Position outflow valve fully open.

The above highlighted procedural steps should be accomplished during all shutdown operations. This will preclude the CPC anomaly from inadvertently pressurizing the cabin. Proper execution of the "Preflight Procedure – First Officer" during the subsequent flight will ensure the pressurization system is properly configured for flight.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin LANF-7 R1 "In Effect" (IE).

This anomaly is corrected by Boeing Service Bulletin 767-21-0166 or 767-21-0168. This Operations Manual Bulletin will be canceled after Boeing is notified that all affected airplanes in the operator's fleet have been modified.

Boeing Maintenance Tip 21-017 is related to this Operations Manual Bulletin.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

Mailing Address:	Manager, Flight Training and Technical Data 767 Model Boeing Commercial Airplane Group P.O. Box 3707 M/C 20-89 Seattle, WA 98124-2207 USA
Fax:	(206) 662-7812
Telex:	32-9430 Station 627
SITA:	SEABO7X

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Limitations — Chapter L
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General

This chapter contains:

- Airplane Flight Manual (AFM) operational information
- Non-AFM operational information.

Information is included if it is:

- operationally significant
- required by FAA Airworthiness Directive
- required by another regulatory requirement

Information is not included if it is:

- incorporated into FCOM normal, supplementary, or non-normal procedures, with a few exceptions
- shown on a placard, display, or other marking

Operational information listed in this chapter that must be memorized (memory items) are marked with a (#) symbol. They meet the following criterion - flight crew access by reference can not assure timely compliance, e.g., severe turbulence penetration speeds. They need only be memorized to the extent that compliance is assured. Knowing the exact wording of the limitation is not required.

Assuming that the remaining items are available to the flight crew by reference, they do not need to be memorized.

Airplane General, Emergency Equipment, Doors, Windows

Operational Limitations

Runway slope	± 2%
Maximum Operating Altitude	43,100 feet pressure altitude
Maximum Takeoff and Landing Altitude	9,500 feet pressure altitude
# Maximum Takeoff and Landing Tailwind Component	15 knots

Non–AFM Operational Information

Note: The following items are not AFM limitations, but are provided for flight crew information.

Turbulent air penetration speed is: 290 KIAS/.78 Mach, whichever is lower.

The navigation and display system does not support operations at latitudes greater than 87° North or South.

Do not operate HF radios during refueling operations.

RVSM Altimeter Cross Check Limits

Standby altimeters do not meet altimeter accuracy requirements of RVSM.

The maximum allowable in-flight difference between Captain and First Officer altitude displays for RVSM operation is 200 feet.

The maximum allowable on-the-ground differences between Captain and First Officer altitude displays for RVSM operation are:

Field Elevation	Max Difference Between Captain & F/O	Max Difference Between Captain or F/O & Field Elevation
SEA LEVEL	40 feet	75 feet
5,000 feet	45 feet	75 feet
10,000 feet	50 feet	75 feet

Weather Radar

Do not operate the weather radar in a hangar or within 50 feet of any personnel or fuel spill.

Note: The hangar and personnel restrictions do not apply to the weather radar test mode.

Maximum Weight Limitations

Maximum Taxi Weight

187,333 Kilograms

Maximum Takeoff Weight

186,880 Kilograms

Maximum Landing Weight

147,871 Kilograms

Maximum Zero Fuel Weight

141,656 Kilograms

Note: Airplane weights may be further restricted by field length limits, climb limits, tire speed limits, brake energy limits, obstacle clearance, or enroute and landing requirements.

Auto Flight

After takeoff, the autopilot must not be engaged below 200 feet AGL.

Do not use the autopilot below 100 ft. Radio Altitude at airport pressure altitudes above 8400 ft.

Use of aileron trim with the autopilot engaged is prohibited.

Maximum allowable wind speeds when landing weather minima are predicated on autoland operations:

# Headwind	25 knots
# Crosswind	25 knots
# Tailwind	15 knots

Aircraft Communications Addressing and Reporting System (ACARS)

N422LA through N526LA

The ACARS is limited to the transmission and receipt of messages which will not create an unsafe condition if the message is improperly received, such as the following conditions:

- the message or parts of the message are delayed or not received,
- the message is delivered to the wrong recipient, or
- the message content may be frequently corrupted.

However, Pre-Departure, Digital Automatic Terminal Information Service, Oceanic Clearances, Weight and Balance and Takeoff Data messages can be transmitted and received over ACARS if they are verified per approved operational procedures.

Engines, APU

Flight crew shall not blank engine vibration display during takeoff.

Engine Fuel System

The minimum inflight fuel tank temperature is 3°C (5°F) above the freeze point of the fuel being used.

The maximum fuel temperature is 49°C (120°F) {Jet B/ JP-4: 43°C (109°F)}

The center tank may contain up to 10,000 kilograms of fuel with less than full main tanks provided center tank fuel weight plus actual zero fuel weight does not exceed the maximum zero fuel weight, and center of gravity limits are observed.

Reverse Thrust

Reverse thrust is for ground use only.

Flight Controls

The maximum altitude for flap extension is 20,000 ft.

Avoid rapid and large alternating control inputs, especially in combination with large changes in pitch, roll, or yaw (e.g. large side slip angles) as they may result in structural failure at any speed, including below VA.

Navigation

N316LA

Do not operate under IFR or at night into airports north of 73° North or south of 60° South Latitude whose navigation aids are referenced to magnetic north.

Ground Proximity Warning System (GPWS) Look–Ahead Alerting

Do not use the terrain display for navigation.

The use of look-ahead terrain alerting and terrain display functions is prohibited within 15 NM of takeoff, approach or landing at an airport not contained in the GPWS terrain database. Refer to Honeywell Document 060-4267-000 for airports and runways contained in the installed GPWS terrain database.

Crew Rest Module

When the Crew Rest Module is required by the Federal Aviation Regulations (4 - pilot crew), it is restricted to use by the essential flight crew only (pilot/co-pilot).

The Crew Rest Module is also restricted to in-flight use only and is therefor not to be occupied during takeoff and landing.

FWIA Revision - 29 June 6, 2013

Table of Contents

Introduction

Amplified

General

This chapter gives:

- An introduction to the normal procedures philosophy and assumptions
- Step by step normal procedures

This section contains Florida West International Airways “Normal” or, what has become commonly referred to as, “Standard Operating Procedures” (SOP’s) for the B767 aircraft. The SOP’s are arranged in order of phase of flight.

Florida West SOP’s were developed using baseline Boeing procedures. Florida West uses a tabular format to present the required crew actions in a sequential order for the following flight operations:

- Before Takeoff Procedure
- Takeoff Procedure
- Climb Procedure
- Cruise Procedure
- Descent Procedure
- Approach Procedure
- Landing Procedure
- Go Around and Missed Approach Procedure
- Landing Roll Procedure

These tables, as provided in the Normal Procedures section, comprise the Company Standard Operating Procedures. In each of the phase of flight tables the basic procedural steps are derived from baseline Boeing procedures. Florida West policy for a particular item or additional information provided by the Company for a particular step is added to the baseline Boeing procedures in the applicable tables.

Standard Operating Procedures (SOP’s)

SOP’s establish the how, when and where items are completed during the course of a normal flight. There may exist many ways to achieve a given objective during a specific phase of flight. SOP’s are spelled out to allow pilots to coordinate their actions in a highly automated cockpit, during periods of heavy workload with the knowledge that each pilot has specific tasks that are performed in a specific, expected manner. This is the best guarantee both pilots are kept "up to speed" on what is happening and why.

The Pilot in Command has the authority to deviate from any procedure if, in his judgment, it is the safest way to proceed. During normal operations, however, SOP's are not voluntary in nature, they must be followed.

Normal Procedures Philosophy and Assumptions

Normal procedures verify for each phase of flight that:

- The airplane condition is satisfactory
- The flight deck configuration is correct

Normal procedures are done on each flight. Refer to the Supplementary Procedures (SP) chapter for procedures that are done as needed, for example the adverse weather procedures.

Normal procedures are written for a trained flight crew and assume:

- All systems operate normally
- The full use of all automated features (LNAV, VNAV, autopilot and autothrottle). This does not preclude the possibility of manual flight for pilot proficiency where allowed.

Normal procedures also assume coordination with the ground crew before:

- Hydraulic system pressurization, or
- Flight control surface movement, or
- Airplane movement

Normal procedures do not include steps for flight deck lighting and crew comfort items.

Normal procedures are done by recall and scan flow. The panel illustration in this section shows the scan flow. The scan flow sequence may be changed as needed.

Configuration Check

It is the crew member's responsibility to verify correct system response. Before engine start, use lights or indications to verify each system's condition or configuration.

If there is an incorrect configuration or response:

- Verify that the system controls are set correctly
- Check the respective circuit breaker as needed. Maintenance must first determine that it is safe to reset a tripped circuit breaker on the ground
- Test the respective system light as needed

Before engine start, review the EICAS alert messages and status display. If there are unexpected messages:

- Check the Minimum Equipment List (MEL) to decide if the condition has a dispatch effect
- Decide if maintenance is needed

If, during or after engine start, there is an alert message:

- Do the respective non-normal checklist (NNC)
- Upon completion of the procedure and prior to takeoff, the Minimum Equipment List (MEL) should be consulted to determine if relief is available. The classification and assignment of MEL/CDL items is determined by specifically authorized personnel.

After engine start, EICAS alert messages are the primary means of alerting the flight crew to non-normal conditions or incorrect configurations.

After engine start there is no need to check status messages. Any message that has an adverse affect on safe continuation of the flight appears as an EICAS alert message.

Crew Duties

Preflight and postflight crew duties are divided between the Captain and First Officer. Phase-of-flight duties are divided between the Pilot Flying (PF) and the Pilot Monitoring (PM).

Each crewmember is responsible for moving the controls and switches in their area of responsibility. The Area of Responsibility illustrations in this section show the area of responsibility for both normal and non-normal procedures.

Typical panel locations are shown. The Captain may direct actions outside of the crewmember's area of responsibility.

The general PF phase-of-flight responsibilities are:

- Taxiing (Captain only)
- Flight path and airspeed control
- Airplane configuration
- Navigation
- Ensure that all applicable air traffic control instructions and FAR's are followed

The general PM phase-of-flight responsibilities are:

- Checklist reading
- Communications
- Tasks asked for by the PF
- Monitoring taxiing, flight path, airspeed, airplane configuration, and navigation
- Fuel shutoff and fire switches (with PF concurrence)
- Ensure that all applicable air traffic control instructions and FAR's are followed

Phase-of-flight duties, beginning with the takeoff procedure and ending with the landing roll procedure, are presented in table form in the appropriate procedures section.

The First Officer, when flying the airplane, performs the duties listed under pilot flying and the Captain performs those duties listed under pilot monitoring.

Normal procedures show who does a step by crew position (C, F/O, PF, or PM):

- In the procedure title, or
- In the far right column, or
- In the column heading of a table

The mode control panel is the PF's responsibility. When flying manually, the PF directs the PM to make the changes on the mode control panel.

The Captain is the final authority for all tasks directed and done.

Control Display Unit (CDU) Procedures

Before taxi, the Captain or First Officer may make CDU entries. The other pilot must verify the entries.

Make CDU entries before taxiing or when stopped. If CDU entries must be made during taxi, the PM makes the entries. The PF must verify the entries before they are executed.

In flight, the PM usually makes the CDU entries. The PF may also make simple CDU entries when the workload allows. The pilot making the entries executes the change only after the other pilot verifies the entries.

During high workload times, for example departure or arrival, try to reduce the need for CDU entries. Do this by using the MCP heading, altitude, and speed control modes. The MCP can be easier to use than entering complex route modifications into the CDU.

Autopilot Flight Director System (ADFS) Procedures

The crew must always monitor:

- Airplane course
- Vertical path
- Speed

When selecting a value on the MCP, verify that the respective value changes on the flight instruments, as applicable.

The crew must verify manually selected or automatic AFDS changes (verification does not require a verbal callout). Use the FMA to verify mode changes for the:

- Autopilot
- Flight director
- Autothrottle

During LNAV and VNAV operations, verify all changes to the airplane's:

- Course
- Vertical path
- Thrust
- Speed

Announcing any unexpected change on the FMA and thrust mode display when they occur is a good CRM practice.

Situational Awareness

One pilot always bears the responsibility of flying the airplane. Both pilots should not be heads down at the same time. Transfer of control is always verbally announced so that control of the airplane is never in doubt.

Likewise, a pilot monitoring who manipulates controls, without direction, in the flying pilot's area of responsibility, has indicated the need for a transfer of control. If one pilot is absent from the cockpit, talking on another frequency or otherwise "out of the loop," the other pilot must brief the pilot who was out of the loop on all changes and must reconfirm any altitude or course changes received.

Third/Fourth Pilot Duties

Relief Officer's qualifications are found in GOM, Chapter 1. Circumstances may be such that a pilot designated RO for a particular trip will occupy the right seat during takeoff or landing. In that case, duties performed by pilots assigned to an augmented crew who are not PF or PM will be considered a Third Pilot (occupies observer seat) or Fourth Pilot. The suggested Third Pilot duties listed below are performed at the Captain's discretion and may be shared with a Fourth Pilot for items not specific to the observer's seat.

At Briefing Area

- Take an active role in flight planning
- Review weather package
- Note forecast fuel remaining at destination and alternate
- Participate in crew briefing
- Determine crew rest schedule in accordance with 121.507 or 121.509 (this may be done at the aircraft)

At Aircraft

- Ensure all crew baggage is properly stowed
- Check contents of Company flight kit and applicable Jepessen Charts
- Complete exterior inspection as requested
- Check catering

- Verify potable water and lavatory service
- Perform HF/SELCAL check when required
- Review aircraft logbook and deferred items log
- Check that the performance computer is onboard (time permitting, verify that it is operational)
- Perform fuel uplifted check

Preflight Procedure

- Be in position at observer's seat before commencement of preflight checklist

Climb Procedure

- Maintain traffic watch and monitor ATC through FL180
- Ensure altimeters are set at transition altitude
- Transmit departure message
- Complete logbook entries for applicable items
- Assist, at PM's request, entering ETA's on the CFP

Descent Procedure

- Maintain traffic watch and monitor ATC from FL180
- Transmit in range message
- Obtain and confirm gate assignment
- Copy ATIS
- Ensure altimeters are set at transition level

Secure Procedure

- Complete logbook, confirm PIC signature and remove crew copy
- Stow Company flight kit items in their proper location
- Confirm performance computer is shutdown, secured and stowed in the lockbox
- Remove log page copies from the log page file and insert them in the trip envelope
- Ensure that all customs disposable catering/garbage items are removed from aircraft

Non-Normal Operations

- Assist PM with appropriate QRH procedures as directed by the PIC
- Coordinate Company notification
- Perform other duties as assigned by PIC

Radio Procedure

The radio communication system consists of VHF, HF and SELCAL units. Unless inoperative system components make alternate methods necessary, the Left VHF radio will be used for active ATC. This means the ATC facility responsible for immediate aircraft control. When not used for simultaneous contact with other ATC facilities or Company Radio, the Right VHF radio will monitor 121.5. The HF radio system should be SELCAL checked during initial preflight if HF communications are required on the planned route of flight. Thereafter, every attempt should be made to tune the HF radios so that SELCAL signals may be received. Unless affected by DMI, both PF and PM will wear and use a headset with boom mike when operating the aircraft below FL 180.

Aircraft Exterior Light Procedure

Exterior aircraft lights are used to see and be seen. Attempting to categorize all possible circumstances a pilot might require activation of a light serves little purpose. The following is a discussion of Florida West light usage policy.

Each exterior light switch on the overhead panel is assigned an “owner.” The owner of the switch is the pilot (by seat position) responsible for the proper positioning of that switch in accordance with Florida West policy. The ownership of a switch may change based on aircraft condition – ground or air. However, only the switch "owner" should operate the switch.

Like all rules, this one has an exception. If the Captain is not in the seat and the FO needs to use one of the Captain’s light switches, he may do so. Similarly, an RO occupying the left seat may operate a light switch owned by the Captain since ownership is related to seat position.

Light Switch Control Table

Name of Light Switch	Owner of Switch	
	Ground	**Air**
Position Lights	**FO**	**N/A**
Red Anti-Collision Light	**FO**	**N/A**
White Anti-Collision Light	**FO**	**N/A**
Wing Leading Edge Illumination Light	**FO**	**PM**
Logo Light	**FO**	**PM**
Taxi Light **– (N422LA, N524LA and CC-CZZ)**	**CA**	**CA**
Left Runway Turnoff Light	**CA**	**CA**
Right Runway Turnoff Light	**CA**	**CA**
Left Wing Landing Light	**CA**	**CA**
Right Wing Landing Light	**CA**	**CA**
Nose Gear Landing Light	**CA**	**CA**

The table above clearly establishes which pilot is responsible for positioning each light switch. The next step is to establish the proper position of each switch based on various external conditions.

Taxi

Position lights are to be illuminated prior to the exterior preflight inspection. Before the hydraulic system is pressurized, activate the Red Anti-Collision light. During night operations, include Wing Leading Edge Illumination and Logo lights at this time. This signals the ground crew to be alert for aircraft movement and engine start. Use the Nose, Taxi and Runway Turnoff lights to enhance visibility or convey location and intent as necessary. Do not taxi with lights off under any circumstances.

The Position and Red Anti-Collision light remain illuminated for the duration of all flights. Once illuminated, the Wing Leading Edge Illumination and Logo lights are controlled in accordance with the ALL LIGHTS section discussed on the following page.

Definition of ALL LIGHTS

The definition of "ALL LIGHTS" varies depending on the existing conditions - day or night. The following table summarized the Florida West definition of "ALL LIGHTS." Position lights and the Red Anti-Collision light are not listed in the ALL LIGHTS definition table since once they are illuminated they remain ON until the engines are shut down at flight termination. Similarly, the White Anti-Collision light is not included in the ALL LIGHTS definition table since a specific time to turn this light ON and OFF is detailed in the Normal Procedures-Amplified Procedures section. For the remainder of this section, whenever the term “ALL LIGHTS” is used, refer to this table for the description.

ALL LIGHTS Definition Table

Name of Light Switch	**“ALL LIGHTS”**	
	Day	**Night**
Wing Leading Edge Light		**X**
Logo Light		**X**
Taxi Light **– (N422LA, N524LA and CC-CZZ)**	**X**	**X**
Left Runway Turnoff Light	**X**	**X**
Right Runway Turnoff Light	**X**	**X**
Left Wing Landing Light	**X**	**X**
Right Wing Landing Light	**X**	**X**
Nose Gear Landing Light	**X**	**X**

Crossing a Runway

ALL LIGHTS should be illuminated when crossing an active runway. In addition, the White Anti-Collision light should be illuminated.

Entering the Departure Runway for Takeoff

When entering a runway to takeoff, or when taxiing into position and hold for takeoff, illuminate ALL LIGHTS and the White Anti-Collision light. The White Anti-Collision light should not be illuminated if it will adversely affect the vision of other pilots.

Takeoff

Ensure ALL LIGHTS and the White Anti-Collision light are positioned **ON** when takeoff clearance is received.

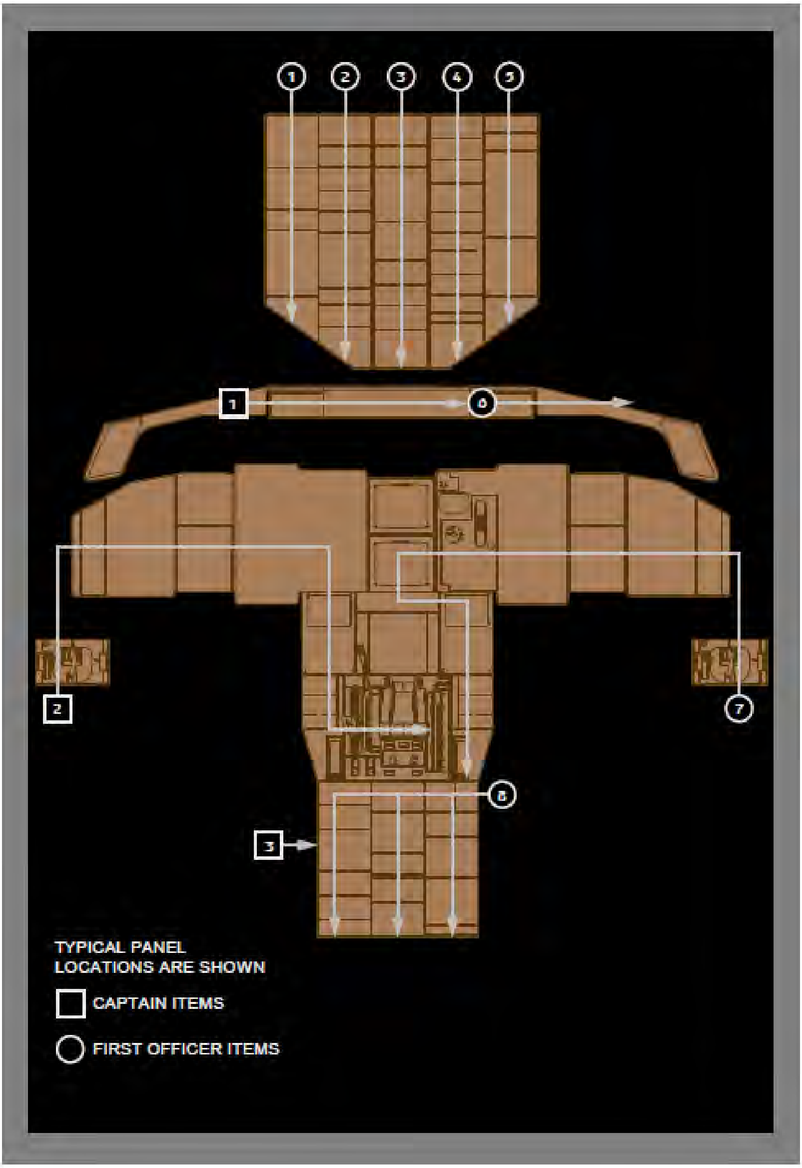
Above FL180 or Transition altitude. (whichever is higher)

ALL LIGHTS - **OFF**

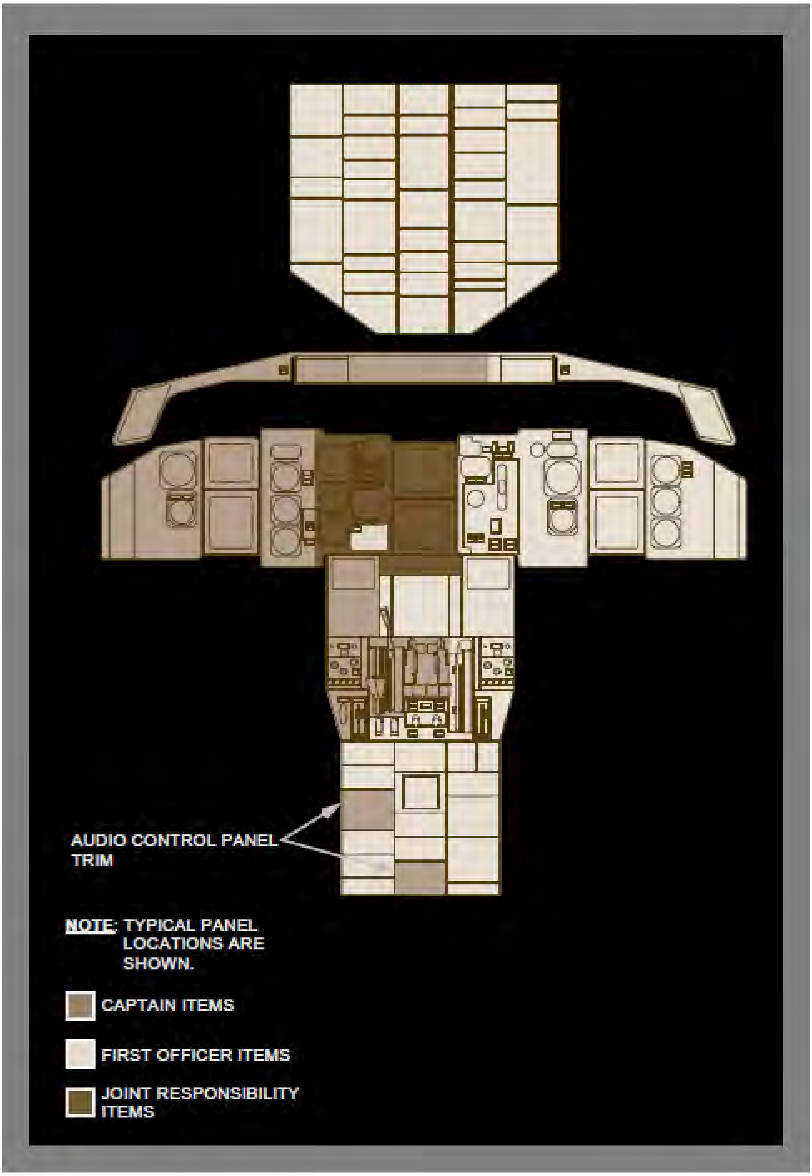
At or Below FL180 or Transition level. (whichever is higher)

ALL LIGHTS - **ON**

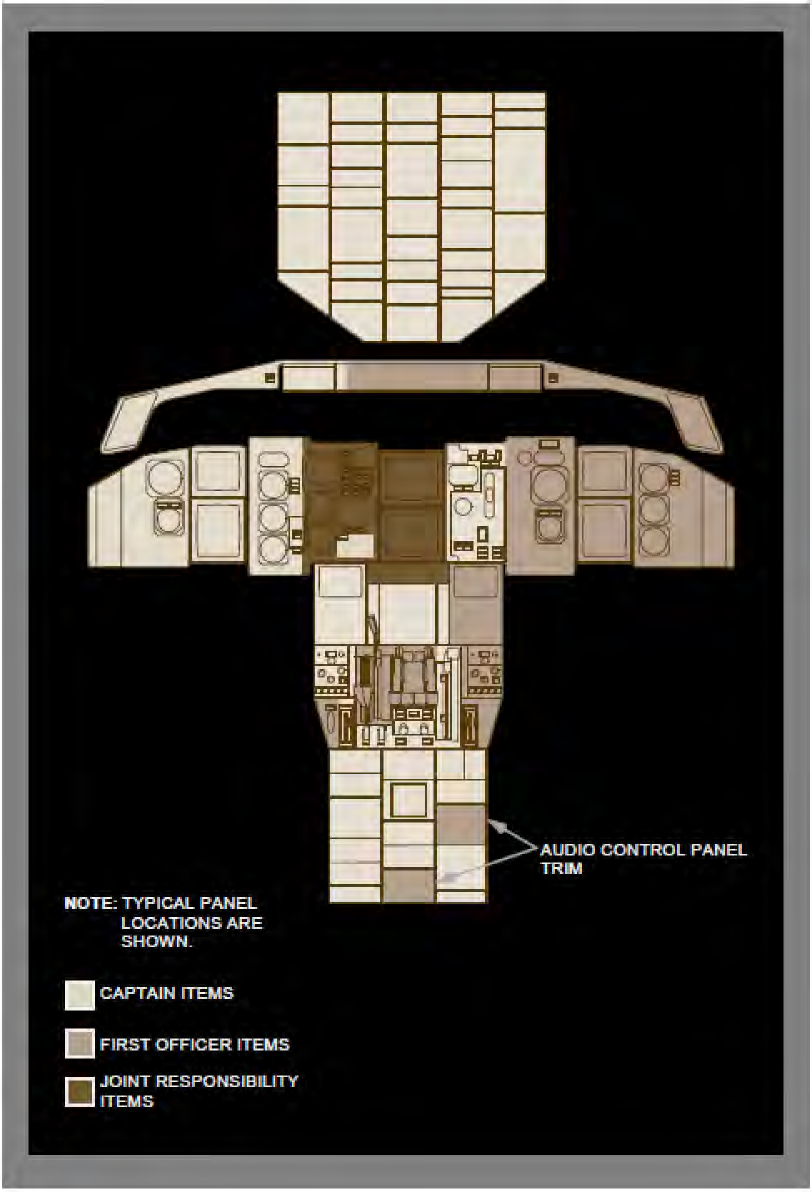
Preflight and Postflight Scan Flow



Areas of Responsibility – Captain Flying or Taxiing



Areas of Responsibility – First Officer as Pilot Flying or Taxiing



Intentionally Blank

Preliminary Preflight Procedure – Captain or First Officer

The Preliminary Preflight Procedure assumes that the Electrical Power Up supplementary procedure is complete. The First Officer normally does this procedure. The Captain may do this procedure as needed.

IRS mode selectors .... OFF, then NAV

Verify that the ON DC lights illuminate then extinguish
Verify that the ALIGN lights are illuminated

STATUS display .... Check

Verify that only expected messages are shown
Verify that the following are sufficient for flight:

- Oxygen pressure (refer to the Performance Inflight section in the QRH)
- Hydraulic quantity
- Engine oil quantity

Do the remaining actions after a crew change or maintenance action:

Maintenance documents .... Check

Performance Computer.. Checked Onboard

MAIN DECK
TEMPERATURE selector................................ANIMAL/NORM or PERISHABLE

BULK CARGO HEAT selector .... NORM or VENT

FLIGHT RECORDER switch.. NORM

SERVICE INTERPHONE switch ....OFF

RESERVE BRAKES and
STEERING RESET/DISABLE switch ....Guard closed

Verify that the ISLN light is extinguished

Circuit breakers .... Check

Required emergency equipment.. Check

Verify that all equipment listed in GOM 6.2.3 is onboard

Parking Brake...As needed

Set parking brake if brake wear indicators will be checked during the exterior inspection

CDU Preflight Procedure – Captain and First Officer

Start the CDU Preflight Procedure anytime after the Preliminary Preflight Procedure. The Initial Data and Navigation Data entries must be complete before the flight instrument check during the Preflight Procedures. The Performance Data entries must be complete before the Before Start Checklist. The First Officer normally does this procedure. The Captain may do this procedure as needed.

The Captain or First Officer may make CDU entries. The other pilot must verify the entries.

Enter data in all the boxed items on the following CDU pages.

Enter data in the dashed items or modify small font items that are listed in this procedure.

Enter or modify other items at pilot's discretion.

Failure to enter Enroute winds can result in flight plan time and fuel burn errors.

Initial Data.. Set

IDENT page:

Verify the MODEL is correct

Verify the navigation data base ACTIVE date range is current

POS INIT page:

Verify that the time is correct

Enter the present position on the SET IRS POS line. Use the most accurate latitude and longitude

1. GPS position - **(NA on CC-CZZ)**
2. REF airport
3. Manual entry

Navigation Data ....Set

RTE page:

Enter the route

Enter the FLIGHT NUMBER– **(NA on CC-CZZ)**

Activate and execute the route

DEPARTURES page:

Select the runway and departure routing

Execute the runway and departure routing

POS REF page: – **(NA on CC-CZZ)**

Verify or enter the correct RNP for the departure

Verify that the route is correct on the RTE pages.

Check the LEGS page as needed to ensure compliance with flight plan.

Performance Data ....Set

PERF INIT page:

Caution: Do not enter the ZFW into the GR WT boxes. The FMC will calculate performance data with significant errors.

Enter the ZFW

Verify that the FUEL on the CDU, the dispatch papers, and the fuel quantity indicator agree

Verify that the fuel is sufficient for flight

Verify that the GR WT on the CDU and the dispatch papers agree

TAKEOFF REF page:

Enter takeoff flap setting and accel height– **(NA on CC-CZZ)**

Enter assumed temperature – **(NA on CC-CZZ)**

Enter CG – verify that a trim value is shown– **(NA on CC-CZZ)**

Enter takeoff V speeds

Exterior Inspection

The Captain is responsible for the exterior inspection. The Captain may delegate exterior inspection duties to the F/O or the Third/Fourth pilot. In all cases, the responsibility remains with the Captain. The recommended sequence starts at the left forward fuselage and proceeds around the aircraft in a clockwise motion.

Prior to each flight, a flight crewmember must verify the airplane is acceptable for flight.

Items at each location may be checked in any sequence.

Use the detailed inspection route below to check that:

- The surfaces and structures are clear (including clear of ice, snow or frost), not damaged, not missing parts and there are no fluid leaks
- The tires are not too worn, not damaged, and there is no tread separation
- The gear struts are not fully compressed
- The engine inlets and tailpipes are clear, the access panels are secured, the exterior is not damaged, and the reversers are stowed
- The doors and access panels that are not in use are latched
- The probes, vents, and static ports are clear and not damaged
- The skin area adjacent to the pitot probes and static ports is not wrinkled
- The antennas are not damaged
- The light lenses are clean and not damaged
- The ramp area is clear of FOD.

For cold weather operations see the Supplementary Procedures.

Left Forward Fuselage

Probes, sensors, ports, vents, and drains (as applicable) .... Check

Doors and access panels (not in use) .... Latched

Nose

Radome .... Check

Diverter strips – Secure

Forward access door .... Secure

E/E access door .... Secure

Nose Wheel Well

Tires and wheels .... Check

Gear strut and doors .... Check

Nose wheel steering assembly .... Check

Nose gear steering lockout pin .... As needed

Gear pin .... As needed

Exterior lights .... Check

Nose wheel spin brake (snubbers) .... In place

Wheel well light switches .... As needed

Right Forward Fuselage

Probes, sensors, ports, vents, and drains (as applicable) .... Check

Doors and access panels (not in use) .... Latched

Oxygen pressure relief green disc .... In place

Negative pressure relief doors .... Closed

Right Wing Root, Pack, and Lower Fuselage

Probes, sensors, ports, vents and drains (as applicable) .... Check

Exterior lights .... Check

Pack inlet and pneumatic access doors .... .Secure

Leading edge slats .... Check

Fuel sticks .... Flush and secure

Right Engine

Access panels .... Latched

Probes, sensors, ports, vents and drains (as applicable) .... Check

Fan blades, probes, spinner .... Check

Thrust reverser .... Stowed

Exhaust area and tail cone .... Check

Right Wing and Leading Edge

Access panels .... Latched

Leading edge slats .... Check

Fuel sticks .... Flush and secure

Wing surfaces .... Check

Fuel tank vent .... Check

Right Wing Tip and Trailing Edge

Winglet Surfaces .... Check

Position and anti-collision lights .... Check

Static discharge wicks .... Check

Fuel jettison nozzle .... Check

Aileron and trailing edge flaps .... Check

Right Main Gear

Tires, brakes and wheels .... Check

Verify that the wheel chocks are in place as needed

If the parking brake is set, the brake wear indicator pins must extend out of the guides

Gear strut, actuators, and doors .... Check

Hydraulic lines .... Secure

Gear pins .... As needed

Right Main Wheel Well

Wheel well .... Check

Right Aft fuselage

Ram air turbine door .... Check

Doors and access panels (not in use) .... Latched

Probes, sensors, ports, vents, and drains (as applicable) .... Check

Negative pressure relief doors .... Closed

Tail

Vertical stabilizer and rudder .... Check

Tail skid .... Check

Verify that the tail skid is not damaged

Horizontal stabilizer and elevator .... Check

Static discharge wicks .... Check

APU exhaust outlet .... Check

Left Aft Fuselage

Outflow valve .... Check

Doors and access panels (not in use) .... Latched

Probes, sensors, ports, vents, and drains (as applicable) .... Check

Left Main Wheel Well

Wheel well .... Check

Left Main Gear

Tires, brakes and wheels .... Check

Verify that the wheel chocks are in place as needed

If the parking brake is set, the brake wear indicator pins must extend out of the guides

Gear strut, actuators and doors .... Check

Hydraulic lines .... Secure

Gear pins .... As needed

Left Wing Tip and Trailing Edge

Winglet Surfaces .... Check

Position and anti-collision lights .... Check

Static discharge wicks .... Check

Aileron and trailing edge flaps .... Check

Fuel jettison nozzle .... Check

Left Wing and Leading Edge

Wing Surfaces .... Check

Fuel sticks.......... Flush and secure

Fuel tank vent .... Check

Leading edge slats.......... Check

Access panels .... Latched

Left Engine

Exhaust area and tail cone .... Check

Thrust reverser .... Stowed

Fan blades, probes, spinner .... Check

Probes, sensors, ports, vents, and drains (as applicable) .... Check

Access panels .... Latched

Left Wing Root, Pack, and Lower Fuselage

Fuel sticks .... Flush and secure

Probes, sensors, ports, vents, and drains (as applicable) .... Check

Exterior lights.......... Check

Pack inlet and pneumatic access doors .... Secure

Negative and positive pressure relief doors .... Closed

Leading edge slats.......... Check

Preflight Procedures – First Officer

The First Officer normally does this procedure. The Captain may do this procedure as needed.

YAW DAMPER switches ....ON

INOP lights remain illuminated until IRS alignment is complete

ELECTRONIC ENGINE CONTROL switches .... NORM

HYDRAULIC panel ....Set

Verify that the SYS PRESS lights are illuminated

Verify that the QTY lights are extinguished

Left and Right ENGINE PRIMARY pump switches – ON

Verify that the PRESS lights are illuminated

Center 1 and Center 2 ELECTRIC PRIMARY pump switches – Off

Verify that the PRESS lights are illuminated

DEMAND pump selectors – OFF

Verify that the PRESS lights are illuminated

N316LA and CC-CZZ

WINDOW HEAT switches..ON

Verify that the INOP lights are extinguished

N316LA and CC-CZZ

Left HF radio ....Set

BATTERY/STANDBY POWER CONTROL panel ....Set

BATTERY switch – ON

N316LA and CC-CZZ

Verify that the MAIN BAT DISCH and APU BAT DISCH lights are extinguished

N422LA and N524LA

Verify that the DISCH light is extinguished

STANDBY POWER selector – AUTO

Verify that the standby power bus OFF light is extinguished

Electrical Panel .... Set

APU GENERATOR switch – ON

BUS TIE switches – AUTO

Verify that the AC BUS OFF lights are extinguished

UTILITY BUS switches – ON

Verify that the OFF lights are extinguished

GENERATOR CONTROL switches – ON

Verify that the OFF lights are illuminated

Verify that the DRIVE lights are illuminated

APU Selector (as needed) ....START, then ON

Do not allow the APU selector to spring back to the ON position

Verify that the RUN light is illuminated

Lighting panel.. Set

N422LA, N425LA and CC-CZZ
TAXI light switch – OFF

RUNWAY TURNOFF light switches – OFF

EMERGENCY LIGHTS switch .... Guard closed

Verify that the UNARMED light is extinguished

WARNING: Do not push the RAM AIR TURBINE switch. The switch causes deployment of the ram air turbine.

Ram air turbine UNLKD light.. Verify extinguished

Engine control panel .... Set

Engine ignition selector – SINGLE

Engine start selectors – AUTO

FUEL JETTISON panel .... Set

Fuel jettison NOZZLE switches – Off

Fuel jettison selector – OFF

FUEL panel ....Set

CROSSFEED switches – Off

Verify that the VALVE lights are extinguished

FUEL PUMP switches – Off

Verify that the left forward pump PRESS light is extinguished if the APU is on or, is illuminated if the APU is off

Verify that the other left and right pump PRESS lights are illuminated

Verify that both center pump PRESS lights are extinguished

ANTI-ICE panel ....Set

WING anti-ice switch – Off

ENGINE anti-ice switch – Off

N316LA and CC-CZZ

WIPER selector ....OFF

N422LA and N524LA

WIPER selectors..OFF

Lighting panel ....Set

POSITION light switch – As needed

ANTI-COLLISION light switches – Off

WING light switch – As needed

LANDING light switches – OFF

FORWARD CARGO AIR CONDITIONING temp control .... AUTO

Verify that the INOP lights are extinguished

N422LA and N524LA

WINDOW HEAT switches..ON

Verify that the INOP lights are extinguished

N316LA and CC-CZZ

Right HF radio ....Set

CABIN ALTITUDE CONTROL panel .... Set

AUTO RATE control – Index

LANDING ALTITUDE selector – Destination airport elevation

MODE SELECTOR – AUTO 1 or AUTO 2

EQUIPMENT COOLING mode selector .... AUTO

CARGO HEAT switches .... ON

Air conditioning panel... Set

FLIGHT DECK and CABIN compartment temp controls – AUTO

Set as needed

The INOP lights stay illuminated until trim air switch is ON

TRIM AIR switch – ON

PACK CONTROL selectors – AUTO

The PACK OFF lights stay illuminated until bleed air or external air is supplied

BLEED AIR panel.. Set

LEFT, CENTER and RIGHT ISOLATION switches – On

Verify that the VALVE lights are extinguished

ENGINE bleed air switches – ON

Verify that the OFF lights are illuminated

APU bleed air switch – ON

Verify that the VALVE light is extinguished

FLIGHT DIRECTOR switch .... ON

VOR/DME switch .... AUTO

Smoke goggles ....Check

Oxygen ....Test and set

Select the status display

Oxygen mask – Stowed and doors closed

RESET/TEST switch – Push and hold

Verify that the yellow cross shows momentarily in the flow indicator

EMERGENCY/TEST selector – Push and hold

Continue to hold the RESET/TEST switch and push the EMERGENCY/TEST selector for 10 seconds.

Verify that the yellow cross shows continuously in the flow indicator.

Verify that the crew oxygen pressure does not decrease more than 100 psig.

If the oxygen cylinder valve is not in the full open position, pressure can:

- Decrease rapidly, or
- Decrease more than 100 psig, or
- Increase slowly back to normal

Release the RESET/TEST switch and the EMERGENCY/TEST selector.

Verify that the yellow cross does not show in the flow indicator.

Normal/100% selector – 100%

Crew oxygen pressure – Check EICAS

Verify that the pressure is sufficient for dispatch.
(refer to the Performance Inflight section in the QRH)

INSTRUMENT SOURCE SELECT panel...Set

FLIGHT DIRECTOR source selector – R

N316LA, N422LA and N524LA
NAVIGATION instrument source selector – FMC R

CC-CZZ
FLIGHT MANAGEMENT COMPUTER switch – Off

ELECTRONIC FLIGHT INSTRUMENT switch – Off

INERTIAL REFERENCE SYSTEM switch – Off

AIR DATA source switch – Off

Do the Initial Data and Navigation Data steps from the CDU Preflight Procedure and verify that the IRS alignment is complete before checking the flight instruments.

Flight Instruments .... Check

Set the altimeter

Verify that the flight instrument indications are correct

Verify that only these flags are shown:

- TCAS OFF

N422LA and N524LA

- RA OFF
- V1 INOP until takeoff V-speeds are selected
- Expected RDMI flags

Verify that the flight mode annunciations are correct:

- Autothrottle mode is blank
- Roll mode is TO
- Pitch mode is TO
- AFDS status is FD

Select the map mode

AUTOLAND STATUS annunciator ....Check

Verify that the indications are blank

Landing gear panel... Set

Landing gear lever – DN

ALTERNATE GEAR EXTEND switch – Guard closed

CC-CZZ

GND PROX FLAP OVRD switch .... Off

N316LA, N422LA and N524LA

Ground proximity FLAP OVERRIDE switch .... Off

CC-CZZ

GND PROX/CONFIG GEAR OVRD switch .... Off

N316LA, N422LA and N524LA

Ground proximity GEAR OVERRIDE switch .... Off

Ground proximity TERRAIN OVERRIDE switch .... Off

HEADING REFERENCE switch ....NORM

Alternate flaps panel... Set

ALTERNATE FLAPS selector – NORM

Alternate flaps switches – Off

EIFICAS display .... Check

Upper EICAS display – Check

Verify that primary engine indications show existing conditions

Verify that no exceedance is shown

Lower EICAS display – Check

Secondary ENGINE indications – Check

Verify that secondary engine indications show existing conditions

Verify that no exceedance is shown

Select the status display

Status messages – Check

COMPUTER selector – AUTO

THRUST REFERENCE SET selector – BOTH and in

Verify that the TO mode is shown

EFIS control panel..Set

Decision height selector – As needed

TERRAIN switch – As needed

HSI RANGE selector – As needed

HSI TRAFFIC switch – As needed

HSI mode selector – MAP

N316LA, N422LA and N524LA
HSI CENTER switch – As needed

WEATHER RADAR switch – Off

CC-CZZ
Verify that the ON light is extinguished

Verify there are no weather radar indications on the HSI

MAP switches – As needed

Weather Radar panel ....Set

N316LA and CC-CZZ
Left VHF communications panel...Set

N422LA and N524LA

Left radio tuning panel .... Set

Verify that the OFF light is extinguished

Captain’s audio control panel .... As needed

ADF panel.. Set

N422LA and N524LA

Center radio tuning panel .... Set

Verify that the OFF light is extinguished

Engine fire panel .... Set

Verify that the ENG BTL 1 DISCH and ENG BTL 2 DISCH lights are extinguished

Engine fire switches – In

Verify that the LEFT and RIGHT fire lights are extinguished

ACARS .... Set

Set the preflight data in the ACARS and verify the airline code is set to “RF.” Verify that the DFDAU has been initialized with the proper flight data.

ILS panel.. As needed

CARGO FIRE panel .... Set

CARGO FIRE ARM switches – Off

Verify that the FWD, AFT and MAIN lights are extinguished

Verify that the DISCH light is extinguished

Verify that the DEPR light is extinguished

APU fire panel..Set

N316LA and CC-CZZ

Verify that the APU BTL DISCH light is extinguished

N422LA and N524LA

Verify that the APU BTL 1 DISCH and APU BTL 2 DISCH lights are extinguished

APU fire switch – In

Verify that the APU light is extinguished

N316LA and CC-CZZ

Right VHF communications panel ....Set

N422LA and N524LA

Right radio tuning panel...Set

Verify that the OFF light is extinguished

First officer's audio control panel ....As needed

N422LA and N524LA

ADF panel ....Set

Transponder panel ....Set

N316LA

Check to see that the ATC indicator is illuminated. If it is not illuminated, press the ATC/FID button to switch to the ATC mode.

Momentarily press the Test Button.

Observe the messages "CP1 PASS" and "CP2 PASS" illuminate on the display screen. The order is dependent on which transponder is currently selected.

Enter the applicable ATC code using the keypad. If you enter an incorrect digit, press clear once to delete the digit.

Flight deck printer ....Set

WARNING: Do not put objects between the seat and the aisle stand. Injury can occur when the seat is adjusted.

Seat..Adjust

Adjust the seat for optimum eye reference

Whenever the seat is adjusted, verify a positive horizontal (fore and aft) seat lock by pushing against the seat.

Rudder pedals.. Adjust

Adjust the rudder pedals to allow full rudder pedal and brake pedal movement

Seat belt and shoulder harness .... Adjust

Do the PREFLIGHT checklist on the Captain’s command

Preflight Procedure – Captain

The Captain normally does this procedure. The First Officer may do this procedure if needed.

VOR/DME switch .... AUTO

Mode control panel ....Set

FLIGHT DIRECTOR switch – ON

AUTOTHROTTLE ARM switch – ARM

BANK LIMIT selector – As desired

Autopilot DISENGAGE bar – UP

Smoke goggles .... Check

Oxygen... Test and set

Select the status display

Oxygen mask – Stowed and doors closed

RESET/TEST switch – Push and hold

Verify that the yellow cross shows momentarily in the flow indicator

EMERGENCY/TEST selector – Push and hold

Continue to hold the RESET/TEST switch and push the EMERGENCY/TEST selector for 10 seconds.

Verify that the yellow cross shows continuously in the flow indicator.

Verify that the crew oxygen pressure does not decrease more than 100 psig

If the oxygen cylinder valve is not in the full open position, pressure can:

- Decrease rapidly, or
- Decrease more than 100 psig, or
- Increase slowly back to normal

Release the RESET/TEST switch and the EMERGENCY/TEST selector.

Verify that the yellow cross does not show in the flow indicator.

Normal/100% selector – 100%

Crew oxygen pressure – Check EICAS

Verify that the pressure is sufficient for dispatch.
(refer to Performance Inflight section in the QRH)

INSTRUMENT SOURCE SELECT panel .... Set

FLIGHT DIRECTOR source selector – L

N316LA, N422LA and N524LA
NAVIGATION instrument source selector – FMC L

CC-CZZ
FLIGHT MANAGEMENT COMPUTER switch – Off

ELECTRONIC FLIGHT INSTRUMENT switch – Off

INERTIAL REFERENCE SYSTEM switch – Off

AIR DATA source switch – Off

Do the Initial Data and Navigation Data steps from the CDU Preflight Procedure and verify that the IRS alignment is complete before checking the flight instruments.

Flight Instruments .... Check

Set the altimeter

Verify that the flight instrument indications are correct

Verify that only these flags are shown:

- TCAS OFF

N422LA and N524LA

- RA OFF
- V1 INOP until takeoff V-speeds are selected
- Expected RDMI flags

Verify that the flight mode annunciations are correct:

- Autothrottle mode is blank
- Roll mode is TO
- Pitch mode is TO
- AFDS status is FD

Select the map mode

AUTOLAND STATUS annunciator .... Check

Verify that the indications are blank

RESERVE BRAKES AND STEERING switch ....Off

Verify that the VALVE light is extinguished

N316LA and CC-CZZ

Integrated Standby Flight Display (IFSD) .... Check

Attitude – RST (reset) push and hold for 2 seconds

APP Mode – OFF

Set the altimeter

Verify that the flight instrument indications are correct

Verify that no messages or flags are shown

N422LA and N524LA

Standby Instruments .... Check

Attitude indicator caging control – Pull, then release

ILS selector – OFF

Set the altimeter

Verify that the flight instrument indications are correct

Verify that no flags are shown

Standby engine indicator selector.. AUTO

AUTOBRAKES selector .... RTO

EFIS control panel...Set

Decision height selector – As needed

TERRAIN switch – As needed

HSI RANGE selector – As needed

HSI TRAFFIC switch – As needed

HSI mode selector – MAP

N316LA and CC-CZZ

HSI CENTER switch – As needed

WEATHER RADAR switch – Off

CC-CZZ

Verify that the ON light is extinguished

Verify that weather radar indications are not shown on the HSI

MAP switches – As needed

ALTERNATE STABILIZER TRIM switches.. Neutral

SPEEDBRAKE lever .... DOWN

Reverse thrust levers .... Down

Forward thrust levers ....Closed

Flap lever .... Set

Set the flap lever to agree with the flap position

Parking brake .... Set

Verify that the PARK BRAKE light is illuminated

Note: Do not assume that the parking brake will prevent airplane movement. Accumulator pressure can be insufficient.

STABILIZER TRIM cutout switches...Guards closed

FUEL CONTROL switches...CUTOFF

FUEL CONTROL switch fire warning lights .... Verify extinguished

Captain's audio control panel .... As needed

WARNING: Do not put objects between the seat and the aisle stand. Injury can occur when the seat is adjusted.

Seat .... Adjust

Adjust the seat for optimum eye reference

Whenever the seat is adjusted, verify a positive horizontal (fore and aft) seat lock by pushing against the seat.

Rudder pedals .... Adjust

Adjust the rudder pedals to allow full rudder pedal and brake pedal movement.

Seat belt and shoulder harness .... Adjust

Call “PREFLIGHT CHECKLIST” C

Do the PREFLIGHT CHECKLIST .... F/O

Call “PREFLIGHT CHECKLIST COMPLETE” .... F/O

Before Start Procedure

Start the Before Start Procedure after papers are on board.

Do the CDU Preflight Procedure performance Data steps before completing this procedure.

CDU display..Set C, F/O

Normally the PF selects the TAKEOFF REF page

Normally the PM selects the LEGS page

Takeoff thrust reference..Set C, F/O

Verify that the thrust reference mode is correct

IAS bugs ....Set C, F/O

Set the bugs at V1, VR, VREF 30+40, and VREF 30+80

MCP..Set C

IAS/MACH selector – Set V2

Initial heading – Set

Initial altitude – Set

Taxi and Takeoff briefings.. Complete C, F/O

It is the Captain's responsibility to ensure the briefings are accomplished. The Captain will give the Taxi Briefing. The Taxi briefing is considered accomplished if completed prior to commencement of the Before Taxi Procedure. The taxi briefing must be completed prior to taxiing. The pilot making the takeoff should give the takeoff briefing. The takeoff briefing is considered accomplished if completed prior to commencement of the Before Takeoff procedure. Consider briefing the takeoff as soon as practical (before pushback if possible) so as not to interfere with taxi operations.

The taxi briefing is a description of the expected ground path to the current active runway. Emphasis will be placed on possible runway crossings, holding points and runway incursion hotspots. Both pilots must have the taxi diagram visible prior to commencing taxi operations.

The takeoff briefing is a description of the departure flight path with emphasis on anticipated track and altitude restrictions. It assumes normal operating procedures are used. Therefore, it is not necessary to brief normal or standard takeoff procedures. Additional briefing items may be required when any elements of the takeoff and/or departure are different from those routinely used.

The takeoff briefing should be recited by the flying pilot and include:

- Flap and thrust settings intended
- V1 speed
- QRH/Emergency assignments for Third/Fourth crewmembers (if applicable)
- Normal SID initial altitude and heading (including unique noise abatement requirements)
- Applicable NOTAMS
- Engine failure departure plan
- Special Instructions. This could be, for example, precautions for weather avoidance, adverse runway conditions, MEL considerations, obstructions/high terrain, bird strike or anti ice.

Maintenance documents ....Check C

Verify that the log book is onboard and the airworthiness release is signed.

Exterior doors ....Verify closed F/O

Flight deck windows .... Closed and locked C, F/O

Verify that the lock lever is in the forward, locked position

Verify that the WINDOW NOT CLOSED decal does not show

Start clearance...Obtain C, F/O

Obtain a clearance to pressurize the hydraulic systems

Obtain a clearance to start the engines

If pushback is needed:

Verify that the nose gear steering is locked out

RED ANTI-COLLISION light switch .... ON F/O

HYDRAULIC panel..Set F/O

WARNING: If the tow bar is connected, do not pressurize the hydraulic system until the nose gear steering is locked out. Unwanted tow bar movement can occur.

Note: Pressurize the right system first to prevent fluid transfer between systems.

Right ELECTRIC DEMAND pump selector – AUTO

Verify that the PRESS light is extinguished

Center 1 and Center 2 ELECTRIC PRIMARY pump switches – ON

Verify that the center 1 PRESS light is extinguished

The center 2 PRESS light stays illuminated until after the engine start due to load shedding

Left ELECTRIC DEMAND pump selector – AUTO

Verify that the PRESS light is extinguished

Center AIR DEMAND pump selector – AUTO

Verify that the PRESS light is extinguished

Fuel panel ....Set F/O

LEFT and RIGHT FUEL PUMP switches – ON

Verify that the PRESS lights are extinguished

If there is fuel in the center tank:

CENTER FUEL PUMP switches – ON

Verify both PRESS lights are illuminated and the CTR L FUEL PUMP and CTR R FUEL PUMP messages are shown

RECALL switch .... Push C

Verify that only the expected alert messages are shown

Trim .... Set C

Stabilizer trim - _____ UNITS

Set the trim for takeoff

Verify that the trim is in the green band

Aileron trim – 0 units

Rudder trim – 0 units

Call "BEFORE START CHECKLIST" C

Do the BEFORE START checklist ....F/O

Call "BEFORE START CHECKLIST COMPLETE" ....F/O

Pushback or Towing Procedure

The Engine Start Procedure may be done during pushback or towing.

Establish communications with ground handling personnel........................ C

CAUTION: Do not or turn the wheel tiller during pushback or towing. This can damage the nose gear or tow bar.

CAUTION: Do not use the airplane brakes to stop the airplane during pushback or towing. This can damage the nose gear or the tow bar.

Transponder.. As needed F/O

At airports where ground tracking radar is not available, select STANDBY. At airports equipped to track airplanes on the ground, select an active transponder setting, but not a TCAS mode.

Parking brake .... Set or Release C

As directed by ground handling personnel

When pushback or towing is complete:

Verify that the tow bar is disconnected.. C

Verify that the nose gear steering is not locked out.................................... C

Engine Start Procedure

Secondary engine indications..Select F/O

APU Bleed Air Switch... off F/O

Allow APU bleed air valve transition light to momentarily illuminate and then extinguish

PACK CONTROL selectors .... OFF F/O

Verify that the PACK OFF lights are illuminated

APU Bleed Air Switch... on F/O

Check pneumatic duct pressure is restored

CANCEL switch...Push C

Verify that messages are cancelled

Start sequence.. Announce C

Call .... “START _____ ENGINE” C

Engine start selector...GND F/O

Start chronograph at N2 rotation and reset at starter cutout. This provides a time reference for engine starter duty cycle.

Oil pressure ....Verify increasing C, F/O

During a cold weather start, the oil pressure can increase higher than normal

When N2 is at 20%, or (if 20% N2 is not possible) at maximum motoring and a minimum of 15% N2:

FUEL CONTROL switch.. RUN C

Start chronograph when fuel control switch is positioned to run and reset at N1 rotation or EGT rise whichever is last. This provides a time reference for light up and N1 rotation.

EGT ....Verify increasing C, F/O

Confirm normal rate of increase and that EGT remains below placarded limit

After engine is stabilized at idle, start the other engine.

Do the ABORTED ENGINE START checklist for one or more of the following abort start conditions:

- The EGT does not increase by 25 seconds after the fuel control switch is moved to RUN
- There is no N1 rotation by 30 seconds after N2 is stabilized at idle
- The EGT quickly nears or exceeds the start limit
- There is no oil pressure indication by the time that the engine is stable at idle

Before Taxi Procedure

The First Officer accomplishes the Before Taxi Flow without command from the Captain. However, the flaps should not be moved until commanded by the Captain.

APU selector .... OFF F/O

Turn off the APU unless previously briefed to leave the APU on by the Captain. Reasons to leave the APU running include weather or extended ground delays that may result in engine shutdown prior to takeoff.

ENGINE ANTI-ICE switches ....As needed F/O

If engine anti-ice is to be used for takeoff or taxi, turn it on at this time. The F/O is responsible for positioning the switches after engine start. Both pilots must verify proper switch position. The F/O is responsible for answering the checklist item per the Normal Checklist Response Guide.

PACK selectors .... AUTO F/O

LEFT and RIGHT ISOLATION switches .... Off F/O

Status display..Select C

Ground equipment .... Verify clear C, F/O

Flaps ....“FLAPS __” C

Call flap setting as needed for takeoff, i.e. “Flaps 5”

Call for flaps prior to taxi unless weather or field conditions dictate otherwise.

Flap lever .... Set takeoff flaps F/O

Flight controls .... Check C

Make slow and deliberate inputs, one direction at a time.

Move the control wheel and the control column to full travel in both directions and verify:

- Freedom of movement
- That the controls return to center
- Correct flight control movement on the EICAS display

Hold the nose wheel tiller during the rudder check to prevent nose wheel movement.
Move the rudder pedals to full travel in both directions and verify:

- Freedom of movement
- That the rudder returns to center
- Correct rudder movement on the EICAS display

Secondary engine indications .... Select C

Transponder... As needed F/O

At airports where ground tracking is not available, select STANDBY. At airports equipped to track airplanes on the ground, select an active transponder setting, but not a TCAS mode.

Recall.. Check C, F/O

Verify that only expected alert messages are shown.

If any message displayed refer to Minimum Equipment List to determine if dispatch relief if available.

The Captain pushes the recall button and responds to the checklist item. Both pilots observe the display for any message that might require pilot or ground crew action, such as exterior doors.

Update changes to the taxi briefing, as needed C

Call “BEFORE TAXI CHECKLIST” C

Do the BEFORE TAXI checklist.. F/O

Call “BEFORE TAXI CHECKLIST COMPLETE”.. F/O

Nose Gear Light .... ON C

Before Takeoff Procedure

Engine warm up **requirements:**

- Engine oil temperature must be above the bottom of the temperature scale

Engine warm up recommendations:

- Run the engines for at least 3 minutes
- Use a thrust setting normally used for taxi operations

Pilot Flying	Pilot Monitoring
	IRS Check: Check all three IRS units on the POS REF 4/4 page to ensure that the groundspeed displays read approximately the same while taxiing. The IRS position should also be checked for reasonableness.
Notify all flight deck occupants to fasten seatbelts and shoulder harnesses. Verify that the flight deck is secure.	
The pilot who will do the takeoff updates changes to the takeoff briefing as needed.	
When at the departure end of the runway or when cleared by ATC to enter the runway environment (“Line up and wait” or “Line up and takeoff.”) Call “BEFORE TAKEOFF CHECKLIST”	Do the BEFORE TAKEOFF checklist. Call “BEFORE TAKEOFF CHECKLIST COMPLETE”

Takeoff Procedure – General

Florida West policy is to perform reduced thrust takeoffs whenever performance limits and noise abatement procedures permit. Thrust reduction or derate lowers EGT and extends engine life. The reduced thrust procedure used by the Company is the Assumed Temperature Method (ATM). This method achieves a takeoff thrust less than the full rated thrust by using an assumed temperature that is higher than the actual temperature. Florida West utilizes the Boeing Onboard Performance Tool (OPT) to determine the appropriate assumed temperature. Reduced thrust may only be used when the data for the applicable airport, runway, flap and bleed configuration is provided by the OPT.

When entering the assumed temperature in the FMC do not use the 1 or 2 buttons on the Thrust Mode Selection Panel (TMSP). At times this may result in a lower assumed temperature setting than allowed by the OPT. However, the use of a lower assumed temperature is more conservative and ensures the thrust setting will be more than adequate.

Do not use the ATM if conditions exist that affect braking such as runway contaminated by slush, snow, standing water, or ice, or if potential windshear conditions exist and in the case of certain MEL/CDL conditions (i.e. Anti-skid). ATM procedures are allowed on a wet runway if suitable performance accountability is made for increased stopping distance on a wet surface.

Autothrottle and flight director use is recommended for all takeoffs. However, do not follow flight director commands until after liftoff. Use an initial target pitch attitude of 15 degrees.

A rolling takeoff procedure is recommended for setting takeoff thrust. It expedites takeoff and reduces risk of foreign object damage or engine surge/stall due to a tailwind or crosswind. Flight test and analysis prove that the change in takeoff roll due to the rolling takeoff procedure is negligible when compared to a standing takeoff.

Rolling takeoffs are accomplished in two ways:

- If cleared for takeoff prior to or while entering the runway, maintain normal taxi speed. Do not increase thrust beyond normal taxi settings until the aircraft is aligned with the runway centerline.

- If holding in position on the runway, the PIC will release the brakes, apply takeoff thrust and perform the takeoff in accordance with normal procedures.

Note: Brakes are not normally held with the thrust above idle unless a static run-up is required in icing conditions.

Florida West policy is for the PIC to be the pilot flying on all takeoffs and for the PIC to maintain control of the thrust levers until V1. Accordingly, in the unlikely event of an abort, no transfer of control of the thrust levers is required. The purpose of this policy is to standardize each takeoff.

When accomplishing the Takeoff Procedure, the Captain performs the PF duties (including aircraft directional control) and the F/O performs the PM duties for all takeoffs until a transfer of control takes place.

If the F/O is making the takeoff, the designated place in the Takeoff Procedure for transfer of aircraft directional control occurs after the PM makes the “THRUST SET” callout. When the PIC hears “THRUST SET,” he will verify that the correct takeoff thrust is indicated, reply “CHECKED” and then state “YOU HAVE CONTROL.” At that time, the F/O will respond “I HAVE CONTROL,” assume the PF duties and physically take directional control of the aircraft. The PIC assumes the PM duties and maintains control of the thrust levers until V1.

Note: The PIC is responsible for making all “abort” decisions and executing all “aborts” regardless of who is making the takeoff.

Note: The PIC should consider making the takeoff whenever conditions indicate that the runway might be slippery or contaminated with ice or snow.

Takeoff Procedure

Pilot Flying	Pilot Monitoring
Before entering the departure runway, verify that the runway and runway entry point are correct.	
When entering the runway, set the LEFT and RIGHT WING LANDING light switches to ON. Set the LEFT and RIGHT RUNWAY TURNOFF LIGHT switches to ON.	When entering the departure runway, set the WHITE ANTI-COLLISION light switch to ON. Set the transponder mode selector to TA/RA
Set WXR and or TERR switches as required	
Verify that the airplane heading agrees with the assigned runway heading	
Verify that the brakes are released. Align the airplane with the runway. Flight directors and autothrottle are recommended for all takeoffs. The flight director will be in the TO mode. Normally runway heading will be set in the MCP. However, if an immediate turn is required the initial heading may be set in the MCP.	
Advance the thrust levers to approximately 70%N1. Allow the engines to stabilize.	
Call “N1” The pilot flying calls for the N1 switch to be pushed to avoid the Thrust Levers being unattended as the engines rapidly develop high thrust.	Push N1 switch when commanded.
Verify that the correct takeoff thrust is set.	

Pilot Flying	Pilot Monitoring
Reply "CHECKED"	Monitor the engine instruments during the takeoff. Call out any abnormal indications. Adjust takeoff thrust before 80 knots as needed. During strong headwinds, if the thrust levers do not advance to the planned takeoff thrust by 80 knots, manually advance the thrust levers. Call "THRUST SET"
Note: The "THRUST SET" callout is the transfer of control point for F/O takeoffs. If the F/O is making the takeoff, the PIC will verify thrust setting, reply "CHECKED" and then state "YOU HAVE CONTROL." The F/O will respond "I HAVE CONTROL." At this point the F/O assumes physical control of the aircraft and becomes the PF.	
After takeoff thrust is set, the PIC's hand must be on the thrust levers until V1.	
Monitor airspeed. Maintain light forward pressure on the control column.	Monitor airspeed and call out any abnormal indications.
Verify 80 knots and reply "CHECKED"	Call "80 KNOTS"
Verify V1 speed.	Call "V1"
At VR, rotate toward 15º pitch attitude. After liftoff, follow F/D commands. **Note:** Initiate a smooth continuous rotation toward 15 degrees of pitch attitude. Liftoff attitude is achieved in approximately 4 seconds. Rotation rates in excess of 2.5 degrees per second may result in a tail strike. **Do not** attempt to match the FD pitch bar during rotation and initial liftoff. It commands a higher than appropriate rate until airspeed approaches V2+15. Establish a positive rate of climb.	At VR call "ROTATE" Monitor airspeed and vertical speed.

Pilot Flying	Pilot Monitoring
Verify a positive rate of climb on the altimeter and call “GEAR UP”	Verify a positive rate of climb on the altimeter and call “POSITIVE RATE” Set the landing gear lever to UP.
Above 400 feet radio altitude, call for a roll mode as needed.	At 400 feet above field elevation, call “400 FEET” Select or verify the roll mode.
	At 1000 feet above field elevation, call “1000 FEET”
At thrust reduction height, call “VNAV” **Or** Call for “Flight Level Change” and “Set Speed __”	Push the VNAV switch **Or** Push FLCH switch and set speed as commanded.
Verify that climb thrust is set If CLB limit not displayed, The PM should push CLB switch on TMSP and then verify pitch mode.	
Verify acceleration. Call “FLAPS ___” according to the flap retraction schedule.	Set the flap lever as directed. Verify appropriate flap indications.
Engage the autopilot after a roll mode and VNAV are engaged (minimum of 1,200 feet AGL). **Or** Call for “Center Command” and verify CMD annunciation on FMA (minimum of 1,200 feet AGL).	At the option of the PF, push the center A/P command switch and verify CMD annunciation on FMA.
Note: The altitudes for selection of LNAV, VNAV and A/P may need to vary from the altitudes in this procedure due to operational considerations. Any changes in these altitudes should be included in the takeoff briefing so both pilots are in the loop.	
	After Flap retraction is complete, set the landing gear lever to OFF.
Call “AFTER TAKEOFF CHECKLIST”	Do the AFTER TAKEOFF checklist. Call “AFTER TAKEOFF CHECKLIST COMPLETE”

Take Off Flap Retraction Schedule

Takeoff Flaps	At "Display" or Speed (knots)	Select Flaps
20 or 15	VREF 30+20	5
	"F" VREF 30+40	1
	"F" VREF 30+60	UP
5	"F" VREF 30+40	1
	"F" VREF 30+60	UP

"F" = Minimum flap retraction speed for next flap setting on speed tape display (as installed)

Climb Procedure

Complete the After Takeoff Checklist before starting the Climb Procedure

Pilot Flying	Pilot Monitoring
If the A/P **is** engaged, the PF sets the cleared altitude in the altitude window. He points to the new altitude until the PM visually or verbally verifies it. **If** the A/P is **not** engaged, the PF calls “SET ALTITUDE___” and visually or verbally verifies it after the PM sets it in the altitude window.	**If** the A/P **is** engaged, point or verbally verify the cleared altitude after the PF sets it in the altitude window. **If** the A/P is **not** engaged, set the cleared altitude as commanded by the PF and point to the new altitude until the PF visually or verbally verifies it.
	Above 10,000 feet AGL, transmit departure message and complete flight plan ETA forecast. If applicable, configure for Single Pack Operations per SP.2.3.
At transition altitude, set and crosscheck altimeters to standard.	
At FL 180 or transition altitude, whichever is higher, position LANDING light switches OFF. Switch ALL LIGHTS off per stated Florida West Policy.	
Reply “CHECKED”	At 1000 feet below assigned altitude or Flight Level, call “1000 FEET TO LEVEL OFF”

Cruise Procedure

Pilot Flying	Pilot Monitoring
Observe that cruise mode specified on flight plan is active at the planned cruise altitude.	When either CTR L or CTR R FUEL PUMP message is shown, select the respective CENTER FUEL PUMP switch off. Select both CENTER FUEL PUMP switches off when either CTR L or CTR R FUEL PUMP message is shown and the center tank is empty. **Note:** During cruise flight, whenever center tank usable fuel is indicated with CENTER PUMP switches selected off, both CENTER FUEL PUMP switches may be re-selected on.
Verify that Flight Deck Panels are corrected for incomplete items. These may include but are not limited to: APU status, CONT ignition, Fuel Tank balance, Engine/Wing Anti Ice, Exterior lighting, COMPT temperatures, Slip indication, Radar, Radio and Transponder settings. Select ENG OUT prompt from ACT CRZ page. Position two white airspeed reference bugs on EO SPD. Position REFERENCE ALTITUDE MARKER (Baro Bug) to MAX engine out altitude. If two REFERENCE ALTITUDE MARKERS are present, set the second outer bug to zero. Press the ERASE prompt. Position two white airspeed reference bugs on Flaps 30 speed from APPROACH REF page. Brief single engine/depressurization max altitude, enroute alternate airport and any terrain avoidance plan required.	
	Before the top of descent, modify the active route as needed for the arrival and approach Verify or enter the correct RNP for the arrival. **– (NA on CC-CZZ)**

Descent Procedure – General

The period prior to the top of descent point is an excellent time to conduct a quality Approach Briefing. The pilot flying (assuming he will be making the approach) should transfer control of the aircraft at this point and conduct the approach briefing and FMS set up. The briefing should include a review of the applicable STAR, approach procedure, FMS set up for the intended landing runway and the expected taxi route to parking. All pertinent approach information, including minimums and missed approach procedures, should be reviewed and alternate courses of action considered. Unless a significant delay is created, Florida West policy is to conduct precision approaches over other options.

As a guide, the approach briefing should include the following:

- Weather and NOTAMS at destination and alternate, as applicable
- Type of approach and the validity of the charts to be used
- Navigation and communication frequencies to be used
- Minimum safe sector altitudes for that airport
- Vertical profile including all minimums altitudes, crossing altitudes and approach minimums
- Determination of the Missed Approach Point (MAP) and the missed approach procedure
- Other related crew actions such as tuning of radios, setting of course information, or other special requirements
- Taxi routing to assigned parking
- Any appropriate information related to a non-normal procedure
- Management of the AFDS
- Reference speeds and altimeter bug settings
- Transition level
- Auto brake setting to be used

At the conclusion of this briefing, the aircraft and both pilots should be ready for the planned approach. At this point the pilot making the approach resumes control of the aircraft and becomes the PF. Any subsequent changes or modifications to the planned approach and landing briefed by the PF will need to be completed by the PM. The PM will make all FMS modifications accomplished during the descent and approach phase of flight to keep the PF from being “heads down.”

Descent Procedure

Start the Descent Procedure before the airplane descends below the cruise altitude for arrival at destination. FWIA policy is to complete the descent procedure prior to commencing a descent.

Pilot Flying	Pilot Monitoring
Do the approach briefing.	
	Verify that pressurization is set to landing altitude.
Review all alert messages.	Recall and review all alert messages.
Verify VREF on the APPROACH REF page.	Enter VREF on the APPROACH REF page.
Set the bugs at VREF, VREF 30+40, and VREF 30+80.	
Set the BARO minimums as needed for the approach. If two BARO bugs are present, set one at minimums and one at field elevation.	
Set or verify the navigation radios and course for the approach.	
	Set the AUTOBRAKE selector to the needed brake setting. Check landing performance (see QRH PI-QRH.21.2)
Note: Florida West Policy is to use AUTO BRAKES for all landings when the system is operational. The selection of the appropriate setting is at the discretion of the Captain (the QRH Performance Inflight Section contains AUTO BRAKE landing distance reference information). However, in order to minimize brake wear a setting of “2” or greater should be selected.	
When cleared to descend, set clearance limit altitude on MCP. **If** the A/P **is** engaged, the PF sets the cleared altitude in the altitude window. He points to the new altitude until the PM visually or verbally verifies it. **If** the A/P is **not** engaged, the PF calls “SET ALTITUDE___” and visually or verbally verifies it after the PM sets it in the altitude window.	**If** the A/P **is** engaged, point or verbally verify the cleared altitude after the PF sets it in the altitude window. **If** the A/P is **not** engaged, set the cleared altitude as commanded by the PF and point to the new altitude until the PF visually or verbally verifies it.
Call “DESCENT CHECKLIST”	Do the DESCENT checklist. Call “DESCENT CHECKLIST COMPLETE”

Approach Procedure

The Approach Procedure is normally started at transition level.

Complete the Approach Procedure before:

- The initial approach fix, or
- The start of radar vectors to the final approach course, or
- The start of a visual approach

Pilot Flying	Pilot Monitoring
	Notify all flight deck occupants to fasten seatbelts and shoulder harnesses.
Reply "CHECKED"	At 1000 feet above assigned altitude or Flight Level, call "1000 FEET TO LEVEL OFF"
	Upon entering the arrival station radio coverage area; make Company in range call.
	At FL180 or transition level, whichever is higher, confirm both Pack Switches on.
At FL 180 or transition level, whichever is higher, position landing light switches on per Florida West lighting policy.	
At transition level, set and crosscheck the altimeters. Since the majority of our operations are international in nature, the transition level varies widely. In addition, crews need to be certain of the units used by ATC when relaying the local altimeter setting so that 1007 mb. is not understood by the crew to be 30.07 inches. The Jeppesen approach plates contain information on the altimeter units used by the local ATC authority. When in doubt confirm any questionable altimeter setting with ATC and use diligence when resetting altimeters.	
Update changes to the arrival and approach as needed. Update the RNP as needed. **– (NA on CC-CZZ)**	
Update the approach briefing as needed.	
Call "APPROACH CHECKLIST"	Do the APPROACH checklist. Call "APPROACH CHECKLIST COMPLETE"

Flap Extension Schedule

Current Flap Position	At "Display" or Speed (knots)	Select Flaps	Command Speed for Selected Flaps
UP	"Ref Bug" VREF30+80	1	VREF30+60
1	VREF30+60	5	"Ref Bug" VREF30+40
5	"Ref Bug" VREF30+40	20	VREF30+20
20	VREF30+20	25 or 30	(VREF25 or VREF30) +wind additives

NOTE: Upon initiating flap extension, the command speed will be set manually using the MCP. FWIA procedure requires the flight crew to manually set command speeds during all approaches. When the aircraft is in the terminal area and the Pilot Flying initiates flap extension, the MCP speed window will be opened and the command speed will be set manually in accordance with the selected flap position.

Desired airspeeds should still be entered into the FMC for VNAV descent and approach planning purposes, but manual command speed selection will be utilized during the approach phase. Manual selection of speed will give the Pilot Flying greater control of the aircraft during this critical phase of flight, as well as an increased awareness of aircraft configuration and position relative to the landing runway. Flap extension should begin no later than 10 NM from the FAF.

Landing Procedure – General

Maintaining a stable speed, descent rate, and vertical/lateral flight path in landing configuration is commonly referred to as the stabilized approach concept. Any significant deviation from the planned flight path, airspeed, or descent rate should be announced. The decision to execute a go-around is no indication of poor performance. Do not attempt to land from an unstable approach.

The following recommendations are consistent with criteria developed by the Flight Safety Foundation and define the Stabilized Approach Criteria used by Florida West.

The target AFE altitude by which the aircraft should be stabilized in IMC is 1500 feet. The limiting, or latest altitude this should occur is 1000 feet. In VMC, the aircraft must be stabilized by 500 feet AFE (limit). If an aircraft is not stabilized within the above constraints, a Go Around is required. If an approach becomes unstabilized below 1,000 feet AFE (IMC) or 500 feet AFE (VMC), an immediate go-around is required.

An approach is considered stable when all of the following criteria are met:

1. The airplane is on the correct flight path.
2. Only small changes in heading and pitch are required to maintain the correct flight path.
3. The airplane should be at approach speed. Deviations of +10 knots to -5 knots are acceptable if the airspeed is trending toward the approach speed.
4. The airplane is in the correct landing configuration.
5. Sink rate is no greater than 1,000 fpm; if an approach requires a sink rate greater than 1,000 fpm, a special briefing should be conducted.
6. Thrust setting is appropriate for the airplane configuration.
7. All briefings and checklists have been conducted.
8. ILS approaches should be flown within one dot of the glide slope and localizer, or within the expanded localizer scale.

Unique approach procedures or abnormal conditions requiring a deviation from the above elements of a stabilized approach require a special briefing.

These conditions should be maintained throughout the rest of the approach for it to be considered a stabilized approach. If the above criteria cannot be established and maintained at and below 500 feet AFE, initiate a go-around.

At 100 feet HAT for all visual approaches, the airplane should be positioned so that the flight deck is within, and tracking to remain within the lateral confines of the runway edge extended.

As the airplane crosses the runway threshold it should be:

1. Stabilized on approach airspeed within +10 knots until arresting the descent rate at flare.
2. On a stabilized flight path using normal maneuvering.
3. Positioned to make a normal landing in the touchdown zone (the first 3,000 feet or first third of the runway, whichever is less)

Initiate a go-around if the above criteria cannot be met.

NOTE: Florida West policy forbids the airborne extension of the Speed Brakes below 3,000 feet AGL.

Landing Procedure – ILS Approach

<table>
<tr><th>Pilot Flying</th><th>Pilot Monitoring</th></tr>
<tr><td></td><td>Notify all flight deck occupants to prepare for landing. Verify that the flight deck is secure.</td></tr>
<tr><td>Call “FLAPS ___” according to the flap extension schedule.</td><td>Set flap lever as directed.
Observe limit speeds and move handle to the requested position.
Verify proper indications.</td></tr>
<tr><td colspan="2">When on localizer intercept heading:
Verify that the ILS is tuned and identified
Verify that the LOC and G/S pointers are shown
If the glide slope will be intercepted before the localizer on an instrument approach, and if descending on the G/S will result in descent below the cleared altitude, arm LOC until CDI moves to center, then arm APP.</td></tr>
<tr><td>Arm the APP mode.</td><td></td></tr>
<tr><td colspan="2">WARNING: When using LNAV to intercept the final approach course, LNAV might parallel the localizer without capturing it. The airplane can then descend on the glide slope with the localizer not captured.</td></tr>
<tr><td>Use LNAV, HDG SEL or HDG HOLD to intercept the final approach course, as needed</td><td></td></tr>
<tr><td colspan="2">Verify that the localizer is captured.</td></tr>
<tr><td></td><td>Call “GLIDE SLOPE ALIVE”</td></tr>
<tr><td>At glide slope alive, call:
“GEAR DOWN”
“FLAPS 20”
The landing gear must be down prior to the outer marker (or substitute) on an ILS approach or 1500 feet AFE on final during a visual.</td><td>Set the landing gear lever to DN.
Set the flap lever to 20.</td></tr>
</table>

Pilot Flying	Pilot Monitoring
The Captain positions the SPEEDBRAKE lever to ARMED due to its location.	In accordance with Florida West Policy, ensure speed brakes are retracted before 3,000 feet AGL. Verify the speed brakes are armed after gear down and flaps 20 are selected.
At glide slope capture, call for "FLAPS__" as required for landing.	Position flap lever as commanded. Verify proper indications.
Set or call for the missed approach altitude to be set on the MCP when established on the glide slope. This must be accomplished by 1000 feet above touchdown zone elevation.	Set missed approach altitude in altitude window as commanded.
Call "LANDING CHECKLIST" Normally this checklist is called for when the flaps are set to the landing setting. This item in the Landing Procedure is the latest that the checklist should be completed.	Do the LANDING checklist. Call "LANDING CHECKLIST COMPLETE"
At the final approach fix or OM, verify the crossing altitude and crosscheck altimeters.	

Pilot Flying	Pilot Monitoring
Call "START TIME" if necessary for a timed approach procedure.	(IMC) Call "____ (name of fix/outer marker) ALTIMETERS AND INSTRUMENTS CROSSED CHECKED"
Monitor approach progress. Verify Autoland status at 500 feet radio altitude. With the exception of simulator training, Autoland operations are not authorized. The autopilot must be disengaged no later than 50 feet above touchdown zone. The autothrottle should be disconnected no later than the flare.	
Reply "CHECKED" In IMC conditions, if the aircraft is not stabilized at the 1000 ft callout, a missed approach is required. Call "SET MISSED APPROACH ALTITUDE" as necessary.	At 1000 feet above touchdown zone elevation, call "1000 FEET, CLEARED (NOT CLEARED, if still pending) TO LAND" If necessary, set missed approach altitude in altitude window as commanded.
Reply "CHECKED" In VMC conditions, if the aircraft is not stabilized at the 500 ft callout, a missed approach is required.	At 500 feet above touchdown zone elevation, call "500 FEET." If flight was not cleared to land at the 1,000 ft callout out, call "CLEARED (NOT CLEARED, if still pending) TO LAND."

Pilot Flying	Pilot Monitoring
Reply “CHECKED”	At 100 feet above DA, without previous acknowledgement of runway in sight, call “APPROACHING MINIMUMS”
Call “LANDING,” “CONTINUING” or “GO AROUND” as required. For Category I operations, if the requirements of 121.651 are met, the approach may be continued below the DA. If the requirements of 121.651 are not met, a GO AROUND is required. **Note:** When runway visual contact is established, a verbal announcement, of “RUNWAY IN SIGHT, LANDING,” is required to relieve the PM of the minimums call out. Likewise, failure to acknowledge a PM minimums call out is a possible indication that the PF is incapacitated.	Reaching Decision Altitude (DA), call “MINIMUMS” and, **If visual contact is made,** the PM will call “APPROACH LIGHTS,” “RUNWAY LIGHTS” or “RUNWAY” in sight along with the relative clock position. This will enable the PF to determine the proper course of action in accordance with 121.651 or, **If visual contact is not made,** the PM will call “NO CONTACT”
Call “LANDING” or “GO AROUND” as required. If the requirements of FAR 121.651 are met, the approach may be continued below 100 feet above touchdown zone elevation. If the requirements of 121.651 are not met, a GO AROUND is required.	At 100 feet above touchdown zone elevation, call “100 FEET” and, **If visual contact is made,** the PM will call “RUNWAY IN SIGHT” or, **If visual contact is not made,** the PM will call “NO CONTACT”
Note: Superior visibility over the nose and the relative lack of visual pitch cues may render pitch changes during the flare difficult for the PF to detect. The normal pitch attitude for the 767-300 during landing is 5-6 degrees. Aft body contact occurs at 8 degrees. Holding the aircraft off during flare while allowing airspeed to decrease below REF at touchdown is the leading single cause of all tail strikes. The PM can assist in strike protection by calling “PITCH” when 6.5 degrees ANU is indicated reference the ADI center box airplane symbol.	

Landing Procedure – Non- ILS Approach Using VNAV

Use the autopilot during the approach to give:

- autopilot alerts and mode fail indications.
- more accurate course and glide path tracking
- lower RNP limits

This procedure is not authorized using QFE.

<table>
<tr><th>Pilot Flying</th><th>Pilot Monitoring</th></tr>
<tr><td></td><td>Notify all flight deck occupants to prepare for landing. Verify that the flight deck is secure.</td></tr>
<tr><td>Call “FLAPS ___” according to the flap extension schedule.</td><td>Set flap lever as directed.
Observe limit speeds and move handle to the requested position.
Verify proper indications.</td></tr>
<tr><td colspan="2">The recommended roll modes for final approach are:
• for an RNAV, GPS, VOR or NDB approach use LNAV
• for a LOC approach use LOC or LNAV</td></tr>
<tr><td></td><td>Verify that the VNAV glide path angle is shown on the final approach segment of the LEGS page.</td></tr>
<tr><td colspan="2">When on the final approach course intercept heading for a LOC approach:
• verify that the localizer is tuned and identified
• verify that the LOC pointer is shown</td></tr>
<tr><td>Arm the LNAV or LOC mode</td><td></td></tr>
<tr><td colspan="2">WARNING: When using LNAV to intercept the localizer, LNAV might parallel the localizer without capturing it. The airplane can then descend on the VNAV path with the localizer not captured.</td></tr>
<tr><td>Use LNAV, HDG SEL or HDG HOLD to intercept the final approach course as needed.</td><td></td></tr>
<tr><td colspan="2">Verify that LNAV is engaged or that the localizer is captured.</td></tr>
</table>

Pilot Flying	Pilot Monitoring
Approximately 2 NM before the final approach fix and after ALT HOLD, VNAV PATH or VNAV ALT is annunciated: • verify that the autopilot is engaged • set DA or MDA on the MCP • select or verify VNAV • select or verify speed intervention	Approximately 2 NM before the final approach fix, call " APPROACHING GLIDE PATH"
Approaching glide path, call: "GEAR DOWN" "FLAPS 20" The landing gear must be down prior to the FAF or OM or 1500 feet AFE on final during a visual.	Set the landing gear lever to DN. Set the flap lever to 20.
The Captain positions the SPEEDBRAKE lever to ARMED due to its location.	In accordance with Florida West Policy, ensure speed brakes are retracted before 3,000 feet AGL. Verify the speed brakes are armed after gear down and flaps 20 are selected.
At glide path capture, call for "FLAPS__" as required for landing. Landing flaps should be selected before the FAF or OM on a (IMC) non-ILS approach.	Position flap lever as commanded. Verify proper indications.
Set or call for missed approach altitude to be set on the MCP. During a VNAV approach, the missed approach altitude must be set on the MCP when at least 300 feet below the missed approach altitude. Normally, this is accomplished at 1000 feet above touchdown zone elevation.	Set missed approach altitude in the altitude window as commanded.

Pilot Flying	**Pilot Monitoring**
Call "LANDING CHECKLIST" Normally this checklist is called for when the flaps are set to the landing setting. This item in the Landing Procedure is the latest that the checklist should be completed.	Do the LANDING checklist. Call "LANDING CHECKLIST COMPLETE"
At the final approach fix or OM, verify the crossing altitude and crosscheck the altimeters.	
	(IMC) Call "____ (name of fix/outer marker) ALTIMETERS AND INSTRUMENTS CROSSED CHECKED"
Monitor approach progress. The autopilot should be disengaged and the autothrottle may be disconnected leaving DA or MDA for landing. Maintain the glide path to landing. At pilot discretion, both flight directors can be turned OFF and the PM's flight director can be turned back on to eliminate unwanted commands and allow flight director guidance for the PM in the event of a go-around.	
Reply "CHECKED" In IMC conditions, if the aircraft is not stabilized at the 1000 ft callout, a missed approach is required. Call "SET MISSED APPROACH ALTITUDE" as necessary.	At 1000 feet above touchdown zone elevation, call "1000 FEET, CLEARED (NOT CLEARED, if still pending) TO LAND" If necessary, set missed approach altitude in altitude window as commanded.
Reply "CHECKED" In VMC conditions, if the aircraft is not stabilized at the 500 ft callout, a missed approach is required.	At 500 feet above touchdown zone elevation, call "500 FEET". If flight was not cleared to land at the 1000 ft call out, call "500 FEET, CLEARED (NOT CLEARED, if still pending) TO LAND".
Reply "CHECKED"	At 100 feet above DA or MDA, without previous acknowledgement of runway in sight, call "APPROACHING MINIMUMS"

Pilot Flying	Pilot Monitoring
Call “LANDING,” or “GO AROUND” as required. **Note:** When runway visual contact is established, a verbal announcement, of “RUNWAY IN SIGHT, LANDING,” is required to relieve the PM of the minimums call out. Likewise, failure to acknowledge a PM minimums call out is a possible indication that the PF is incapacitated.	Reaching DA or MDA, call “MINIMUMS” and, **If visual contact is made,** call “RUNWAY IN SIGHT” along with the relative clock position or, **If visual contact is not made,** call “NO CONTACT”
Note: Superior visibility over the nose and the relative lack of visual pitch cues may render pitch changes during the flare difficult for the PF to detect. The normal pitch attitude for the 767-300 during landing is 5-6 degrees. Aft body contact occurs at 8 degrees. Holding the aircraft off during flare while allowing airspeed to decrease below REF at touchdown is the leading single cause of all tail strikes. The PM can assist in strike protection by calling “PITCH” when 6.5 degrees ANU is indicated reference the ADI center box airplane symbol.	

Landing Procedure Callouts

The GPWS installed in the Florida West B767's provides voice callouts to assist the flight crew with situational awareness and to advise the flight crew of the aircraft's approximate height above the ground. Voice callouts are provided at:

- 2500 feet – "TWENTY FIVE HUNDRED"
- 1000 feet – "ONE THOUSAND"
- 50 feet – "FIFTY"
- 40 feet – "FORTY"
- 30 feet – "THIRTY"
- 20 feet – "TWENTY"
- 10 feet – "TEN"

A voice callout occurs when the airplane reaches 100 feet prior to the DH set in the Captain's Decision Height Reference Window:

- "APPROACHING DECISION HEIGHT"

A voice callout advises the flight crew when reaching the DH set in the Captain's Decision Height Reference Window:

- "MINIMUMS"

The flight crew is not required to make a callout if the aircraft correctly makes the callout. Similarly, the flight crew is expected to make all required callouts in the event the GPWS voice callouts are not made by the aircraft automatically. In addition, in cases where the GPWS voice callouts made by the aircraft are incorrect due to the terrain in the approach area relative to the touchdown zone elevation, the crew should acknowledge and respond to the incorrect altitude to confirm the actual position of the aircraft relative to the ground.

Go-Around and Missed Approach Procedure

Pilot Flying	Pilot Monitoring
Call "Go-Around"	
At the same time: Push the GA switch Call "FLAPS 20"	Verify go-around switch is pushed by checking for appropriate FMA. Position the flap lever to 20.
Verify: The rotation to go-around attitude That the thrust increases	
	Verify that the thrust is sufficient for the go-around or adjust as needed.
Verify a positive rate of climb on the altimeter and call "GEAR UP"	Verify a positive rate of climb on the altimeter and call "POSITIVE RATE." Set the landing gear lever to UP.
Above 400 feet radio altitude, select a roll mode. If aircraft is being flown manually, call "LNAV" or "Heading Select."	At 400 feet above field elevation, call "400 FEET" Select LNAV or HDG SEL at PF's command. Verify that the missed approach altitude is set.
Verify that the missed approach route is tracked.	
At acceleration height, set speed to the maneuver speed for the planned flap setting. If aircraft is being flown manually, call "SET SPEED VREF 30+___" Call "CLIMB THRUST"	At 1000 feet above field elevation, call "1000 FEET" Set speed to VREF 30+___ at PF's command. Select CLB thrust.
Call "FLAPS ___" according to the flap retraction schedule.	Set the flap lever as directed.

Pilot Flying	Pilot Monitoring
After flap retraction to the planned flap setting, select FLCH or VNAV as needed. If aircraft is being flown manually, call "Flight Level Change" or "VNAV"	Select FLCH or VNAV at PF's command.
Push A/P ENGAGE COMMAND switch. **Or** Call for "Center Command" and verify CMD annunciation on FMA.	At the option of the PF, push the center A/P command switch and verify CMD annunciation on FMA.
Verify that climb thrust is set.	
Verify that the missed approach altitude is captured.	
	After landing gear retraction is complete, set the landing gear lever to OFF.
Call "AFTER TAKEOFF CHECKLIST"	Do the AFTER TAKEOFF checklist. Call "AFTER TAKEOFF CHECKLIST COMPLETE."

Landing Roll Procedure

Pilot Flying	Pilot Monitoring
Verify that the thrust levers are closed. Verify the SPEEDBRAKE lever is UP. If the SPEEDBRAKE lever is not UP, the CAPTAIN will extend the SPEEDBRAKES.	Verify the SPEEDBRAKE lever is UP. Call "SPEEDBRAKES UP" If the SPEEDBRAKE lever is not UP, call "SPEEDBRAKES NOT UP"
Monitor the rollout progress.	
Verify correct autobrake operation.	
Note: In terms of cost effectiveness, together with the effective use of thrust reversers and speed brakes, auto brakes are the best way to slow the aircraft. Unless there is a valid reason, avoid using manual brakes at high speed. However, pilots should be alert for disarm annunciations during the landing roll so that manual braking can be applied if necessary. Do not use auto brakes if any of the following EICAS messages are displayed: ANTISKID, ANTISKID OFF, AUTOBRAKES or R HYD SYS PRES.	
WARNING: After the reverse thrust levers are moved, a full stop landing must be made. If an engine stays in reverse, safe flight is not possible.	
Without delay, move the reverse thrust levers to the interlocks and hold light pressure until the interlocks release. Then apply reverse thrust as needed. See "Use of Reverse Thrust" on page 21.60.	Verify that the forward thrust levers are closed. When both REV indications are green, call "REVERSERS NORMAL." If there is no REV indication(s) or the indication(s) stay amber, call "NO REVERSER LEFT ENGINE," or "NO REVERSER RIGHT ENGINE," or "NO REVERSERS."
If the F/O is making the landing, the Captain must take control of the aircraft before 60 knots. The Captain should verbally announce "I HAVE CONTROL." The F/O should acknowledge the transfer by stating "YOU HAVE CONTROL." In the event this verbal command is not acknowledged, the Captain should consider a tap on the F/O's hand to ensure the F/O knows the time has arrived to transfer control. When the F/O feels this tap, he should remove his hand from the thrust levers acknowledging the transfer of control. At this time, the Captain is the PF and the F/O is the PM for the remainder of the Landing Roll Procedure.	

Pilot Flying	Pilot Monitoring
By 60 knots, start movement of the reverse thrust levers to be at the reverse idle detent before taxi speed.	Call “60 KNOTS”
After the engines are at reverse idle, move the reverse thrust levers full down. The thrust levers should remain in idle reverse until the aircraft is at taxi speed and a safe turn off the runway is assured.	
Before taxi speed, disarm the autobrakes. Use manual braking as needed.	

Use of Reverse Thrust

FWIA standard operating procedure is to use idle reverse with an Autobrakes setting of 2 or higher unless one or more of the following conditions exist:

- The landing airport elevation is above 3,000 feet MSL.
- The OAT is greater than 30° centigrade.
- The available landing distance is less than 9,200 feet.
- There is a tailwind.
- The runway is not dry.
- Low visibility operations are in effect (visibility less than 3/4sm or 1,200m, RVR less than 2,400ft or 750m).
- Any open MEL item that degrades stopping capacity (for example, brakes, Anti-skid, or Auto Speed Brakes).

Autobrakes should be used until the aircraft slows to taxi speed. This technique results in lower brake temperatures versus the use of manual braking.

Under no circumstances will FWIA’s standard operating procedure to use idle reverse prevent the PIC from using full reverse whenever he determines that it is necessary.

After Landing Procedure

Start the After Landing Procedure when clear of the active runway.

Engine cool down recommendations:

- Run the engine for at least 3 minutes (no cool down time is required when idle reverse was used for landing).
- Use a thrust setting normally used for taxi operations

Pilot Flying	Pilot Monitoring
When clear of the active runway, retract the speed brake lever and position the “Captain owned” landing light switches as required.	After the aircraft is clear of the runway and the Captain retracts the speed brake lever, complete the after landing flow as listed below.
	Set the flap lever to UP.
	Set the APU selector to START, then ON. Do not allow the APU selector to spring back to the ON position
	Set LEFT and RIGHT ISOLATION Switches to On
	Set the WHITE ANTI-COLLISION light switch to OFF.
	Set the AUTOBRAKE selector to OFF.
Set WXR or TERR switch to off	Set WXR or TERR switch to off
.	Set the transponder mode selector as needed. At airports where ground tracking is not available, select STANDBY. At airports equipped to track airplanes on the ground, select an active transponder setting, but not a TCAS mode.
	Set Stab Trim to 2 units nose up

First Officer After Landing Flow

When the Captain retracts the SPEEDBRAKE lever, the First Officer should accomplish the following items immediately. These items are done without command from the Captain:

- Flaps .... UP
- APU .... Start, then ON
- LEFT and RIGHT ISOLATION Switches .... ON
- WHITE ANTI-COLLISION LIGHT .... OFF
- AUTO BRAKES Selector .... OFF
- WXR/TERR Switches (both) .... OFF
- Transponder .... AS NEEDED
- Stab Trim .... Set to 2 units

Once these initial items are done, the primary responsibility of the First Officer is to assist the Captain during the taxi in. Both pilots will have their airport taxi diagrams in view and will place emphasis on runway crossing clearances and runway incursion awareness.

The remaining items of the First Officer After Landing Flow can be accomplished on a time permitting basis provided they are completed prior to the Preflight checklist on a continuing flight or before leaving the aircraft at the termination of a trip:

- Decision Height Reference Windows .... Set to -20
- Transponder .... SET 4444
- ILS Control Panel .... STBY POSITION
- MCP Speed Window 200
- MCP Heading Window 000
- MCP Altitude Window 10,000

When the aircraft reaches the blocks, the First Officer must turn OFF the Wing Leading Edge Illumination Lights and the Logo Light. The Red- Anti-Collision light is switched OFF when the aircraft is at the blocks and the engines are shutdown. The Position Lights remain illuminated.

Single Engine Taxi In

FWIA standard operating procedure is to taxi in to the ramp on one engine. The PIC will direct the First Officer to shutdown the appropriate engine after the following items have been completed:

- The engine must be allowed to cool for 3 minutes at or near idle thrust prior to shutdown (no cool down time is required when idle reverse was used for landing).
- The After Landing Procedure and First Officer After Landing Flow have been completed.
- The APU is running and the APU generator is operational.

The PIC will not conduct a single engine taxi in if one or more of the following conditions exist:

- The taxiway or ramp is slippery or soft (for example, wet or icy, covered in oil or sand, hot soft asphalt).
- The ramp is congested and will require substantial maneuvering with high thrust settings.
- Low visibility taxi operations are in effect (visibility less than 3/4sm or 1,200m, RVR less than 2,400ft or 750m).

Procedures For The Proper Use Of The APU

FWIA standard operating procedure is to use the ground power unit (GPU) rather than the APU to provide aircraft power on the ground whenever a GPU is available. When using the GPU, the APU will be shutdown. The exceptions to this policy are as follows:

- Turnaround flights with no crew change and cockpit temperature is above 25
- Transit flight with perishable cargo on board or being loaded.
- Any flight where cargo includes live animals (leave packs on too).
- GPU is not available.
- Maintenance requires the APU on for specific works or repairs, etc.

At MIA, the APU (and Packs) will be switched OFF at the gate as soon as the GPU is available. When crews arrive at the aircraft they may operate the APU and Packs for cooling purposes at their discretion.

Shutdown Procedure

Start the Shutdown Procedure after taxi is complete

Parking brake .... Set C

Verify that the PARK BRAKE light is illuminated

Electrical power .... Set C

If APU power is needed:

Verify that the APU RUN light is illuminated

If external power is needed:

Verify that the EXTERNAL POWER AVAIL light is illuminated

EXTERNAL POWER switch – Push

Verify that the ON light is illuminated

ENGINE ANTI-ICE switches .... Off F/O

FUEL CONTROL switches .... CUTOFF C

If towing is needed:

Establish communications with ground handling personnel C

WARNING: If the nose gear steering is not locked out, any change to hydraulic power with the tow bar connected may cause unwanted tow bar movement.

Verify that the nose gear is locked out C

CAUTION: Do not hold or turn the nose wheel tiller during push back or towing. This can damage the nose gear or the tow bar.

CAUTION: Do not use airplane brakes to stop the airplane during push back or towing. This can damage the nose gear or tow bar.

Parking brake .... Set or Release C

As directed by ground handling personnel

When towing is complete:

HYDRAULIC panel .... Set F/O

Note: Depressurize right system last to prevent fluid transfer between systems.

Center AIR DEMAND pump selector – OFF

Left ELECTRIC DEMAND pump selector – OFF

Center 1 and Center 2 ELECTRIC PRIMARY pump switches – Off

Right ELECTRIC DEMAND pump selector – OFF

FUEL PUMP switches .... Off F/O

RED ANTI-COLLISION light switch .... Off F/O

FLIGHT DIRECTOR switches .... OFF C, F/O

Status messages .... Check F/O

Record shown status messages in maintenance log

TCAS mode selector .... STANDBY F/O

After wheel chocks are in place:

Parking brake .... Release C

APU selector .... As needed F/O

Call "SHUTDOWN CHECKLIST" C

Do the SHUTDOWN checklist .... F/O

Call "SHUTDOWN CHECKLIST COMPLETE" .... F/O

Secure Procedure

IRS mode selectors..OFF F/O

Perform IRS Post Flight Accuracy Check if required

EMERGENCY LIGHTS switch ....OFF F/O

WINDOW HEAT switches ....Off F/O

CARGO HEAT switches ....Off F/O

PACK CONTROL selectors..OFF F/O

Call "SECURE CHECKLIST." C

Do the SECURE CHECKLIST .... F/O

Call "SECURE CHECKLIST COMPLETE." .... F/O

The crew should leave the aircraft at the completion of a trip only after the flight deck has been properly readied for acceptance by the next crew. Items to be checked include but are not limited to:

- White speed reference bugs squeezed at three o'clock position
- Zero out any ET chronometers used
- CRT's and panel lights at minimum intensity
- CDU's on INDEX page
- All trash removed
- Ensure all maps, charts and Company manuals are returned to their appropriate storage position
- Remove log page copies from the log page file and insert them in the trip envelope
- Performance Computer is shutdown and secured in the lock box. The PIC is responsible for the performance computer
- All seat belts fastened

Maximum Quick Turnaround Weights

When landing at a weight in excess of the maximum quick turnaround weight you must wait at least 75 minutes and check that the wheel thermal plugs have not melted before making a subsequent takeoff unless the following FAA approved alternate procedures is utilized:

1. No sooner than 10 and no later than 15 minutes after parking, check the brake temperature display digits on the EICAS status page and the BRAKE TEMP light.
2. If all the brake temperature values are within the range of 1 through 4 and the BRAKE TEMP light is not on, no further ground waiting period is required.
3. If any brake temperature value is 5 or higher, or the BRAKE TEMP light is on, a minimum ground waiting time of 75 minutes is required and you must check to ensure that the wheel thermal plugs have not melted prior to making a subsequent takeoff.

NOTE: If any brake temperature display digit is blank or indicates zero, you must wait at least 75 minutes and check that the wheel thermal plugs have not melted prior to making a subsequent takeoff.

The above procedure is only applicable to landings in excess of the maximum quick turnaround weight. For brake cooling times associated with a rejected takeoff or multiple takeoffs and landings in a short period of time refer to the Recommended Brake Cooling Schedule contained in the Advisory Information section behind the Performance Inflight tab in the QRH.

Normal Checklist Response Guide

The Boeing 767 Normal Checklists appear in the Normal Procedures-Amplified Procedures Section for the purpose of identifying which pilot is expected to respond for each item challenged. Explanations for the response are included below the item. The checklist itself remains the same. The F/O reads checklists accomplished on the ground. Checklists accomplished in the air are read by the PM. Whenever an item calls for both pilots to respond, the Captain or PF answers first, then the First Officer or PM responds. The responding pilot is indicated as:

C...... Captain

F ...... First Officer

B...... Both

PF .... Pilot Flying

PM .. Pilot Monitoring

Normal Checklists — Chapter NC

PREFLIGHT

Oxygen.. Tested, 100% **B**

Both pilots respond, "tested, 100%."

Flight Instruments .... Heading___ Altimeter___ **B**

If the heading was 270 and the altimeter was 29.92, the Captain responds "heading 270, altimeter 29.92." The First Officer should verify these settings on his panel and respond "set."

Parking Brake .... Set **C**

The Captain responds, "set" confirming that the parking brake is set.

FUEL CONTROL Switches .... CUTOFF **C**

The Captain responds, "cut off" confirming that the fuel control switches are in the cut off position.

BEFORE START

Windows.. Locked **B**

Both pilots respond, "locked."

MCP .... V2___, HDG___, ALT___ **C**

The Captain answers this challenge by stating the applicable information set on the MCP. For example, "V2 160, heading 092, altitude 5,000 ft." The First Officer should silently verify these settings are correct.

Takeoff Speeds.. V1___, VR___, V2___ **B**

The Captain answers this challenge by stating the takeoff speeds set on his airspeed indicator. For example, "V1 143, VR 145, V2 150." The First Officer should verify these settings and respond, "set."

CDU Preflight.. Completed **C**

The Captain responds, "completed" indicating that the CDU preflight is complete, that the PF is on the TAKEOFF REF page and the PM is on the LEGS page.

Trim .... __UNITS, 0, 0 **C**

The Captain states the number of units of stabilizer trim, rudder trim and aileron trim. For example the Captain would respond "2 units, zero, zero." The First Officer should silently verify these settings are correct.

Taxi and takeoff briefing .... Completed **C**

The Captain should respond, "completed." This indicates that the Captain has briefed the taxi routing and the pilot flying has briefed the takeoff procedure.

RED ANTI COLLISION light... ON **F**

The First Officer turns on the red anti-collision light as part of his Before Start flow and responds, "on."

Cellular Phones .... Off **B**

Both pilots respond, "off." The Captain's response also indicates he has advised and confirmed that all other people on the flight deck have turned off their cellular phones.

BEFORE TAXI

Anti-Ice ....____ **F**

The First Officer positions the engine anti ice switches as per the takeoff briefing and responds, “on” or “off” as applicable. The Captain silently verifies the switch position.

L and R Isolation switches...Off **F**

The First Officer responds, “off.”

Recall ....Checked **C**

The Captain pushes the recall button and responds, “checked.” Both pilots observe the display for any messages that might require action.

Autobrake ....RTO **C**

The Captain responds, “RTO.”

Flight Controls ....Checked **C**

The Captain responds, “checked.”

Ground Equipment ....Clear **B**

Both pilots respond, “clear.”

BEFORE TAKEOFF

Flaps..____ **C**

The Captain responds with the indicated setting, for example, “5.”

Takeoff Runway ....____ **B**

The Captain will respond with the assigned takeoff runway. The First Officer will respond “confirmed” indicating that the airplane is at the departure end of the assigned departure runway.

AFTER TAKEOFF

Landing gear...UP AND OFF **PM**

The PM responds, “up and off.”

Flaps...UP **PM**

The PM responds, “up.”

DESCENT

Pressurization .... LDG ALT__ **PM**

The PM states the altitude set in the Landing Altitude window and verifies that it is the same as the landing airport.

Recall ....Checked **PM**

The PM pushes the recall button. Both pilots review any alert messages. The PM responds, "checked."

Autobrake ....____ **PM**

The PM verifies the autobrake selector is set to the briefed setting and responds with the setting, for example, "2."

Landing data .... VREF____, MINIMUMS ____ **B**

The PF states the VREF speed and the DA for the approach. For example, the PF responds, "VREF 140, MINIMUMS 207 feet." The PM then states "set."

Approach briefing.. Completed **PF**

The PF responds, "completed."

APPROACH

Altimeters ....____ **B**

The PF states the current local altimeter setting and set, for example "30.30, set." The PM responds, "set."

LANDING

Speedbrake .... ARMED **C**

The Captain checks that the speedbrake is not extended, that it is set to the armed position and then responds, "armed."

Landing gear.. DOWN **PF**

The PF confirms that the gear lever is in the down position with three green lights illuminated and then responds, "down."

Flaps...____ **PF**

The PF confirms that the flaps are selected to and indicating the correct position for landing and then responds with the position. For example, "30."

SHUTDOWN

Hydraulic Panel .... Set **F**

The First Officer responds, “set.”

Fuel Pumps.. Off **F**

The First Officer responds, “off.”

Flaps...UP **F**

The First Officer responds, “up.” The Captain should confirm that the speedbrake lever is down at this time.

Parking brake ....____ **C**

The Captain responds with the position of the parking brake, either “set” or “released.”

FUEL CONTROL switches...CUTOFF **C**

The Captain responds, “cut off” confirming that the fuel control switches are in the cut off position

Weather Radar .... Off **F**

The First Officer responds, “off’ indicating both weather radar switches are in the off position.

SECURE

IRS’s ....OFF **F**

The First Officer responds, “off.”

Emergency lights ....OFF **F**

The First Officer responds, “off.”

Window heat .... Off **F**

The First Officer responds, “off.”

Packs..OFF **F**

The First Officer responds, “off.” However, if current Company procedure requires the packs to be left on, he should respond, “on.”

Call Out Summary

Below is a summary of selected, required callouts, in phase of flight sequence, taken from the Normal Procedures section. They do not represent every callout a pilot will use. However, a normal flight will typically include each of the items listed. On page NP.21.77 there is a table that summarizes all the PM call outs that are made without command during a normal flight.

Engine Start Procedure

START___ENGINE .... (C)
BEFORE TAXI CHECKLIST .... (C)
BEFORE TAXI CHECKLIST COMPLETE .... (F)

Before Takeoff Procedure

FLAPS___ .... (C)
BEFORE TAKEOFF CHECKLIST .... (C)
BEFORE TAKEOFF CHECKLIST COMPLETE .... (F)

Takeoff Procedure

N1 .... (PF)
THRUST SET .... (PM)
CHECKED .... (PF)
80 KNOTS .... (PM)
CHECKED .... (PF)
V1 .... (PM)
ROTATE .... (PM)
POSITIVE RATE .... (PM)
GEAR UP .... (PF)
400 FEET .... (PM)
LNAV **or** HEADING SELECT .... (PF)
1000 FEET .... (PM)
VNAV **or** FLIGHT LEVEL CHANGE, SET SPEED __ .... (PF)
FLAPS___ .... (PF)
CENTER COMMAND .... (PF)
AFTER TAKEOFF CHECKLIST .... (PF)
AFTER TAKEOFF CHECKLIST COMPLETE .... (PM)

Climb Procedure

SET ALTITUDE___ .... (PF)

1000 FEET TO LEVEL OFF ....(PM)

CHECKED .... (PF)

Descent Procedure

DESCENT CHECKLIST .... (PF)

DESCENT CHECKLIST COMPLETE..(PM)

SET ALTITUDE___ .... (PF)

1000 FEET TO LEVEL OFF ....(PM)

CHECKED .... (PF)

Approach Procedure

APPROACH CHECKLIST.. (PF)

APPROACH CHECKLIST COMPLETE ....(PM)

Landing Procedure

FLAPS___ ....(PF)

GLIDESLOPE ALIVE OR APPROACHING GLIDEPATH .... (PM)

GEAR DOWN...(PF)

FLAPS 20 ....(PF)

FLAPS___ ....(PF)

(IMC) ___ (NAME OF FIX/OUTER MARKER),

ALTIMETERS AND INSTRUMENTS CROSSED CHECKED .... (PM)

LANDING CHECKLIST ....(PF)

LANDING CHECKLIST COMPLETE .... (PM)

1000 FEET, CLEARED TO LAND .... (PM)

CHECKED ....(PF)

SET MISSED APPROACH ALTITUDE ....(PF)

500 FEET (if not cleared at 1,000 ft), CLEARED TO LAND .... (PM)

CHECKED ....(PF)

APPROACHING MINIMUMS .... (PM)

CHECKED ....(PF)

MINIMUMS .... (PM)

- Approach Lights
- Runway Lights
- Runway
- No Contact

LANDING, CONTINUING or GO AROUND ....(PF)

100 FEET .... (PM)

- Runway in sight
- No Contact

LANDING or GO AROUND...(PF)

Go Around Procedure

GO-AROUND .... (PF)
FLAPS 20 .... (PF)
POSITIVE RATE .... (PM)
GEAR UP .... (PF)
400 FEET .... (PM)
LNAV or HEADING SELECT .... (PF)
1000 FEET .... (PM)
SET SPEED___ .... (PF)
CLIMB THRUST .... (PF)
FLAPS___ .... (PF)
FLIGHT LEVEL CHANGE or VNAV .... (PF)
CENTER COMMAND .... (PF)
AFTER TAKEOFF CHECKLIST .... (PF)
AFTER TAKEOFF CHECKLIST COMPLETE .... (PM)

Landing Roll Procedure

SPEEDBRAKES UP .... (PM)
REVERSERS NORMAL .... (PM)
60 KNOTS .... (PM)

PM Callout Summary

Phase of Flight	Condition	PM Callout
Takeoff	Engines stabilize at the takeoff thrust setting Airspeed reaches 80 knots, V1, Vr Positive climb on pressure altimeter 400 feet above field elevation 1000 feet above field elevation or briefed acceleration height	"Thrust Set" "80 Knots," "V1," "Rotate" "Positive rate" "400 feet" "1000 or __ feet"
Climb	1000 feet below each assigned altitude	"1000 feet to level off"
Descent	1000 feet above each assigned altitude	"1000 feet to level off"
Approach Procedure	On all approaches (IMC or VMC) below 500 feet AFE, the PM will monitor the instruments and call out any warning flags or significant deviation from the planned flight path, descent rate or airspeed. Any observed significant discrepancy or omission should be called out. All altitude callouts will be made in reference to the barometric altimeter. When meteorological conditions vary, good judgment will dictate whether to use IMC or VMC callouts; if it is obvious that IMC callouts are not needed, VMC callouts will suffice. For non-ILS approaches during IMC, both the IMC and VMC callouts should be made. When the glideslope begins to move or 2 NM prior to the FAF.	"Glideslope alive" or "Approaching Glidepath"

Phase of Flight	Condition	PM Callout
Landing Procedure – IMC	When continuous visual reference with the surface, approach lights or runway is established	"Visual contact" or "Approach lights in sight" or "Runway in sight:____ (state clock position relative to the nose)"
	At final approach fix	"___ (Name of fix/outer marker), altimeters and instruments cross checked"
	1000 feet above touchdown zone elevation	"1000 feet, cleared to land (not cleared to land)"
	500 feet above touchdown zone elevation	"500 feet." If not cleared to land at 1,000 ft, "500 feet, cleared to land (not cleared to land)"
	100 feet above decision altitude	"Approaching minimums"
	Reaching decision altitude	"Minimums." If the PM sees the runway or approach environment, he should state "Approach lights," "Runway lights" or "Runway" in sight, combined with a clock position relative to the nose, i.e. runway lights at 12 o'clock. If he does not see the runway or approach environment he should call "No contact."
	100 feet above touchdown zone elevation	"100 feet." If the PM sees the runway he should call "Runway in sight." If he does not see the runway he should call "No contact."
Landing Procedure – VMC	1000 feet above touchdown zone elevation	"1000 feet, cleared to land (not cleared to land)"
	500 feet above touchdown zone elevation	"500 feet." If not cleared to land at 1,000 ft, "500 feet, cleared to land (not cleared to land)"

Go Around Procedure	Positive climb on pressure altimeter 400 feet above field elevation. 1000 feet above field elevation or briefed acceleration height	"Positive rate" "400 feet" "1000 or __ feet"
Landing Roll Procedure	When speedbrakes deploy When both REV indications are green When reaching 60 knots	"Speedbrakes up" "Reversers Normal" "60 knots"

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Supplementary Procedures — Chapter SP

Introduction — Section 05

General

This chapter contains procedures (adverse weather operation, engine crossbleed start, and so on) that are accomplished as required rather than routinely performed on each flight. System tests which the flight crew are likely to perform are also included.

Procedures accomplished in flight, or those that are an alternate means of accomplishing normal procedures (such as selecting reduced T.O. thrust), are usually accomplished by memory. Infrequently used procedures, not normally accomplished (such as engine crossbleed start) are usually accomplished by reference.

Supplementary procedures are provided by section. Section titles correspond to the respective chapter title for the system being addressed except for the Adverse Weather section.

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Doors

Crew Entry Door Closing

Note: If interior door handle is down when door is open, raise handle to open position prior to closing door.

Capture Lever ....Pull Inboard

Door .... Lower

Raise door slightly, push and hold uplatch release button, then lower door approximately 2 inches (5 centimeters). Then, release button and continue to lower door until closed.

WARNING: Stand clear of the door handle as the handle may move as the door is lowered.

Door handle ....Down

Push to the down (flush) position.

Capture Lever ....Push Outboard

Crew Entry Door Opening

Capture Lever ....Pull Inboard

Door handle .... Up

Pull to the up position.

Door ....Raise

Raise the door until the uplatch is engaged.

Main Cargo Door Operation

Opening

WARNING: Keep personnel and equipment clear of main cargo door, when operating door, to avoid injury to personnel and/or damage to door and equipment.

CAUTION: Although the door structure will withstand gusts up to 65 knots in the full open position, the door cannot be opened or closed against steady winds exceeding 40 knots. Should it become necessary to lower the door in high winds, the airplane should be positioned with the door opening on the lee side.

APU or external power.. Establish

Main deck cargo door LOCK/UNLOCK switch .... UNLOCK

Hold switch in UNLOCK position until UNLOCKED light illuminates.

Main deck cargo door OPEN/CLOSE switch ....OPEN

Hold switch in OPEN position until OPEN light illuminates.

Closing

APU or external power.. Establish

Observe the CLOSED light and LATCHED light are both extinguished. Observe the UNLOCKED light illuminated.

Main deck cargo door OPEN/CLOSE switch .... CLOSE

Hold switch in CLOSE position until CLOSED and LATCHED light both illuminate.

Observe the LOCKED light extinguished.

Main deck cargo door LOCK/UNLOCK switch .... LOCK

Hold switch in LOCK position until LOCKED light illuminates.

Windows

Flight Deck Window Closing

Window crank .... Rotate

Crank the window to the full closed position (the WINDOW NOT CLOSED placard not visible).

Window lock lever .... Rotate

Rotate the window lock lever forward to the locked position.

Flight Deck Window Opening

Window lock lever .... Rotate

Rotate the window lock lever aft to the open position.

Window crank .... Rotate

Crank the window to the full open position (the WINDOW NOT CLOSED placard is visible).

Lights

Indicator Lights Test

INDICATOR LIGHTS TEST switch .... Push

Verify all indicator lights in the flight deck, except lights in the fuel control and APU/engine fire switches illuminated.

INDICATOR LIGHTS TEST switch .... Push

Main Cargo Alert

For any normal or non-normal situation which the flight crew requires the main deck cargo compartment occupants to return to the flight deck:

MAIN CARGO ALERT switch .... Push

Emergency Equipment

Oxygen Mask Microphone Test

BOOM/OXYGEN switch .... OXY

RESET/TEST switch .... Push and hold

EMERGENCY/TEST selector.. Push and hold

N422LA through N526LA
MICROPHONE/INTERPHONE switch... INT

Verify oxygen flow sound is heard through the flight deck loudspeaker.

N316LA
Push to talk switch .... Push

Simultaneously push the push to talk switch, emergency/test selector, and reset/test switch.

Verify oxygen flow sound is heard through the flight deck loudspeaker.

N316LA
Push to talk switch .... Release

N422LA through N526LA
MICROPHONE/INTERPHONE switch...................................... Release

EMERGENCY/TEST selector.. Release

RESET/TEST switch .... Release

Air Conditioning Packs

Ground Conditioned Air Use

Before connecting ground conditioned air:

Pack Control selectors .... OFF

Prevents pack operation when conditioned air is supplied to the airplane. The packs or pack components can be damaged if operated with conditioned air.

After disconnecting conditioned air:

Pack Control selectors ....AUTO

Packs Off Takeoff

Before takeoff:

Pack Control selectors (both) .... OFF

After takeoff:

Note: If engine failure occurs, pack control selectors should remain OFF until reaching 1,500 feet or until obstacle clearance height has been attained, whichever is higher.

Pack Control selector (one only) ....AUTO

After engine thrust is reduced from takeoff, position one pack control selector to AUTO.

Pack Control selector (remaining pack) ....AUTO

When cabin pressurization stabilizes, position remaining pack control selector to AUTO.

Landing Airport Elevation Between 8500 Feet and 9500 Feet

Before start:

Landing Altitude selector .... 8000 FT

Before descent:

Landing Altitude selector .... Set

Set to destination altitude.

Note: CABIN ALTITUDE warning may occur with lower than standard barometric conditions.

Forward Cargo Air Conditioning

Forward Cargo Air Conditioning System .... Set

If cargo carried in the forward cargo compartment is not temperature sensitive:

Forward Cargo Air Conditioning Temperature Control ....OFF

If temperature sensitive cargo is carried in the forward cargo compartment:

Forward Cargo Air Conditioning Temperature Control ..... AUTO

Adjust temperature as appropriate for cargo.

Note: Select FWD Cargo Heat switch OFF if a temperature below 45 degrees F (7 degrees C) is being maintained by the forward cargo air conditioning system.

Single Pack Operations

Conditions for Single Pack Operation:

1. No perishable on board.
2. No animals on board.

Procedures for single pack operation:

1. Climbing through 10,000’ AFE
   a. Set appropriate PACK selector Switch to OFF.
      i. Even Cruise FL: Right Pack off
      ii. Odd Cruise FL: Left Pack off
2. Descending through FL180 or transition level, whichever is higher
   a. Return appropriate PACK Selector Switch to ON
3. In the event of non-normal condition or EICAS message concerning pressurization, pneumatics, ice protection or air conditioning
   a. Both PACK Selector Switches must be set to ON prior to initiating any non-normal procedure or checklist.
4. If for any reason during flight it is necessary for one pilot to leave the controls of the aircraft
   a. Set both PACK Selectors to ON

Shipping considerations for Single Pack operation:

1. Any cargo or Hazardous Materials that could emit gases, vapors or odors, must be loaded away from the Flight Deck (Aft Lower Cargo compartment or the rear Main Deck area) to avoid the possibility of accidental inhalation.

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Ice Protection

Ice protection is provided by the airplane anti-ice systems.

Anti-Ice Use

Requirements for use of anti-ice and operational procedures for engine and wing anti-ice are moved from SP.3 to Supplementary Procedures, Adverse Weather Section SP.16.

Windshield Wiper Use

CAUTION: Do not use windshield wipers on a dry window.

Windshield Wiper selector (as required) .... LOW/HIGH

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AFDS

AFDS Operation

If Flight Director (F/D) operation is desired:

FLIGHT DIRECTOR switches ....ON

On ground, observe flight director command wings level and 8° pitch up and flight mode annunciations display TO, TO, FD.

N316LA

In–flight, observe flight director command and flight mode annunciations display vertical speed (V/S) and heading hold (HDG HOLD) or attitude (ATT) if no autopilot in command (CMD), or display existing autopilot modes if any autopilot in command (CMD).

N422LA through N526LA

In–flight, observe flight director command and flight mode annunciations display vertical speed (V/S) and heading hold (HDG HOLD) if no autopilot in command (CMD), or display existing autopilot modes if any autopilot in command (CMD).

AFDS Mode(s) ....Engage as desired

Observe flight director command and selected AFDS mode(s) is displayed.

If the autopilot is desired:

Command switch ....Engage

N316LA

Observe flight mode annunciations display V/S and HDG HOLD or ATT, or existing AFDS modes if flight director on and not in takeoff or go–around mode.

N422LA through N526LA

Observe flight mode annunciations display V/S and HDG HOLD, or existing AFDS modes if flight director on and not in takeoff or go–around mode.

Heading Hold

Rolls wings level and maintains the heading that exists at the time the wings become level.

Heading Hold switch .... Engage

Observe HDG HOLD displayed in the roll mode annunciator.

Heading Select

Heading selector .... Set as desired

Heading selector switch .... Push

Observe HDG SEL is displayed in the roll mode annunciator.

Bank Limit selector .... Set as desired

Altitude Hold

Altitude Hold switch .... Engage

Verify ALT HOLD is displayed in the pitch mode annunciator.

Flight Level Change, Climb or Descent

Altitude selector .... Set

Set level off altitude in the altitude window.

Flight Level Change switch .... Engage

Observe SPD in the pitch mode annunciator and FLCH displayed in the autothrottle mode annunciator.

IAS/MACH selector .... Set

Set the desired speed in the speed window.

Climb Thrust Reference Mode Select switch (if required) .... Select

If climb initiated, select climb reference N1.

Vertical Speed, Climb or Descent

Altitude selector....................Set

Set level off altitude in the altitude window.

Vertical Speed switch....................Engage

Observe V/S displayed in the pitch mode annunciator.

Note: The vertical speed mode does not provide automatic low speed protection and permits flight away from selected altitude. For level–off protection, always select new level–off altitude prior to engaging vertical speed mode.

Vertical Speed selector....................Set

Set desired rate in vertical speed window.

Climb Thrust Reference Mode Select switch (if required)....................Select

If climb initiated, select climb reference N1.

Intermediate Level Off

Altitude selector .... Rotate

Set desired altitude in altitude window.

At MCP altitude:

N316LA
Verify pitch mode annunciation is ALT HOLD.

N422LA through N526LA
Verify pitch mode annunciation is VNAV ALT (if VNAV engaged) or ALT HOLD (if FLCH or V/S was engaged).

To resume climb/descent:

Altitude selector .... Rotate

Set desired altitude in the altitude window.

If using VNAV:

N316LA
VNAV switch .... Engage

Verify pitch mode annunciation is VNAV SPD or VNAV PTH as appropriate.

N422LA through N526LA
Altitude selector .... Push

Verify pitch mode annunciation is VNAV SPD or VNAV PTH as appropriate.

If using Flight Level Change:

Flight Level Change switch .... Engage

Verify pitch mode annunciation is SPD and autothrottle annunciation is FLCH.

IAS/MACH selector .... Rotate

Set the desired speed in the IAS/MACH window.

Speed Intervention

IAS/MACH selector .... Push

Verify IAS/MACH window opens.

IAS/MACH selector .... Rotate

Set the desired speed in the IAS/MACH window.

To resume FMC speed schedule:

IAS/MACH selector .... Push

Verify IAS/MACH window blanks.

Autothrottle Operation

Autothrottle switch ....A/T ARM

If N1 mode desired:

Thrust Reference Mode Select switch (As desired).................. Select

Select desired reference N1.

N316LA

N1 switch .... Engage

Observe N1 displayed in the autothrottle mode annunciator.

N422LA through N526LA

THR switch .... Engage

Observe N1 displayed in the autothrottle mode annunciator.

If Speed mode desired:

Thrust Reference Mode Select switch (As desired).................. Select

Select desired reference N1.

Speed switch .... Engage

Observe SPD displayed in the autothrottle mode annunciator.

IAS/MACH selector ....Set

Set the desired speed in the IAS/MACH window.

Instrument Approach Using (V/S)

Note: Autopilot use is recommended until suitable visual reference is established.

Note: If required to remain at or above the MDA(H) during the missed approach, missed approach must be initiated at least 50 feet above MDA(H).

Recommended roll modes for final approach:

N422LA through N526LA
- RNAV, GPS, LOC-BC, VOR or NDB approach: LNAV or HDG SEL

N316LA
- LOC-BC, VOR or NDB approach: LNAV or HDG SEL (B/CRS for LOC-BC approaches)
- LOC, SDF, or LDA approach: LOC or LNAV

Note: When using LNAV to intercept a localizer, LNAV might parallel the localizer without capturing it. Use HDG SEL or HDG HOLD to intercept the final approach course, if needed.

Ensure appropriate navaids (VOR, LOC or NDB) are tuned and identified prior to commencing the approach.

RNP appropriate for approach (if required) ....Verify/Enter

Allows appropriate alerting to occur if ANP exceeds RNP.

Before descent to MDA(H):

MCP altitude selector ....Set

Set the first intermediate altitude constraint or MDA(H). When the current constraint is assured, the next constraint may be set prior to ALT HOLD engaged to achieve continuous descent path.

If constraints or MDA(H) do not end in zero zero (00; for example, 1820), set MCP ALTITUDE window to the closest 100 foot increment below the constraint or MDA(H).

At descent point:

V/S switch .... Push

Verify V/S Mode annunciates.

Desired V/S .... Set

Set desired V/S to descend to MDA(H). Use a V/S that results in no level flight segment at MDA(H).

Approximately 300 feet above MDA(H):

MCP altitude selector..........................Set Missed Approach Altitude

At MDA(H)/Missed Approach Point:

If suitable visual reference is not established, execute missed approach.

After suitable visual reference is established:

A/P Disengage Switch .... Push

Disengage autopilot in accordance with regulatory requirements.

A/T Disconnect Switch .... Push

Disconnect the autothrottle with the autopilot.

Circling Approach

Note: Autopilot use is recommended until intercepting the landing profile.

MCP Altitude Selector ....Set

If the MDA(H) does not end in zero zero (00; for example, 1820), set MCP ALTITUDE window to the closest 100 foot increment below the MDA(H)

Accomplish an instrument approach and establish suitable visual reference.

At MDA(H):

ALT HOLD switch (if required)..Push

Enables level off at MDA(H). Verify ALT HOLD mode annunciates.

MCP altitude selector .... Set Missed Approach Altitude

HDG SEL Switch ....Push

Verify HDG SEL mode annunciates.

Intercepting the landing profile:

Autopilot disengage switch ....Push

Autothrottle disconnect switch ....Push

Autoland Status Annunciator Test

AUTOLAND STATUS ANNUNCIATOR TEST switch 1 ....Push

Observe LAND 3 and NO LAND 3 in view.

AUTOLAND STATUS ANNUNCIATOR TEST switch 2 ....Push

Observe LAND 2 and NO AUTOLND in view.

Autoland Status Annunciator Reset

AUTOLAND STATUS ANNUNCIATOR
PUSH/RESET switch ....Push

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Cockpit Voice Recorder Test

Voice Recorder Test switch..Push

Observe STATUS light is illuminated (extinguishes after one second). A tone may be heard with a headset plugged into the headset jack on the voice recorder panel.

Aircraft Communications Addressing and Reporting System (ACARS)

N422LA through N526LA

The following procedures are applicable to the noted ACARS functions from the company pages.

Pre-Departure Clearance

The flight crew shall manually verify (compare) the filed flight plan versus the digital pre-departure clearance and shall initiate voice contact with Air Traffic Control if any question/confusion exists between the filed flight plan and the digital pre-departure clearance.

Digital-Automatic Information Service (D-ATIS)

The flight crew shall verify that the D-ATIS altimeter setting numeric value and alpha value are identical. If the D-ATIS altimeter setting numeric and alpha values are different, the flight crew must not accept the D-ATIS altimeter setting.

Oceanic Clearances

The flight crew shall manually verify (compare) the filed flight plan versus the digital oceanic clearance and shall initiate voice contact with Air Traffic Control if any question/confusion exists between the filed flight plan and the digital oceanic clearance.

Weight and Balance

The flight crew shall verify the Weight and Balance numeric and alphabetical values are identical. If the Weight and Balance numeric and alphabetical values are different, the flight crew must not accept the Weight and Balance data.

Takeoff Data

The flight crew shall verify the Takeoff Data numeric and alphabetic values are identical. If the Takeoff Data numeric and alphabetic values are different, the flight crew must not accept the Takeoff Data message.

Electrical Power Up

The following procedure is accomplished to permit safe application of electrical power.

Battery switch ....ON

Standby Power selector ....AUTO

N316LA

Verify APU BAT DISCH and MAIN BAT DISCH lights illuminated and standby bus OFF light extinguishes.

N422LA through N526LA

Verify battery DISCH light illuminated and standby bus OFF light extinguishes.

Hydraulic Electric Primary Pump switches .... Off

Hydraulic Demand Pump switches .... Off

Landing Gear Lever ....DN

Alternate Flaps selector ....NORM

Electrical Power ....Establish

Bus Tie switches ....AUTO

If external power is desired:

If External Power AVAIL light is illuminated:

External Power switch ....Push

If APU power is desired:

APU Generator switch .... ON

APU selector ....START, then ON

Position the APU selector back to the ON position. Do not allow the APU selector to spring back to the ON position.

Electrical Power Down

The following flight deck procedures are accomplished to permit removal of electrical power from the airplane.

APU selector/External Power switch ....Off

When APU RUN light extinguishes:

Standby Power selector ....OFF

Battery switch ....OFF

Operation With Less Than 90 KVA External Power Source

When external power source is less than required (90 KVA), airplane electrical loads must be minimized by supplementing normal procedures as follows:

Before Start Procedure

Accomplish normal exterior Inspection, Preflight Procedure – First Officer, Preflight Procedure – Captain and Before Start Procedure through “Start Clearance......Obtain”.

Confirm cargo loading complete.

Utility Bus switches ....OFF

Hydraulic System ....Set

Demand Pump selector (right) .... AUTO

Observe PRESS light extinguished.

Fuel Pump switches (one left and one right main wing).................... ON

Observe PRESS lights extinguished.

Note: Delay activation of the remaining hydraulic and fuel pumps, setting trim and checking flight controls until after engines are started.

Complete the normal Before Start and Engine Start procedures.

Before Taxi Procedure

Hydraulic System ....Set

Electric Primary Pump switches (both)..ON

Demand Pump selectors (remaining pumps) ....AUTO

Utility Bus switches ....ON

Fuel Pump switches (remaining pumps) ....ON

Position switches ON for all tanks containing fuel.

Trim ....Set

Flight controls .... Check

Displace control wheel and control column to full travel in both directions and verify:

- freedom of movement
- controls return to center
- proper flight control movement on EICAS status display.

Hold the nose wheel steering tiller during rudder check to prevent undesired nose wheel movement.

Displace rudder pedals to full travel in both directions and verify:

- freedom of movement
- rudder pedals return to center
- proper flight control movement on EICAS status display.

Complete normal Before Taxi procedure.

Shutdown Procedure

After park brake is set and prior to establishing external power:

Hydraulic System ....Set

Electric Primary Pump switches (both) .... OFF

Demand Pump selectors (All) .... OFF

Fuel Pump switches .... OFF

Accomplish normal Shutdown procedure.

Standby Power Test

Airplane must be on ground with all busses powered.

Standby Power Selector ....BAT

N422LA through N526LA

Observe battery DISCH light illuminates and standby power OFF light remains extinguished.

N316LA

Observe APU BAT DISCH and MAIN BAT DISCH lights illuminate and standby power OFF light remains extinguished.

Standby Power Selector .... AUTO

N422LA through N526LA

Observe battery DISCH light extinguishes and standby power OFF light remains extinguished.

N316LA

Observe APU BAT DISCH and MAIN BAT DISCH lights extinguish and standby power OFF light remains extinguished.

Transfer From External Power To APU Power

Prior to disconnecting external power:

External Power switch.. Push

Observe ON light extinguish.

Hydraulic Generator Test

Electrical and pneumatic power must be established on the airplane.

Center 1/2 Electric Primary Pump Switches .... OFF

Center Air Demand Pump Selector ....AUTO

EICAS Status Display ....ON

Hydraulic Generator Test Switch ....HYD GEN

While holding the test switch in the HYD GEN position, verify the HYD GEN ON and HYD GEN VAL Status messages appear on EICAS, and Captain ADI and HSI are powered with no flags displayed. The HYD GEN ON and HYD GEN VAL messages should no longer be displayed when the test switch is released.

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Engines

Engine Crossbleed Start

The APU must be shut down or the APU bleed air switch must be OFF

Check that the area behind the airplane is clear

Engine Bleed Air switch (operating engine) ....ON

Advance thrust on operating engine to approximately 70% N2 and accomplish normal Engine Start procedure

Engine Ground Pneumatic Start

Check duct pressure 30 psi or greater

Start engine using normal Engine Start procedure

Reduced Thrust Selection Prior To Takeoff

N316LA

If reduced takeoff thrust desired:

Assumed Temperature .... Set

Rotate assumed temperature selector clockwise and set desired temperature value or enter required temperature on Takeoff Reference page

Observe D–TO displayed in green on the EICAS

If reduced climb thrust desired:

Thrust Reference Mode Select switch .... 1 or 2

Select desired climb thrust reference; 1 or 2

Observe TO 1 or TO 2 (D-TO 1 or D-TO 2 for an assumed temperature derated takeoff) displayed on the EICAS in green for the TO or D-TO and in white for the numerals 1 or 2

Reduced Thrust Selection Prior To Takeoff

N422LA through N526LA

If both reduced takeoff thrust and reduced climb thrust desired:

Thrust Reference Mode Select switch ....1 or 2

Select desired thrust reference; 1 or 2

CLB 1 or CLB 2 is preselected

Observe TO 1 or TO 2 displayed in green on the EICAS

If additional takeoff thrust reduction desired:

Assumed Temperature ....Set

Rotate assumed temperature selector clockwise and set desired temperature value or enter temperature on Takeoff Reference page

CLB 1 or CLB 2 is preselected

Observe D–TO 1 or D–TO 2 displayed in green on the EICAS

If only reduced takeoff thrust desired:

Assumed Temperature ....Set

Rotate assumed temperature selector clockwise and set desired temperature value or enter temperature on Takeoff Reference page

Observe D–TO displayed in green on the EICAS

Reduced Takeoff Thrust Change or Cancellation

N316LA

If change desired:

Assumed Temperature ....Set

Enter new temperature value on Takeoff Reference page

If cancellation desired:

Thrust Reference Mode Select switch ....As desired

Select desired thrust reference mode; TO/GA, CLB, CON or CRZ

Observe associated mode displayed

Note: If full takeoff thrust desired during takeoff following 80 knots (autothrottle in THR HOLD mode) thrust levers must be adjusted manually.

Reduced Takeoff Thrust Change or Cancellation

N422LA through N526LA

If change desired:

Accomplish "Reduced Thrust Selection Prior To Takeoff" procedural steps

If cancellation desired:

Thrust Reference Mode Select switch ....As desired

Select desired thrust reference mode; TO/GA, CLB, CON or CRZ

Observe associated mode displayed

Note: If full takeoff thrust desired during takeoff following 80 knots (autothrottle in THR HOLD mode) thrust levers must be adjusted manually.

Reduced Climb Thrust Change or Cancellation

N316LA

If change desired:

Thrust Reference Mode Select switch ....1 or 2

Select desired climb thrust reference; 1 or 2

Observe CLB 1 or CLB 2 (TO 1 or TO 2; ground only) displayed

If cancellation desired:

Thrust Reference Mode Select switch ....1 or 2

Push switch associated with current thrust reduction

Observe CLB or TO (ground only) displayed

Note: If preselected reduced climb thrust is changed or cancelled and reduced takeoff thrust is still desired, reduced takeoff thrust must be reselected.

Reduced Climb Thrust Change or Cancellation

N422LA through N526LA

If change desired:

Thrust Reference Mode Select switch ....1 or 2

Select desired climb thrust reference; 1 or 2

Observe CLB 1 or CLB 2 (TO 1 or TO 2; ground only) displayed

If cancellation desired:

Thrust Reference Mode Select switch ....1 or 2

Push switch associated with current thrust reduction

Observe CLB or TO (ground only) displayed

Reduced Climb Thrust Selection In–flight

Thrust Reference Mode Select switch... CLB

Observe CLB displayed

Thrust Reference Mode Select switch...1 or 2

Select desired thrust reference; 1 or 2

Observe CLB 1 or CLB 2 displayed

Engine, APU and Cargo Fire/Overheat Test

Engine/APU/Cargo Fire/Overheat Test switch ....Push

Observe the fire bell ring intermittently

Observe the following lights illuminate:

- Discrete FIRE warning
- Fuel control switches
- L and R ENG OVHT
- LEFT, RIGHT and APU fire switches
- MAIN, FWD and AFT cargo fire
- Master Warning

Observe the following EICAS messages:

- APU FIRE warning
- MAIN, FWD and AFT CARGO FIRE warning
- L and R ENGINE FIRE warning
- L and R ENG OVHT caution

Wheel Well Fire Detection Test

Wheel Well Fire Test switch ....Push

Observe the fire bell ring intermittently

Observe the following lights illuminate:

- Discrete FIRE warning
- WHL WELL FIRE
- Master Warning

Observe the following EICAS message:

- WHEEL WELL FIRE warning

Intentionally
Blank

Flight Recorder Test

Flight Recorder switch .... Test

Observe OFF light extinguish.

Heading Reference Switch Operation

Use TRUE when operating in a region where true referencing is needed. Use NORM in all other regions.

HDG REF switch .... NORM or TRUE

Note: If using HDG SEL mode and the HDG REF switch position is changed, the AFDS roll mode will change to HDG HOLD. HDG SEL can be reselected.

Note: If the HDG REF switch position must be changed for an approach, it must be changed before the LOC or APP switch is pushed to arm LOC mode.

If the HDG REF switch position is changed after LOC mode is armed:

- The AFDS roll mode will not change from HDG SEL to HDG HOLD
- The AFDS will not follow the MCP-selected heading
- LOC capture and tracking performance may be degraded
- Exiting the LOC mode restores normal operation of the HDG REF switch and the AFDS. LOC can be reselected.

QFE Operation

Use this procedure when ATC altitude assignments are referenced to QFE altimeter settings.

Note: Do not use LNAV or VNAV.

Altimeters .... Set

Set primary and standby altimeters to QFE when below transition altitude/level.

Note: If the QFE altimeter setting is beyond the range of the altimeters, QNH procedures must be used with QNH set in the altimeters.

Landing Altitude Indicator ....Set at Zero

Transponder Test (TCAS equipped airplanes)

This procedure requires the IRSs to be aligned and in NAV mode.

N316LA
TCAS Test switch .... Push
Verify "TCAS SYSTEM TEST OK" aural sounds.

N422LA through N526LA
Transponder Mode selector .... TEST
Verify "TCAS SYSTEM TEST OK" aural sounds.

Weather Radar Test

Weather Radar Mode .... TEST

HSI Mode selector .... MAP

Weather Radar switch .... ON
Observe radar test pattern on HSI.

N422LA through N526LA
Note: If the airplane is on the ground and the thrust levers are not advanced for takeoff, the WXR tests the predictive windshear system (PWS) indications. These include the WINDSHEAR SYS EICAS advisory, the PWS caution, and PWS warning. Deactivating WXR on the EFIS control panel will not discontinue the test and can result in automatic WXR activation on both pilot displays. The PWS test lasts approximately 15 seconds.

N316LA
Note: If the airplane is on the ground and the thrust levers are not advanced for takeoff, the WXR tests the predictive windshear system (PWS) indications. These include the WINDSHEAR SYS EICAS advisory, the PWS caution, and PWS warning. Deactivating WXR on the EFIS control panel will discontinue the test. The PWS test lasts approximately 15 seconds.

Weather Radar switch .... OFF
Select captain’s and first officer’s weather radar displays off.

Weather Radar Mode .... As desired

IRS

Align Lights Flashing

Do not move IRS Mode selector to OFF except where called for in procedure.

POS INIT page .... Select

Set IRS Position ....Enter Present Position

Enter present position using most accurate latitude and longitude available. If a position is already displayed on the SET IRS POS line, enter new position over displayed position.

If ALIGN light continues to flash:

Set IRS Position ....Enter Present Position

Re–enter same present position.

If ALIGN light continues to flash after re–entry:

IRS ....OFF

Rotate IRS Mode selector to OFF and verify ALIGN light extinguished.

Note: Light must be extinguished before continuing with procedure (approximately 30 seconds).

IRS ....NAV

Rotate IRS Mode selector to NAV and verify ALIGN light illuminated.

Set IRS Position ....Enter

Enter present position in boxes. If ALIGN light flashes, re–enter same present position over displayed position.

Note: Approximately ten minutes is required for realignment.

If ALIGN light continues to flash, maintenance action is required.

Fast Realignment

If the combined operating time from the last full IRS alignment to the expected next destination arrival time does not exceed 18 hours, a fast realignment may be accomplished.

IRS Mode selectors .... ALIGN

CDU ....Set

Enter present position on SET IRS POSITION line of Position Initialization page.

IRS Mode selectors ....NAV

High Latitude Alignment

This procedure applies to alignment at latitudes greater than 70°12.0' and less than 78°15.0'.

IRS Mode selectors .... OFF, then ALIGN

POS INIT page ....Set

Enter present position on SET IRS POS line using the most accurate latitude and longitude available.

IRS Mode selectors ....NAV

Select NAV after remaining in ALIGN for 17 minutes minimum. Verify ALIGN lights extinguished.

Position Entry Using IRS Mode Selector Panel

Latitude ....Enter

Begin with N or S, followed by latitude including trailing zeros, i.e., N003°30.0' entered as N3300.

Longitude ....Enter

Begin with E or W, followed by longitude including trailing zeros, i.e., E001°11.0' entered as E1110.

Lateral Navigation

Alternate Route Entry/Activation

Desired RTE page 1 .... Select

If desired route (1 or 2) not displayed, select desired route.

Route (if required) ....Enter

Enter route using preflight procedure.

ACTIVATE .... Select

If in–flight, use DIRECT TO or INTC LEG TO boxes to enter desired course from present position to new route.

EXEC key .... Push

Direct To A Waypoint Using Overwrite

RTE LEGS page .... Select

Desired Waypoint ....Enter

Enter the desired waypoint over the active waypoint.

Waypoint Sequence ....Check

Enter waypoints in desired sequence.

EXEC key .... Push

Estimate For Alternate

PROGRESS page 1 .... Select

Desired Destination ....Enter

Note: Estimates displayed are for present position direct.

Holding Pattern Entry

Holding fix must be a route waypoint or present position before accomplishing following steps.

HOLD key .... Push

NEXT HOLD (if displayed) .... Select

Holding Fix .... Enter

To hold at present position, select PPOS. To hold at waypoint, enter waypoint identifier in HOLD AT boxes.

HOLD page .... Check

EXEC key .... Push

Holding Pattern Exit

To exit holding accomplish the following procedure or refer to one of the "Direct to a Waypoint" procedures.

EXIT HOLD .... Select

EXEC key .... Push

Intercept A Leg Or Course To A Waypoint Using Overwrite

RTE LEGS page .... Select

Desired Waypoint ....Enter

Enter the desired waypoint over the active waypoint.

Note: If waypoint not previously in route, a discontinuity occurs.

If waypoint was previously in route, the inbound course is set to same inbound great circle course. For airways, displayed course may not be identical to charted value.

If inbound course not correct:

Intercept Course ....Enter

Enter course desired at waypoint in INTC CRS TO boxes (or over existing intercept course to value if waypoint was already in route).

EXEC key .... Push

Waypoint Sequence ....Check

Enter waypoints in desired sequence.

EXEC key .... Push

If necessary, use Heading Select mode to change intercept heading. Then, arm LNAV mode.

Lateral Offset

RTE page .... Select

Offset ....Enter

Enter desired offset direction and distance over OFFSET dashes.

EXEC key .... Push

To remove offset, accomplish Direct To procedure or enter "0" in OFFSET line.

Leg Modification

To modify active waypoint or leg, accomplish one of the Direct To or Intercept A Leg Or Course procedures except when entering along track waypoints.

RTE LEGS page .... Select

To change waypoint sequence:

Desired Waypoint Sequence .... Enter

Note: If waypoint not previously in route a discontinuity occurs except when entering along track waypoints.

EXEC key .... Push

To delete a waypoint at end of route:

DEL key .... Push

Waypoint .... Select

EXEC key .... Push

To enter along track waypoints:

Along Track Displacement .... Enter

Select reference waypoint to scratch pad and modify for desired displacement.

Reference Waypoint .... Select

The FMC will automatically position the created waypoint to the appropriate position.

EXEC key .... Push

Route Removal

RTE page 1 .... Select

Origin .... Enter

If EXEC key illuminates:

EXEC key .... Push

SID Change Or Runway Change

This entire procedure must be accomplished when a SID is used and the runway or SID is changed. This will prevent the possibility of incorrect routing or inadequate obstacle clearance.

DEPARTURES page .... Select

Runway ....Reselect

SID ....Reselect

Transition (if required) ....Reselect

RTE LEGS page .... Select

Waypoint Sequence and Altitudes ....Check

Modify as necessary to agree with clearance.

EXEC key .... Push

STAR, Profile Descent Or Approach Change

Associated airport must be entered as route origin or destination.

ARRIVALS page .... Select

STAR or Profile Descent (if required) .... Select

Transition (if required) .... Select

Approach .... Select

Approach Transition (if required) .... Select

RTE LEGS page .... Select

Waypoint Sequence and Altitudes ....Check

Modify as necessary to agree with clearance.

EXEC key .... Push

Vertical Navigation

Climb, Cruise Or Descent Speed Schedule Change

CLB or CRZ or DES page .... Select

To change schedule:

Desired Schedule .... Select

To enter fixed speed schedule:

Desired Speed .... Enter

Enter speed on ECON/SEL SPD line (line 2L).

EXEC key .... Push

Climb Or Descent Direct To MCP Altitude

This procedure deletes all waypoint altitude constraints between current airplane altitude and altitude set in MCP.

Altitude Window .... Set

CLB or DES page .... Select

CLB DIR or DES DIR .... Select

EXEC key .... Push

Cruise Altitude Change

N422LA through N526LA

Altitude Window .... Set

Altitude selector .... Push

Cruise Altitude Change

N316LA

Altitude Window .... Set

CRZ page .... Select

Cruise Altitude .... Enter

EXEC key .... Push

Speed/Altitude Constraint At Waypoint

RTE LEGS page .... Select

To enter or modify constraint:

Speed/Altitude ....Enter

Note: Speed entry requires "/" mark and altitude.

EXEC key .... Push

To delete constraint:

DEL key .... Push

Speed/Altitude .... Select

Select undesired constraint and observe estimated values appear.

EXEC key .... Push

Speed/Altitude Transition And Restriction

CLB or DES page .... Select

To enter speed/altitude restriction:

Speed/Altitude ....Enter

EXEC key .... Push

To delete speed/altitude restriction or transition:

DEL key .... Push

Speed/Altitude .... Select

EXEC key .... Push

Temporary Altitude Restriction

Altitude Window ....Set

To resume climb or descent:

Altitude Window ....Set

N422LA through N526LA
Altitude selector ....Push

N316LA
VNAV ....Engage

Temporary Speed Restriction

IAS/MACH selector ....Push

Speed Window ....Set

To resume FMC speed schedule:

IAS/MACH selector ....Push

Performance Data Entries

Descent Forecast

DES page .... Select

DESCENT FORECAST page .... Select

Transition Level .... Check

Thermal Anti–ice On Altitude (if required) .... Enter

Wind Altitude .... Enter

Enter altitude over dashes on left.

Wind Direction/Speed .... Enter

Step Climb Evaluation

CRZ page .... Select

Step to Altitude .... Enter

Savings .... Check

Waypoint Winds

RTE LEGS page .... Select

RTE DATA page .... Select

WINDS page .... Select

Altitude and Wind .... Enter

EXEC key .... Push

Additional CDU Functions

Data Link Request

N422LA through N526LA

For Pegasus FMC

FMC COMM page .... Select

Desired page .... Select

Request send .... Select

Fix Page Entries

FIX page .... Select

Fix Identifier .... Enter

Bearing or Distance From Fix .... Enter

Enter desired bearing or distance or select ABEAM.

Note: Bearing/distance from fix may be used as route waypoint.

HSI Plan Mode Control

HSI Mode .... PLAN

RTE LEGS page .... Select

Map Center Step .... Select

Navaid Inhibit

To inhibit use of radio navigation aids from position updating:

INIT REF page .... Select

INDEX page .... Select

NAV DATA page .... Select

Navaid Identifier .... Enter

To inhibit use of a VOR and DME:

NAVAID line .... Enter

To inhibit use of a VOR only:

VOR ONLY line .... Enter

To inhibit use of all VORs:

VOR/DME NAV OFF/ON prompt .... Select

ALL is displayed in the VOR ONLY inhibit line and OFF is displayed in large font.

Update Active Navigation Database

The navigation database can be changed only on the ground. Changing the database removes all previously entered route data.

INIT REF .... Select

IDENT page .... Enter

Inactive Date line .... Enter

Transfers inactive date range to scratchpad

Active Date line .... Enter

Transfers inactive database line to active database line. Transfers active database line to the inactive database line.

Fuel Balancing

If an engine fuel leak is suspected:

Accomplish the FUEL LEAK ENGINE checklist

Note: Fuel pump pressure should be supplied to the engines at all times. At high altitude, without fuel pump pressure, thrust deterioration or engine flameout may occur.

When the fuel quantities in left main and right main tanks differ by an appreciable amount:

Crossfeed switches (both)..ON

Fuel pump switches (low quantity tank) .... OFF

When fuel load balanced:

Fuel pump switches ....ON

Crossfeed switches (both)... OFF

Fuel Quantity Test

Fuel Quantity Test switch .... FUEL QTY

Observe FUEL CONFIG light illuminate and LOW FUEL message display

Observe fuel quantity indicators display all eights (8) except initial digit in total fuel quantity indicator which displays one (1). Observe fuel temperature indicator display -188 degrees Centigrade.

Intentionally
Blank

EICAS Test

This procedure requires the airplane to be on the ground and parking brake set.

EICAS Test switch ....Push

Wait 5 seconds and switch to L then R.

Observe TEST OK message displayed on CRTs in both positions.

Note: Standby engine indications will be displayed during test and siren aural will sound.

EICAS Test switch ....Push

Event Record

Event Record switch ....Push

Use as directed by Flight Operations for maintenance analysis or at the discretion of the captain to manually record parameters for a suspect condition.

Landing Configuration Warning Test

Configuration Test switch .... LDG

Observe CONFIG light illuminate and GEAR NOT DOWN message display.

Stall Warning Test

L Stall Warning Test switch .... STALL

Observe control columns vibrate.

R Stall Warning Test switch .... STALL

Observe control columns vibrate.

L and R Stall Warning Test switches.. STALL

Observe both stall warning systems vibrate control columns and also move control columns forward.

Note: A minimum of one hydraulic system must be pressurized for proper verification of the control column nudger.

Takeoff Configuration Warning Test

Establish one or more of the following conditions:

Flaps not in takeoff position

Speedbrakes not down

Stabilizer units set greater than green band

Park brake set

Configuration Test switch ....T/O

Observe CONFIG light illuminate, and appropriate configuration warning message(s) display.

Establish appropriate configuration.

Introduction

Airplane operation in adverse weather conditions may require additional considerations due to the effects of extreme temperatures, precipitation, turbulence, and windshear. Procedures in this section supplement normal procedures and should be observed when applicable.

Takeoff - Wet or Contaminated Runway Conditions

The following information applies to takeoffs on wet or contaminated runways:

N422LA through N526LA

- For wet runways, reduced thrust (fixed derate, assumed temperature method, or both) is allowed provided suitable takeoff performance accountability is made for the increased stopping distance on a wet surface.

N422LA through N526LA

- For runways contaminated by slush, snow, standing water, or ice reduced thrust (fixed derate) is allowed provided takeoff performance accounts for the runway surface condition. Reduced thrust using assumed temperature method, whether alone or in combination with a fixed derate, is not allowed.

N316LA

- For wet runways, reduced thrust (assumed temperature method) is allowed provided suitable takeoff performance accountability is made for the increased stopping distance on a wet surface.

N316LA

- For runways contaminated by slush, snow, standing water or ice, reduced thrust (assumed temperature method) is not allowed.
- V1 may be reduced to minimum V1 to provide increased stopping margin provided the field length required for a continued takeoff from the minimum V1 and obstacle clearance meet the regulatory requirements. The determination of such minimum V1 may require a real-time performance calculation tool or other performance information supplied by dispatch.
- Takeoffs are not recommended when slush, wet snow, or standing water depth is more than 1/2 inch (13 mm) or dry snow depth is more than 4 inches (102 mm).

Cold Weather Operations

Considerations associated with cold weather operation are primarily concerned with low temperatures and with ice, snow, slush and standing water on the airplane, ramps, taxiways, and runways.

Icing conditions exist when OAT (on the ground) or TAT (in-flight) is 10°C or below and any of the following exist:

- visible moisture (clouds, fog with visibility of one statute mile (1600 m) or less, due to meteorological conditions such as rain, snow, sleet, ice crystals), or
- ice, snow, slush or standing water is present on the ramps, taxiways, or runways.

CAUTION: Do not use engine anti-ice when OAT (on the ground) is above 10°C. Do not use engine or wing anti-ice when TAT (in-flight) is above 10°C.

Exterior Inspection

Although removal of surface snow, ice and frost is normally a maintenance function, during preflight procedures, the captain or first officer should carefully inspect areas where surface snow, ice or frost could change or affect normal system operations.

Do the normal Exterior Inspection with the following additional steps:

Surfaces .... Check

Takeoff with light coatings of frost, up to 1/8 inch (3mm) in thickness, on lower wing surfaces due to cold fuel is allowable; however, all leading edge devices, all control surfaces, and upper wing surfaces must be free of snow, ice and frost.

Thin hoarfrost is acceptable on the upper surface of the fuselage provided all vents and ports are clear. Thin hoarfrost is a uniform white deposit of fine crystalline texture, which usually occurs on exposed surfaces on a cold and cloudless night, and which is thin enough to distinguish surface features underneath, such as paint lines, markings or lettering.

Pitot/static probes and static ports .... Check

Verify that all pitot/static probes and static ports are free of snow and ice. Water rundown after snow removal may freeze immediately forward of static ports and cause an ice buildup which disturbs airflow over the static ports resulting in erroneous static readings even when static ports are clear.

Air conditioning inlets and exits .... Check

Verify that the air inlets and exits, including the outflow valve, are free of snow and ice.

Engine inlets .... Check

Verify that the inlet cowling is free of snow and ice.

Fuel tank vents .... Check

Verify that all traces of ice and frost are removed.

Landing gear doors .... Check

Landing gear doors should be free of snow and ice.

APU air inlets .... Check

The APU inlet door must be free of snow and ice before APU start.

Engine Start Procedure

Do the normal Engine Start Procedure with the following considerations:

- If the engine has been cold soaked for more than 4 hours at ambient temperatures below -30°C, do not start or motor the engine. Maintenance personnel should do appropriate procedures for adverse weather heating of the engine fuel system components.
- Oil pressure may be slow to rise
- Initial oil pressure rise may be higher than normal
- Additional warm-up time may be needed to allow oil temperature to reach the normal range

Engine Anti-ice Operation - On the Ground

Engine anti-ice must be selected ON immediately after both engines are started and remain on during all ground operations when icing conditions exist or are anticipated, except when the temperature is below –40°C OAT.

WARNING: Do not rely on airframe visual icing cues before activating engine anti-ice. Use the temperature and visible moisture criteria because late activation of engine anti-ice may allow excessive ingestion of ice and result in engine damage or failure.

CAUTION: Do not use engine anti-ice when OAT is above 10°C.

When engine anti-ice is needed:

ENGINE ANTI-ICE switches .... ON F/O

When engine anti-ice is no longer needed:

ENGINE ANTI-ICE switches ....OFF F/O

Before Taxi Procedure

Do the normal Before Taxi Procedure with the following modifications:

If taxi route is through ice, snow, slush or standing water in low temperatures or if precipitation is falling with temperatures below freezing, taxi out with the flaps up. Taxiing with the flaps extended subjects the flaps and flap drives to contamination. Leading edge devices are also susceptible to slush accumulations.

Call “FLAPS ___” as needed. C

Flap lever... Set flaps, as needed F/O

Taxi-Out

CAUTION: Taxi at a reduced speed. Use smaller tiller and rudder inputs, and apply minimum thrust smoothly. Differential thrust may be used to help maintain airplane momentum during turns. At all other times, apply thrust evenly.Taxiing on slippery taxiways or runways at excessive speed or with high crosswinds may start a skid.

When engine anti-ice is required and the OAT is 3°C or below, do an engine run up, as needed, to minimize ice build-up. Use the following procedure: C

Check that the area behind the airplane is clear.

Run-up to a minimum of 60% N1 for approximately 30 seconds duration at intervals no greater than 30 minutes.

De-icing / Anti-icing

Testing of undiluted de-icing/anti-icing fluids has shown that some of the fluid remains on the wing during takeoff rotation and initial climb. The residual fluid causes a temporary decrease in lift and increase in drag, however, the effects are temporary. Use the normal takeoff rotation rate.

If de-icing / anti-icing is needed:

Call “FLAPS UP”. C

Flaps .... UP F/O

Prevents ice and slush from accumulating in flap cavities during de-icing.

Thrust levers .... Idle C

Reduces the possibility of injury to personnel at inlet or exhaust areas.

Engine BLEED air switches .... OFF F/O

Reduces the possibility of fumes entering the air conditioning system.

APU BLEED air switch .... OFF F/O

Reduces the possibility of fumes entering the air conditioning system.

After de-icing / anti-icing is completed:

Wait approximately one minute after de-icing is completed to turn BLEED air switches on to ensure all de-icing fluid has been cleared:

Engine BLEED air switches .... ON F/O

APU BLEED air switch .... ON F/O

Before Takeoff Procedure

Do the normal Before Takeoff Procedure with the following modification:

Call “FLAPS ___” as needed for takeoff. PF

Flap lever .... Set takeoff flaps, as needed PM

Extend the flaps to the takeoff setting at this time if they have been held because of slush, standing water, or icing conditions, or because of exterior de-icing / anti-icing.

Takeoff Procedure

Do the normal Takeoff Procedure with the following modification:

When engine anti-ice is required and the OAT is 3°C or below, the takeoff must be preceded by a static engine run-up.
Use the following procedure: PF

Run-up to a minimum of 60% N1 for approximately 30 seconds duration and confirm stable engine operation before the start of the takeoff roll.

Engine Anti-ice Operation - In-flight

Engine anti-ice must be ON during all flight operations when icing conditions exist or are anticipated, except when the temperature is below –40°C SAT.

N316LA
WARNING: Do not rely on airframe visual icing cues before activating engine anti-ice. Use the temperature and visible moisture criteria because late activation of engine anti-ice may allow excessive ingestion of ice and result in engine damage or failure.

N422LA through N526LA
WARNING: Do not rely on airframe visual icing cues or illumination of the ICING light before activating engine anti-ice. Use the temperature and visible moisture criteria because late activation of engine anti-ice may allow excessive ingestion of ice and result in engine damage or failure.

CAUTION: Do not use engine anti-ice when TAT is above 10°C.

When engine anti-ice is needed:

ENGINE ANTI-ICE switches ....ON PM

When engine anti-ice is no longer needed:

ENGINE ANTI-ICE switches ....OFF PM

Fan Ice Removal

CAUTION: Avoid prolonged operation in moderate to severe icing conditions.

If moderate to severe icing conditions are encountered:

During flight in moderate to severe icing conditions for prolonged periods with N1 settings at or below 70%, or if fan icing is suspected due to high engine vibration, increase thrust on one engine at a time to a minimum of 70% N1 for 10 to 30 seconds every 10 minutes.

Wing Anti-ice Operation - In-flight

Ice accumulation on the flight deck window frames, windshield center post, or windshield wiper arm, or side windows may be used as an indication of structural icing conditions and the need to turn on wing anti-ice.

The wing anti-ice system may be used as a de-icer or anti-icer in flight only. The primary method is to use it as a de-icer by allowing ice to accumulate before turning wing anti-ice on. This procedure provides the cleanest airfoil surface, the least possible runback ice formation, and the least thrust and fuel penalty. Normally it is not necessary to shed ice periodically unless extended flight through icing conditions is necessary (holding).

The secondary method is to select the WING ANTI-ICE switch ON when wing icing is possible and use the system as an anti-icer.

CAUTION: Do not use wing anti-ice when TAT is above 10°C.

When wing anti-ice is needed:

WING ANTI-ICE switch .... ON PM

When wing anti-ice is no longer needed:

WING ANTI-ICE switch ....OFF PM

Airframe Buffet on Approach in Icing Conditions

Note: Operations in icing conditions have resulted in rare occurrences of higher than normal airframe buffet upon selection of landing flaps. No flight crew action is needed..

Cold Temperature Altitude Corrections

Extremely low temperatures create significant altimeter errors and greater potential for reduced terrain clearance. When the temperature is colder than ISA, true altitude will be lower than indicated altitude. Altimeter errors become significantly larger when the surface temperature approaches -30°C or colder, and also become larger with increasing height above the altimeter reference source.

Apply the altitude correction table when needed:

- no corrections are needed for reported temperatures above 0°C or if the airport temperature is at or above the minimum published temperature for the procedure being flown
- do not correct altimeter barometric reference settings
- ATC assigned altitudes or flight levels should not be adjusted for temperature when under radar control
- corrections apply to QNH and QFE operations
- apply corrections to all published minimum departure, en route and approach altitudes, including missed approach altitudes, according to the table below. Advise ATC of the corrections
- MDA/DA settings should be set at the corrected minimum altitudes for the approach
- subtract the elevation of the altimeter barometric reference setting source (normally the departure or destination airport elevation) from the published minimum altitude to be flown to determine "height above altimeter reference source"
- enter the table with Airport Temperature and with "height above altimeter reference source." Read the correction where these two entries intersect. Add the correction to the published minimum altitude to be flown to determine the corrected indicated altitude to be flown. To correct an altitude above the altitude in the last column, use linear extrapolation (e.g., to correct 6000 feet or 1800 meters, use twice the correction for 3000 feet or 900 meters, respectively) The corrected altitude must always be greater than the published minimum altitude
- if the corrected indicated altitude to be flown is between 100 foot increments, set the MCP altitude to the closest 100 foot increment above the corrected indicated altitude to be flown.

Altitude Correction Table - Heights and Altitudes in Feet

Airport Temp °C	Height Above Altimeter Source											
	200 feet	300 feet	400 feet	500 feet	600 feet	700 feet	800 feet	900 feet	1000 feet	1500 feet	2000 feet	3000 feet
0°	20	20	30	30	40	40	50	50	60	90	120	170
-10°	20	30	40	50	60	70	80	90	100	150	200	290
-20°	30	50	60	70	90	100	120	130	140	210	280	420
-30°	40	60	80	100	120	140	150	170	190	280	380	570
-40°	50	80	100	120	150	170	190	220	240	360	480	720
-50°	60	90	120	150	180	210	240	270	300	450	590	890

Altitude Correction Table - Heights and Altitudes in Meters

Airport Temp °C	Height Above Altimeter Source											
	60 MTRS	90 MTRS	120 MTRS	150 MTRS	180 MTRS	210 MTRS	240 MTRS	270 MTRS	300 MTRS	450 MTRS	600 MTRS	900 MTRS
0°	5	5	10	10	10	15	15	15	20	25	35	50
-10°	10	10	15	15	20	20	25	30	30	45	60	90
-20°	10	15	20	25	25	30	35	40	45	65	85	130
-30°	15	20	25	30	35	40	45	55	60	85	115	170
-40°	15	25	30	40	45	50	60	65	75	110	145	220
-50°	20	30	40	45	55	65	75	80	90	135	180	270

After Landing Procedure

CAUTION: Taxi at a reduced speed. Use smaller tiller and rudder inputs, and apply minimum thrust smoothly. Differential thrust may be used to help maintain airplane momentum during turns. At all other times, apply thrust evenly. Taxiing on slippery taxiways or runways at excessive speed or with high crosswinds may start a skid.

Do the normal After Landing Procedure with the following modifications:

After prolonged operation in icing conditions with the flaps extended, or when an accumulation of airframe ice is observed, or when operating on a runway or taxiway contaminated with ice, snow, slush or standing water:

Do not retract the flaps to less than flaps 20 until the flap areas have been checked to be free of contaminants.

Engine anti-ice must be selected ON and remain on during all ground operations when icing conditions exist or are anticipated, except when the temperature is below –40°C OAT.

WARNING: Do not rely on airframe visual icing cues before activating engine anti-ice. Use the temperature and visible moisture criteria because late activation of engine anti-ice may allow excessive ingestion of ice and result in engine damage or failure.

CAUTION: Do not use engine anti-ice when OAT is above 10°C.

When engine anti-ice is needed:

ENGINE ANTI-ICE switches .... ON F/O

When engine anti-ice is no longer needed:

ENGINE ANTI-ICE switches .... OFF F/O

When engine anti-ice is required and the OAT is 3°C or below, do an engine run up, as needed, to minimize ice build-up. Use the following procedure: C

Check that the area behind the airplane is clear.

Run-up to a minimum of 60% N1 for approximately 30 seconds duration at intervals no greater than 30 minutes.

Secure Procedure

Do the following steps after completing the normal Secure Procedure:

If the airplane will be attended, do the normal Secure Procedure with the following modification:

PACK CONTROL selectors ....AUTO F/O

If the airplane will not be attended, or if staying overnight at off-line stations or at airports where normal support is not available, the flight crew must arrange for or verify that the following steps are done:

Cabin altitude mode selector....................................MAN F/O

Cabin altitude manual control ....DESCEND F/O

Position the outflow valve fully closed to inhibit the intake of snow or ice.

Wheel chocks .... Verify in place C or F/O

Parking brake ....Released C

Reduces the possibility of frozen brakes.

Cold weather maintenance procedures for securing the airplane may be required. These procedures are found in the approved Aircraft Maintenance Manual.

Hot Weather Operation

During ground operation the following considerations will help keep the airplane as cool as possible:

- If a ground source of conditioned air is available, the supply should be plugged in immediately after engine shutdown and should not be removed until either the APU or the engines are started.
- If a ground source of conditioned air is not available, use both air conditioning packs.
- Keep all doors and windows, including cargo doors, closed as much as possible.
- Electronic components which contribute to a high temperature level in the flight deck should be turned off while not in use.
- Open all flight deck air outlets.

Note: If only a ground source of conditioned air is supplied (no bleed air from the APU or ground external air), then TAT probes are not aspirated. Because of high TAT probe temperatures, the FMCs or TMSP may not accept an assumed temperature derate. Delay selecting an assumed temperature derate until after bleed air is available.

Moderate to Heavy Rain, Hail or Sleet

Flight should be conducted to avoid thunderstorms, hail activity or visible moisture over storm cells. To the maximum extent possible, moderate to heavy rain, hail or sleet should also be avoided.

When flight in or near heavy rain or hail is encountered or anticipated, accomplish the following:

Engine Start selectors ....CONT

[This selection maintains a minimum thrust setting of approach idle and provides continuous ignition.]

Turbulence

During flight in light to moderate turbulence, the autopilot may remain engaged unless airspeed, altitude or attitude deviations require use of manual control. The turbulent air penetration speed is 290 knots/.78 Mach. Below 10,000 feet a speed between 240 and 250 knots provides adequate buffet margin.

If occupants in main cargo compartment:

MAIN CARGO ALERT switch .... Push

Advise supernumeraries to fasten seat belts prior to entering areas of reported or anticipated turbulence.

Severe Turbulence

Severe turbulence should be avoided if at all possible. If severe turbulence cannot be avoided, an increased buffet margin is recommended. This can be obtained by descending approximately 4,000 feet below optimum altitude. The autothrottle should be off in severe turbulence.

Engine start selectors.. CONT

Windshear

Windshear is a change of wind speed and/or direction over a short distance along the flight path. Indications of windshear are listed in the Windshear non-normal maneuver in this manual.

Avoidance

The flight crew should search for any clues to the presence of windshear along the intended flight path. Presence of windshear may be indicated by:

- Thunderstorm activity
- Virga (rain that evaporates before reaching the ground)
- Pilot reports
- Low level windshear alerting system (LLWAS) warnings.

Stay clear of thunderstorm cells and heavy precipitation and areas of known windshear. If presence of windshear is confirmed, delay takeoff or do not continue an approach.

Precautions

If windshear is suspected, be especially alert to any of the danger signals and be prepared for the possibility of an inadvertent encounter. The following precautionary actions are recommended if windshear is suspected:

Takeoff

N316LA

- Takeoff with full rated takeoff thrust is recommended.

N422LA through N526LA

- Takeoff with full rated takeoff thrust is recommended, unless the use of a fixed derate is required to meet a dispatch performance requirement.
- For optimum takeoff performance, use Flaps 20 for takeoff unless limited by obstacle clearance and/or climb gradient. Flaps 15 may also be used as a precautionary setting and will provide nearly equivalent performance to Flaps 20.
- Use the longest suitable runway provided it is clear of areas of known windshear.
- Use the flight director after takeoff.
- Consider increasing Vr speed to the performance limited gross weight rotations speed, not to exceed actual gross weight Vr+20 knots. Set V speeds for the actual gross weight. Rotate at the adjusted (higher) rotation speed. This increased rotation speed results in an increased stall margin, and meets takeoff performance requirements. If windshear is encountered at or beyond the actual gross weight Vr, do not attempt to accelerate to the increased Vr, but rotate without hesitation.
- Be alert for any airspeed fluctuations during takeoff and initial climb. Such fluctuations may be the first indication of windshear.
- Know the all-engine initial climb pitch attitude. Rotate at the normal rate to this attitude for all non-engine failure takeoffs. Minimize reductions from the initial climb pitch attitude until terrain and obstruction clearance is assured, unless stick shaker activates.
- Crew coordination and awareness are very important. Develop an awareness of normal values of airspeed, attitude, vertical speed and airspeed build-up. Closely monitor vertical flight path instruments such as vertical speed and altimeters. The pilot monitoring should be especially aware of vertical path instruments and call out any deviations from normal.

- Should airspeed fall below the trim airspeed, unusual control column forces may be required to maintain the desired pitch attitude. Stick shaker must be respected at all times.

Approach and Landing

- Use either Flaps 25 or 30 for landing.
- Establish a stabilized approach no lower than 1000 feet above the airport to improve windshear recognition capability.
- Use the most suitable runway that avoids the areas of suspected windshear and is compatible with crosswind or tailwind limitations. Use ILS G/S, VNAV path or VASI/PAPI indications to detect flight path deviations and help with timely detection of windshear.
- If the autothrottle is disengaged, or is planned to be disengaged prior to landing, add an appropriate airspeed correction (correction applied in the same manner as gust), up to a maximum of 20 knots.
- Avoid large thrust reductions or trim changes in response to sudden airspeed increases as these may be followed by airspeed decreases.
- Crosscheck flight director commands using vertical flight path instruments.
- Crew coordination and awareness are very important, particularly at night or in marginal weather conditions. Closely monitor the vertical flight path instruments such as vertical speed, altimeters and glideslope displacement. The pilot monitoring should call out any deviations from normal. Use of the autopilot and autothrottle for the approach may provide more monitoring and recognition time.

Recovery

Accomplish the WINDSHEAR maneuver found in the Non-Normal Maneuvers section of this manual.

Ice Crystal Icing

At temperatures below freezing near convective weather, the airplane can encounter visible moisture made up of high concentrations of small ice crystals. Ice crystals can accumulate aft of the engine fan, in the engine core. Ice shedding can cause engine vibration, engine power loss, and engine damage.

These weather conditions are difficult to detect because ice crystals do not cause significant weather radar returns. They are often found in high concentrations above and near regions of heavy precipitation. Ice crystals do not stick to cold aircraft surfaces.

Flight in clouds containing ice crystals has been associated with engine vibration, engine power-loss, engine damage and airplane Total Air Temperature (TAT) probe icing.

Recognizing Ice Crystal Icing Weather

Ice crystals are most frequently found in areas of visible moisture and above altitudes normally associated with icing conditions. Their presence can be indicated by one or more of the following:

- Appearance of rain on the windshield at temperatures too cold for liquid water to exist. This is due to ice crystals melting on the heated windows (sounds different than rain).
- Airplane TAT indication remains near 0 degrees C due to TAT probe icing
- Areas of light to moderate turbulence
- In IMC with:
  - No significant radar returns at airplane altitude and
  - Heavy precipitation below the airplane, identified by amber and red radar returns on weather radar
- Cloud tops above typical cruise levels (above the tropopause)

N316LA

Note: There is no significant airframe icing.

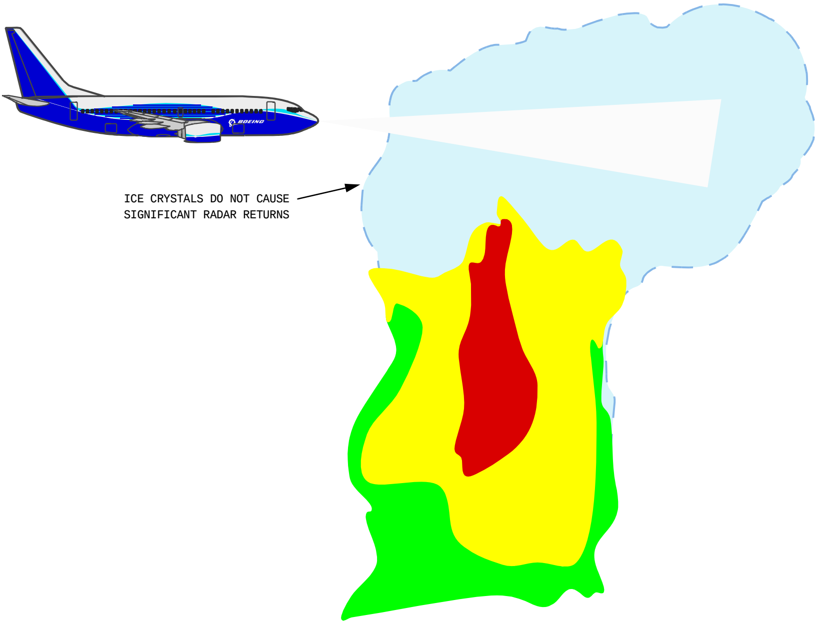
N422LA through N526LA

Note: There is no significant airframe icing. The icing conditions detection system does not detect ice crystal icing. It is designed to detect supercooled water only.

Avoiding Ice Crystal Icing Weather

During flight in IMC, avoid flying directly over significant amber or red radar returns, even if there are no returns at airplane altitude

Use the weather radar controls to assess weather radar reflectivity below the airplane flight path. Refer to weather radar operating instructions for additional information.



Suspected Ice Crystal Icing

Exit the ice crystal icing conditions. Request a route change to minimize the time above red and amber radar returns.

Do the Ice Crystal Icing non-normal checklist in QRH NNC-03.

Intentionally
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Performance Inflight — Chapter PI
Table of Contents — Section 10

767-300W CF6-80C2B6F KG FAA CATC CATD TO1-10% TO2-20%

Intentionally
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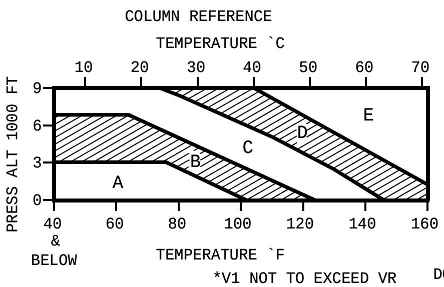
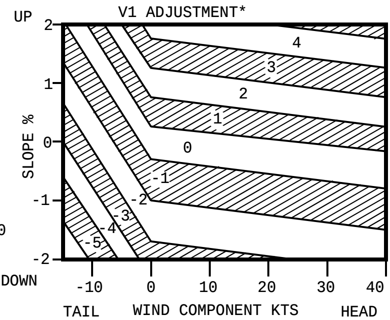
Performance Inflight — Chapter PI
General — Section 10

Takeoff Speeds
Max Takeoff Thrust





FLAPS	WT 1000 KG	A V1	A VR	A V2	B V1	B VR	B V2	C V1	C VR	C V2	D V1	D VR	D V2	E V1	E VR	E V2
5	190	166	170	175	167	171	176									
	180	160	165	171	162	166	171									
	170	154	160	166	156	161	166	159	162	166						
	160	148	154	161	150	156	161	153	157	161						
	150	141	148	156	144	150	156	147	151	156	150	153	156			
	140	135	142	151	137	144	150	140	145	150	144	147	150			
	130	128	136	145	130	137	145	134	139	145	137	141	145	141	142	145
	120	121	129	140	124	131	140	127	132	140	130	134	140	134	136	140
	110	114	122	134	116	124	134	119	126	134	123	127	134	126	129	134
	100	106	114	128	109	116	128	112	118	127	115	120	127	118	122	127
15	190	160	163	168												
	180	154	158	164	157	159	164									
	170	148	152	159	151	154	159									
	160	142	147	154	145	148	154									
	150	137	142	150	139	143	149	142	145	150						
	140	130	135	144	132	136	144	135	138	144						
	130	124	129	139	126	130	139	128	132	139	132	134	139			
	120	117	122	134	120	124	134	122	126	134	125	128	133			
	110	111	117	128	113	118	128	116	120	128	119	122	128	123	124	128
	100	104	109	122	106	111	122	108	113	122	112	115	122	115	117	122
20	190	158	159	165												
	180	152	153	159	155	155	159									
	170	146	148	154	148	149	154									
	160	140	142	149	142	143	149	144	145	150						
	150	133	136	145	136	138	144	139	140	145						
	140	127	131	139	130	132	139	132	134	139						
	130	121	125	134	124	127	134	126	128	134	130	130	134			
	120	114	119	129	117	120	129	120	122	129	124	124	129			
	110	107	112	124	110	114	124	113	116	124	117	118	124	119	120	124
	100	99	105	118	103	108	118	105	109	118	109	111	118	113	113	118

CHECK V1(MCG) IN BOXED AREA

V1(MCG)
Max Takeoff Thrust

ACTUAL OAT		PRESSURE ALTITUDE (FT)						
°C	°F	-1000	0	2000	4000	6000	8000	9000
50	122	103	101	97				
40	104	108	106	101	97	93	90	
30	86	111	109	105	101	97	94	92
20	68	111	110	107	104	100	96	95
10	50	111	110	107	104	101	98	96
-50	-58	113	111	108	105	102	98	97

Maximum Allowable Clearway

FIELD LENGTH (FT)	MAX ALLOWABLE CLEARWAY FOR V1 REDUCTION (FT)
4000	350
6000	500
8000	600
10000	700
12000	800
14000	900

Clearway and Stopway V1 Adjustments

CLEARWAY MINUS STOPWAY (FT)	NORMAL V1 (KIAS)		
	120	140	160
800	-5	-3	-2
600	-3	-2	-2
400	-2	-1	-1
200	-1	-1	-1
0	0	0	0
-200	1	1	1
-400	2	1	1
-600	3	2	2
-800	5	3	2

Stab Trim Setting
Max Takeoff Thrust

WEIGHT (1000 KG)	C.G. %MAC						
	12	16	20	24	28	32	36
190	7	6 1/2	5 1/2	4 1/2	4	3	2
180	7	6	5 1/2	4 1/2	3 1/2	2 1/2	2
170	6 1/2	6	5	4	3 1/2	2 1/2	1 1/2
160	6 1/2	5 1/2	5	4	3	2 1/2	1 1/2
150	6	5	4 1/2	3 1/2	3	2	1
140	5 1/2	4 1/2	4	3	2 1/2	1 1/2	1/2
130	5	4	3	2 1/2	1 1/2	1	1/2
120	4	3 1/2	2 1/2	2	1 1/2	1/2	1/2
110	3 1/2	3	2 1/2	1 1/2	1	1/2	1/2
100	3 1/2	2 1/2	2	1	1/2	1/2	1/2

VREF (KIAS)

WEIGHT (1000 KG)	FLAPS		
	30	25	20
190	179	170	179
180	171	166	173
170	164	161	168
160	156	156	162
150	148	151	157
140	142	146	151
130	137	141	146
120	131	135	141
110	125	129	135
100	119	123	128

Flap Maneuver Speeds

FLAP POSITION	MANEUVER SPEED
UP	VREF30 + 80
1	VREF30 + 60
5	VREF30 + 40
15	VREF30 + 20
20	VREF30 + 20
25	VREF25
30	VREF30

ADVISORY INFORMATION

Slush/Standing Water Takeoff

Maximum Reverse Thrust

Weight Adjustment (1000 KG)

FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
210	-19.5	-23.6	-27.8	-22.8	-26.9	-31.1	-32.7	-36.8	-41.0
200	-19.4	-23.6	-27.7	-22.7	-26.9	-31.1	-31.5	-35.7	-39.8
190	-19.0	-23.2	-27.4	-22.3	-26.4	-30.6	-30.0	-34.2	-38.3
180	-18.4	-22.5	-26.7	-21.4	-25.5	-29.7	-28.1	-32.3	-36.5
170	-17.4	-21.5	-25.7	-20.0	-24.2	-28.4	-25.9	-30.1	-34.2
160	-16.0	-20.2	-24.4	-18.3	-22.5	-26.6	-23.4	-27.6	-31.7
150	-14.5	-18.7	-22.8	-16.3	-20.5	-24.7	-20.6	-24.8	-29.0
140	-12.7	-16.8	-21.0	-14.2	-18.4	-22.5	-17.6	-21.8	-26.0
130	-10.6	-14.8	-19.0	-11.9	-16.1	-20.3	-14.5	-18.7	-22.8
120	-8.4	-12.6	-16.8	-9.7	-13.8	-18.0	-11.2	-15.4	-19.6
110	-6.1	-10.3	-14.4	-7.5	-11.7	-15.8	-7.9	-12.1	-16.3

V1(MCG) Limit Weight (1000 KG)

ADJUSTED FIELD LENGTH (FT)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
5000				93.5			107.6		
5400	105.9			113.8			128.0	102.6	
5800	127.1	100.8		135.4	108.7		149.7	122.8	97.6
6200	149.8	121.6	95.8	158.2	129.8	103.6	172.5	144.2	117.7
6600	173.7	144.0	116.3	182.2	152.4	124.4	196.0	166.7	138.8
7000	198.8	167.6	138.3	206.7	176.2	146.6	220.1	190.0	161.0
7400	224.9	192.4	161.6		200.6	170.1		214.1	184.1
7800		218.4	186.1		225.3	194.4			208.0
8200			211.9			219.1			

1. **Enter Weight Adjustment table with slush/standing water depth and field/obstacle limit weight to obtain slush/standing water weight adjustment.**
2. **Adjust field length available by -108 ft/+108 ft for every 5°C above/below 4°C.**
3. **Find V1(MCG) limit weight for adjusted field length and pressure altitude.**
4. **Max allowable slush/standing water limited weight is lesser of weights from 1 and 3.**

V1 Adjustment (KIAS)

WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
190	-21	-21	-21	-16	-16	-16	-7	-7	-7
180	-21	-21	-21	-16	-16	-16	-6	-6	-6
170	-22	-22	-22	-17	-17	-17	-6	-6	-6
160	-22	-22	-22	-17	-17	-17	-6	-6	-6
150	-23	-23	-23	-18	-18	-18	-7	-7	-7
140	-24	-24	-24	-19	-19	-19	-8	-8	-8
130	-24	-24	-24	-20	-20	-20	-9	-9	-9
120	-25	-25	-25	-21	-21	-21	-11	-11	-11
110	-26	-26	-26	-22	-22	-22	-13	-13	-13

1. **Obtain V1, VR and V2 for the actual weight.**
2. **If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG).**

ADVISORY INFORMATION

Slush/Standing Water Takeoff

No Reverse Thrust

Weight Adjustment (1000 KG)

FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
210	-27.5	-32.0	-36.5	-32.2	-36.7	-41.3	-43.4	-48.0	-52.5
200	-26.2	-30.7	-35.3	-30.4	-34.9	-39.5	-40.2	-44.7	-49.3
190	-24.8	-29.4	-33.9	-28.5	-33.0	-37.6	-37.0	-41.5	-46.1
180	-23.3	-27.8	-32.4	-26.5	-31.0	-35.6	-33.8	-38.3	-42.9
170	-21.7	-26.2	-30.8	-24.4	-29.0	-33.5	-30.6	-35.2	-39.7
160	-19.9	-24.5	-29.0	-22.3	-26.8	-31.3	-27.5	-32.0	-36.5
150	-18.0	-22.6	-27.1	-20.0	-24.5	-29.1	-24.3	-28.8	-33.4
140	-16.0	-20.6	-25.1	-17.7	-22.2	-26.7	-21.2	-25.7	-30.3
130	-13.9	-18.4	-23.0	-15.2	-19.7	-24.3	-18.1	-22.6	-27.1
120	-11.6	-16.2	-20.7	-12.7	-17.2	-21.7	-15.0	-19.5	-24.0
110	-9.3	-13.8	-18.3	-10.0	-14.6	-19.1	-11.9	-16.4	-21.0

V1(MCG) Limit Weight (1000 KG)

ADJUSTED FIELD LENGTH (FT)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
6200							98.8		
6600							122.3	90.9	
7000	90.6			113.9			146.9	114.0	
7400	118.7			141.3	104.7		173.0	138.2	105.8
7800	148.5	108.7		170.2	131.5	95.6	200.8	163.7	129.5
8200	180.4	137.8	98.9	201.1	159.9	122.0	229.9	190.9	154.6
8600	214.7	168.9	127.4		190.0	149.8		219.7	181.2
9000		202.4	157.8		222.0	179.3			209.5
9400			190.4			210.7			
9800			225.3						

1. **Enter Weight Adjustment table with slush/standing water depth and field/obstacle limit weight to obtain slush/standing water weight adjustment.**
2. **Adjust field length available by -155 ft/+155 ft for every 5°C above/below 4°C.**
3. **Find V1(MCG) limit weight for adjusted field length and pressure altitude.**
4. **Max allowable slush/standing water limited weight is lesser of weights from 1 and 3.**

ADVISORY INFORMATION

Slush/Standing Water Takeoff
No Reverse Thrust
V1 Adjustment (KIAS)

WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
210	-28	-28	-28	-21	-21	-21	-11	-11	-11
200	-29	-29	-29	-22	-22	-22	-11	-11	-11
190	-30	-30	-30	-23	-23	-23	-11	-11	-11
180	-30	-30	-30	-24	-24	-24	-11	-11	-11
170	-31	-31	-31	-25	-25	-25	-12	-12	-12
160	-32	-32	-32	-26	-26	-26	-13	-13	-13
150	-32	-32	-32	-27	-27	-27	-15	-15	-15
140	-32	-32	-32	-28	-28	-28	-17	-17	-17
130	-33	-33	-33	-29	-29	-29	-19	-19	-19
120	-33	-33	-33	-30	-30	-30	-21	-21	-21
110	-33	-33	-33	-31	-31	-31	-24	-24	-24

1. **Obtain V1, VR and V2 for the actual weight.**
2. **If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG).**

ADVISORY INFORMATION

Slippery Runway Takeoff

Maximum Reverse Thrust

Weight Adjustment (1000 KG)

FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
210	0.0	0.0	0.0	-9.0	-9.0	-9.0	-19.9	-19.9	-19.9
200	0.0	0.0	0.0	-10.1	-10.1	-10.1	-20.1	-20.1	-20.1
190	-1.1	-1.1	-1.1	-10.8	-10.8	-10.8	-20.0	-20.0	-20.0
180	-2.1	-2.1	-2.1	-11.2	-11.2	-11.2	-19.6	-19.6	-19.6
170	-2.7	-2.7	-2.7	-11.3	-11.3	-11.3	-18.9	-18.9	-18.9
160	-3.0	-3.0	-3.0	-11.1	-11.1	-11.1	-18.0	-18.0	-18.0
150	-3.0	-3.0	-3.0	-10.5	-10.5	-10.5	-16.9	-16.9	-16.9
140	-2.7	-2.7	-2.7	-9.5	-9.5	-9.5	-15.4	-15.4	-15.4
130	-2.2	-2.2	-2.2	-8.2	-8.2	-8.2	-13.7	-13.7	-13.7
120	-1.3	-1.3	-1.3	-6.6	-6.6	-6.6	-11.8	-11.8	-11.8
110	-0.3	-0.3	-0.3	-4.6	-4.6	-4.6	-9.6	-9.6	-9.6

V1(MCG) Limit Weight (1000 KG)

ADJUSTED FIELD LENGTH (FT)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
3800	99.1								
4200	138.1								
4600	176.7	114.8							
5000	214.9	153.6	91.3	93.8					
5400		192.0	130.4	120.4					
5800			169.0	148.3	104.3				
6200			207.3	177.8	131.4				
6600				209.3	159.9	115.0	98.4		
7000					190.2	142.6	114.6		
7400					222.4	171.8	131.5	100.0	
7800						202.8	149.3	116.2	
8200							168.1	133.2	101.6
8600							188.2	151.1	117.9
9000							209.8	170.1	135.0
9400								190.3	153.0
9800								212.0	172.0
10200									192.4
10600									214.3

1. **Enter Weight Adjustment table with reported braking action and field/obstacle limit weight to obtain slippery runway weight adjustment.**
2. **Adjust “Good” field length available by - 81 ft/ + 81 ft for every 5°C above/below 4°C.**
   Adjust “Medium” field length available by - 81 ft/ + 81 ft for every 5°C above/below 4°C.
   Adjust “Poor” field length available by - 126 ft/ + 126 ft for every 5°C above/below 4°C.
3. **Find V1(MCG) limit weight for adjusted field length and pressure altitude.**
4. **Max allowable slippery runway limited weight is lesser of weights from 1 and 3.**

ADVISORY INFORMATION

Slippery Runway Takeoff
Maximum Reverse Thrust
V1 Adjustment (KIAS)

WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
190	-7	-7	-7	-17	-17	-17	-29	-29	-29
180	-8	-8	-8	-18	-18	-18	-30	-30	-30
170	-9	-9	-9	-19	-19	-19	-32	-32	-32
160	-10	-10	-10	-21	-21	-21	-33	-33	-33
150	-10	-10	-10	-22	-22	-22	-35	-35	-35
140	-11	-11	-11	-23	-23	-23	-36	-36	-36
130	-12	-12	-12	-24	-24	-24	-38	-38	-38
120	-12	-12	-12	-25	-25	-25	-40	-40	-40
110	-12	-12	-12	-26	-26	-26	-41	-41	-41

1. **Obtain V1, VR and V2 for the actual weight.**
2. **If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG).**

No Reverse Thrust
Weight Adjustment (1000 KG)

FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
210	-2.1	-2.6	-3.0	-15.0	-15.4	-15.8	-25.8	-26.2	-26.7
200	-3.3	-3.8	-4.2	-15.6	-16.0	-16.5	-25.9	-26.3	-26.7
190	-4.3	-4.7	-5.1	-16.0	-16.4	-16.8	-25.6	-26.0	-26.4
180	-5.0	-5.4	-5.8	-16.1	-16.5	-16.9	-25.0	-25.4	-25.8
170	-5.4	-5.8	-6.3	-15.9	-16.3	-16.7	-24.0	-24.4	-24.9
160	-5.6	-6.0	-6.5	-15.4	-15.9	-16.3	-22.8	-23.2	-23.6
150	-5.6	-6.0	-6.4	-14.7	-15.1	-15.5	-21.2	-21.6	-22.0
140	-5.3	-5.7	-6.1	-13.6	-14.1	-14.5	-19.2	-19.7	-20.1
130	-4.7	-5.1	-5.6	-12.3	-12.7	-13.1	-17.0	-17.4	-17.8
120	-3.9	-4.4	-4.8	-10.7	-11.1	-11.5	-14.4	-14.8	-15.3
110	-2.9	-3.3	-3.7	-8.8	-9.2	-9.6	-11.5	-11.9	-12.4

ADVISORY INFORMATION

Slippery Runway Takeoff

No Reverse Thrust

V1(MCG) Limit Weight (1000 KG)

ADJUSTED FIELD LENGTH (FT)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
4600	141.3								
5000	187.8	111.6							
5400	228.6	163.2							
5800		206.4	136.2						
6200			183.5						
6600			224.6	122.6					
7000				167.1	96.4				
7400				208.3	143.1				
7800					186.0	118.0			
8200					226.3	162.8			
8600						204.3			
9800							109.0		
10200							135.3		
10600							163.5	109.0	
11000							194.1	135.3	
11400							226.8	163.5	109.0
11800								194.1	135.3
12200								226.8	163.5
12600									194.1
13000									226.8

1. **Enter Weight Adjustment table with reported braking action and dry field/obstacle limit weight to obtain slippery runway weight adjustment.**
2. **Adjust “Good” field length available by -100 ft/+100 ft for every 5°C above/below 4°C.**
   Adjust “Medium” field length available by -100 ft/+100 ft for every 5°C above/below 4°C.
   Adjust “Poor” field length available by -175 ft/+175 ft for every 5°C above/below 4°C.
3. **Find V1(MCG) limit weight for available field length and pressure altitude.**
4. **Max allowable slippery runway limited weight is lesser of weights from 1 and 3.**

V1 Adjustment (KIAS)

WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
210	-7	-7	-7	-21	-21	-21	-41	-41	-41
200	-8	-8	-8	-22	-22	-22	-41	-41	-41
190	-9	-9	-9	-23	-23	-23	-42	-42	-42
180	-10	-10	-10	-24	-24	-24	-43	-43	-43
170	-11	-11	-11	-25	-25	-25	-45	-45	-45
160	-12	-12	-12	-27	-27	-27	-47	-47	-47
150	-13	-13	-13	-29	-29	-29	-49	-49	-49
140	-14	-14	-14	-30	-30	-30	-51	-51	-51
130	-15	-15	-15	-32	-32	-32	-52	-52	-52
120	-16	-16	-16	-33	-33	-33	-53	-53	-53
110	-17	-17	-17	-34	-34	-34	-54	-54	-54

1. **Obtain V1, VR and V2 for the actual weight.**
2. **If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG).**

Takeoff %N1

Max Takeoff Thrust

Based on engine bleed for packs on, EEC NORM or ALTN and anti-ice on or off

AIRPORT OAT		TAT	AIRPORT PRESSURE ALTITUDE (FT)						
°C	°F	(°C)	-1000	0	2000	4000	6000	8000	9000
55	131	58	106.1	106.1	105.9	105.5	105.1	104.9	104.7
50	122	53	106.8	106.9	106.8	106.5	106.1	105.9	105.7
45	113	48	107.5	107.5	107.5	107.3	107.0	106.9	106.6
40	104	43	108.2	108.2	108.2	108.0	107.9	107.8	107.7
35	95	38	109.0	108.9	109.0	108.8	108.7	108.7	108.6
30	86	33	109.1	109.8	109.8	109.7	109.6	109.7	109.6
25	77	28	108.2	108.9	110.3	110.6	110.5	110.6	110.6
20	68	23	107.3	108.0	109.4	110.6	111.3	111.4	111.3
15	59	18	106.4	107.1	108.5	109.7	111.0	112.0	112.1
10	50	13	105.5	106.2	107.5	108.8	110.0	111.3	112.1
0	32	3	103.6	104.3	105.7	106.9	108.1	109.4	110.1
-10	14	-7	101.7	102.4	103.8	104.9	106.1	107.4	108.1
-20	-4	-17	99.8	100.4	101.8	103.0	104.2	105.4	106.1
-30	-22	-27	97.9	98.5	99.8	101.0	102.2	103.4	104.0
-40	-40	-37	95.9	96.4	97.8	99.0	100.1	101.3	102.0
-50	-58	-47	93.8	94.4	95.8	96.9	98.0	99.2	99.8

%N1 Adjustments for Engine Bleeds

BLEED CONFIGURATION	AIRPORT PRESSURE ALTITUDE (FT)						
	-1000	0	2000	4000	6000	8000	9000
PACKS OFF	0.3	0.3	0.3	0.4	0.5	0.5	0.5

Assumed Temperature Reduced Thrust

Minimum Assumed Temperature

MINIMUM ASSUMED TEMP	PRESSURE ALTITUDE (FT)									
	-1000	0	1000	2000	3000	4000	5000	6000	7000	8000
°F	90	86	83	79	76	72	69	65	62	58
°C	32	30	28	26	24	22	20	18	16	14

Assumed Temperature Limit %N1

Based on engine bleed for packs on

ACTUAL OAT (°C)	ASSUMED TEMPERATURE (°C)											
	15	20	25	30	35	40	45	50	55	60	65	70
55										104.3	102.5	100.9
50									105.3	103.5	101.8	100.1
45								106.0	104.5	102.7	101.0	99.4
40							106.6	105.2	103.7	101.9	100.2	98.6
35						107.3	105.8	104.3	102.8	101.1	99.4	97.8
30					108.0	106.5	104.9	103.5	102.0	100.3	98.6	97.0
25				108.9	107.1	105.6	104.1	102.7	101.2	99.5	97.8	96.2
20			109.7	108.0	106.2	104.7	103.2	101.8	100.3	98.7	97.0	95.5
15		110.6	108.8	107.1	105.4	103.9	102.4	101.0	99.5	97.9	96.2	94.7
10	111.2	109.6	107.9	106.1	104.4	103.0	101.5	100.1	98.6	97.0	95.4	93.8
5	110.2	108.6	106.9	105.2	103.5	102.1	100.6	99.2	97.8	96.2	94.5	93.0
0	109.2	107.7	106.0	104.3	102.6	101.2	99.7	98.3	96.9	95.3	93.7	
-10	107.2	105.7	104.0	102.4	100.7	99.3	97.9	96.5	95.2	93.6	92.0	
-20	105.2	103.7	102.1	100.4	98.8	97.4	96.0	94.7	93.4	91.8		
-30	103.2	101.7	100.1	98.5	96.9	95.5	94.2	92.9	91.5			
-40	101.0	99.6	98.0	96.5	94.9	93.6	92.2					
-50	98.9	97.5	95.9	94.4	92.9	91.6						
-60	96.7	95.3	93.8	92.3								

%N1 Adjustment for Engine Bleeds

BLEED CONFIGURATION	AIRPORT PRESSURE ALTITUDE (FT)										
	-2000	-1000	0	1000	2000	3000	4000	5000	6000	7000	8000
PACKS OFF	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.5	0.5	0.5	0.5

%N1 Altitude Adjustment

ASSUMED TEMP (°C)	PRESSURE ALTITUDE (FT)										
	-2000	-1000	0	1000	2000	3000	4000	5000	6000	7000	8000
70	0.2	0.1	0.0	-0.2	-0.3	-0.5	-0.6	-0.8	-1.0	-1.2	-1.3
60	0.1	0.1	0.0	-0.2	-0.3	-0.5	-0.6	-0.8	-1.0	-1.2	-1.3
50	0.0	0.0	0.0	0.0	0.0	-0.1	-0.2	-0.5	-0.7	-0.9	-1.0
40	0.0	0.0	0.0	0.0	0.0	-0.1	-0.2	-0.3	-0.4	-0.4	-0.4
32 & BELOW	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.2	-0.2	-0.2	-0.2

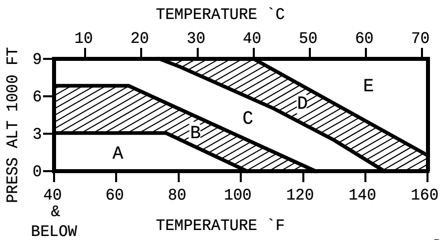
Assumed Temperature Reduced Thrust
Assumed Temperature Minimum %N1
Based on 25% takeoff thrust reduction

ACTUAL OAT (°C)	PRESSURE ALTITUDE (FT)										
	-2000	-1000	0	1000	2000	3000	4000	5000	6000	7000	8000
55	96.9	96.9	96.9	96.8	96.6	96.5	96.4	96.2	96.0	95.9	95.9
50	97.4	97.4	97.4	97.4	97.3	97.2	97.1	97.0	96.8	96.7	96.6
45	97.8	97.8	97.8	97.8	97.8	97.8	97.7	97.5	97.4	97.4	97.3
40	98.3	98.3	98.2	98.2	98.2	98.1	98.1	98.0	97.9	97.9	97.9
35	98.6	98.6	98.5	98.5	98.5	98.5	98.5	98.4	98.4	98.4	98.4
30	98.0	98.5	98.9	98.9	98.9	98.9	98.8	98.8	98.8	98.8	98.8
25	97.2	97.7	98.1	98.5	98.9	98.9	99.1	99.1	99.0	99.1	99.1
20	96.4	96.9	97.3	97.7	98.1	98.4	98.8	99.0	99.2	99.2	99.2
15	95.6	96.0	96.5	96.9	97.2	97.6	98.0	98.3	98.6	98.9	99.1
10	94.8	95.2	95.6	96.0	96.4	96.8	97.1	97.5	97.8	98.1	98.4
0 & BELOW	93.1	93.6	94.0	94.3	94.7	95.1	95.4	95.8	96.1	96.4	96.7

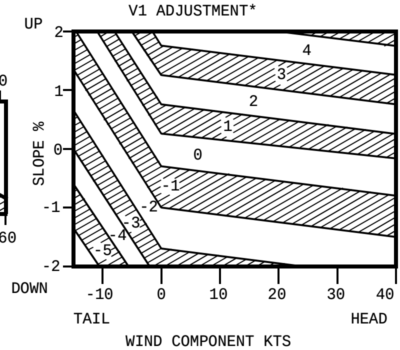
1. **Enter Minimum Assumed Temperature table with airport pressure altitude to determine minimum assumed temperature.**
2. **Enter Assumed Temperature Limit %N1 table with actual airport temperature and assumed temperature to determine assumed temperature limit %N1. If operating with packs off, apply the bleed adjustment shown in the %N1 Adjustment for Engine Bleeds table.**
3. **Enter %N1 Altitude Adjustment table with assumed temperature and airport pressure altitude to determine altitude adjustment to %N1 found in step 2.**
4. **Ensure Takeoff %N1 from step 3 is greater than or equal to minimum %N1 allowed for airport conditions from Assumed Temperature Minimum %N1 table.**

TO1 Takeoff Speeds
10% Thrust Reduction

COLUMN REFERENCE



V1 ADJUSTMENT*



*V1 NOT TO EXCEED VR

FLAPS	WT 1000 KG	A			B			C			D			E		
		V_1	V_R	V_2	V_1	V_R	V_2	V_1	V_R	V_2	V_1	V_R	V_2	V_1	V_R	V_2
5	190	168	171	175	170	173	176									
	180	163	167	171	165	168	171									
	170	156	161	166	159	162	166	162	164	166						
	160	150	156	161	153	157	161	156	159	161						
	150	144	150	156	147	151	156	150	153	156	153	155	156			
	140	137	144	151	140	145	150	143	147	150	146	148	150			
	130	130	137	145	133	138	145	136	140	145	139	142	145	143	143	145
	120	124	130	140	126	132	140	129	134	140	132	136	140	136	137	140
	110	116	123	134	118	125	134	121	127	134	125	128	134	128	130	134
	100	108	116	128	109	117	128	114	120	127	117	122	127	120	124	127
15	190	162	164	168												
	180	157	159	164	159	160	164									
	170	151	154	159	153	155	159									
	160	145	149	154	148	151	154									
	150	139	143	150	142	145	149	144	146	150						
	140	133	137	144	136	139	144	138	141	144						
	130	126	131	139	129	132	139	131	134	139	135	136	139			
	120	120	125	134	123	126	134	125	128	134	129	130	133			
	110	$\boxed{113}$	118	128	113	119	128	118	121	128	120	123	128	125	125	128
	100	$\boxed{106}$	111	122	108	113	122	110	115	122	114	117	122	117	119	122
20	190	160	160	165												
	180	155	155	159	157	157	159									
	170	148	149	154	150	150	154									
	160	143	144	149	145	145	149	147	147	150						
	150	136	139	145	139	139	144	141	141	145						
	140	130	133	139	133	134	139	135	136	139						
	130	123	126	134	126	128	134	128	129	134	131	131	134			
	120	116	120	129	119	122	129	122	124	129	126	126	129			
	110	$\boxed{109}$	114	124	112	115	124	115	117	124	119	119	124	121	121	124
	100	$\boxed{101}$	107	118	104	109	118	107	111	118	111	113	118	115	115	118

CHECK V1(MCG) IN BOXED AREA

TO1 V1(MCG)
10% Thrust Reduction

ACTUAL OAT		PRESSURE ALTITUDE (FT)					
°C	°F	-1000	0	2000	4000	6000	8000
50	122	99	97	93			
40	104	103	101	97	93	89	86
30	86	106	105	101	97	93	90
20	68	107	105	102	100	96	93
10	50	107	106	103	100	97	94
-50	-58	108	107	104	101	98	95

TO1 Takeoff %N1

10% Thrust Reduction

Based on engine bleed for packs on, EEC NORM or ALTN and anti-ice on or off

AIRPORT OAT		AIRPORT PRESSURE ALTITUDE (FT)					
°C	°F	-1000	0	2000	4000	6000	8000
55	131	103.6	103.6	103.4	103.0	102.7	102.5
50	122	104.4	104.4	104.4	104.0	103.6	103.4
45	113	105.0	105.0	105.0	104.8	104.6	104.4
40	104	105.5	105.4	105.5	105.3	105.2	105.1
35	95	105.8	105.8	105.8	105.7	105.6	105.6
30	86	105.7	106.2	106.2	106.1	106.1	106.1
25	77	104.8	105.3	106.4	106.6	106.5	106.6
20	68	103.9	104.4	105.5	106.4	106.9	106.9
15	59	103.1	103.6	104.6	105.5	106.4	107.1
10	50	102.2	102.7	103.7	104.6	105.5	106.4
0	32	100.4	100.9	101.9	102.8	103.7	104.5
-10	14	98.6	99.0	100.1	100.9	101.8	102.6
-20	-4	96.7	97.2	98.2	99.1	99.9	100.7
-30	-22	94.8	95.3	96.3	97.1	98.0	98.8
-40	-40	92.9	93.3	94.3	95.2	96.0	96.8
-50	-58	90.9	91.3	92.3	93.2	94.0	94.7

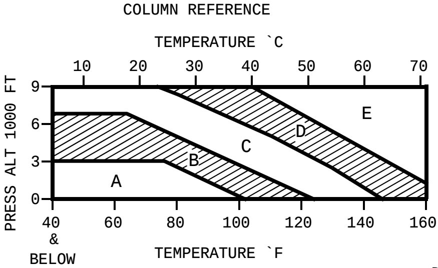
%N1 Adjustments for Engine Bleeds

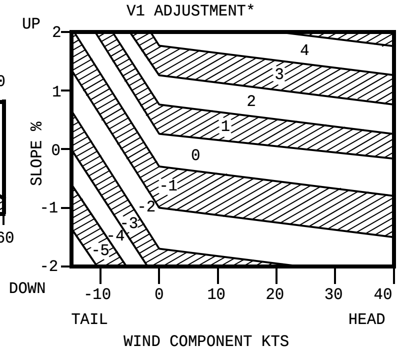
BLEED CONFIGURATION	AIRPORT PRESSURE ALTITUDE (FT)					
	-1000	0	2000	4000	6000	8000
PACKS OFF	0.3	0.3	0.3	0.4	0.5	0.5

TO1 Stab Trim Setting
10% Thrust Reduction

WEIGHT (1000 KG)	C.G. %MAC						
	12	16	20	24	28	32	36
190	7	7	6	5	4 1/2	3 1/2	2 1/2
180	7	6 1/2	6	5	4	3	2 1/2
170	7	6 1/2	5 1/2	4 1/2	4	3	2
160	7	6	5 1/2	4 1/2	3 1/2	3	2
150	6 1/2	5 1/2	5	4	3 1/2	2 1/2	1 1/2
140	6	5	4 1/2	3 1/2	3	2	1
130	5 1/2	4 1/2	3 1/2	3	2	1 1/2	1
120	4 1/2	4	3	2 1/2	2	1	1
110	4	3 1/2	3	2	1 1/2	1	1
100	4	3	2 1/2	1 1/2	1	1	1

TO2 Takeoff Speeds
20% Thrust Reduction





*V1 NOT TO EXCEED VR

FLAPS	WT 1000 KG	A V_1	A V_R	A V_2	B V_1	B V_R	B V_2	C V_1	C V_R	C V_2	D V_1	D V_R	D V_2	E V_1	E V_R	E V_2
5	190	171	172	175	173	174	176									
	180	165	168	171	167	169	171									
	170	159	162	166	162	163	166	164	165	166						
	160	153	157	161	156	158	161	158	160	161						
	150	146	151	156	149	152	156	152	154	156						
	140	139	145	151	142	146	150	145	148	150	148	149	150			
	130	133	138	145	136	139	145	139	141	145	142	143	145	144	144	145
	120	126	131	140	128	133	140	131	135	140	134	137	140	138	138	140
	110	118	124	134	120	126	134	123	128	134	127	129	134	130	131	134
	100	111	117	128	111	118	128	116	121	127	119	123	127	123	125	127
15	190	165	165	168												
	180	159	160	164	161	161	164									
	170	154	155	159	156	156	159									
	160	148	150	154	150	152	154									
	150	141	144	150	144	146	149	146	147	150						
	140	135	138	144	138	140	144	140	142	144						
	130	129	132	139	131	133	139	134	135	139	137	137	139			
	120	122	126	134	125	127	134	127	129	134	131	131	133			
	110	115	119	128	116	120	128	120	122	128	122	124	128	126	126	128
	100	108	112	122	110	114	122	112	116	122	116	118	122	119	120	122
20	190	161	161	165												
	180	156	156	159	158	158	159									
	170	150	150	154	151	151	154									
	160	145	145	149	146	146	149	148	148	150						
	150	138	140	145	140	140	144	142	142	145						
	140	132	134	139	135	135	139	137	137	139						
	130	125	127	134	128	129	134	130	130	134	132	132	134			
	120	118	121	129	121	123	129	124	125	129	127	127	129			
	110	111	115	124	114	116	124	117	118	124	120	120	124	122	122	124
	100	103	108	118	106	110	118	109	112	118	113	114	118	116	116	118

TO2 V1(MCG)
20% Thrust Reduction

ACTUAL OAT		PRESSURE ALTITUDE (FT)					
°C	°F	-1000	0	2000	4000	6000	8000
50	122	94	92	88			
40	104	98	96	92	88	85	82
30	86	101	100	96	92	88	85
20	68	101	100	97	94	91	88
10	50	101	100	97	95	92	89
-50	-58	103	101	98	96	93	90

TO2 Takeoff %N1

20% Thrust Reduction

Based on engine bleed for packs on, EEC NORM or ALTN and anti-ice on or off

AIRPORT OAT		AIRPORT PRESSURE ALTITUDE (FT)					
°C	°F	-1000	0	2000	4000	6000	8000
55	131	99.8	99.7	99.5	99.1	98.8	98.6
50	122	100.5	100.5	100.4	100.1	99.7	99.6
45	113	101.1	101.1	101.1	100.9	100.7	100.5
40	104	101.7	101.7	101.7	101.5	101.4	101.3
35	95	101.8	101.8	101.8	101.7	101.7	101.7
30	86	101.6	102.0	102.0	101.9	101.8	101.9
25	77	100.7	101.1	102.0	102.2	102.2	102.2
20	68	99.9	100.3	101.2	101.9	102.3	102.3
15	59	99.0	99.4	100.3	101.1	101.7	102.2
10	50	98.2	98.6	99.5	100.2	100.9	101.5
0	32	96.5	96.9	97.7	98.4	99.1	99.7
-10	14	94.7	95.1	96.0	96.7	97.3	97.9
-20	-4	92.9	93.3	94.2	94.9	95.5	96.0
-30	-22	91.1	91.5	92.4	93.0	93.6	94.2
-40	-40	89.2	89.6	90.5	91.1	91.7	92.3
-50	-58	87.3	87.7	88.6	89.2	89.8	90.3

%N1 Adjustments for Engine Bleeds

BLEED CONFIGURATION	AIRPORT PRESSURE ALTITUDE (FT)					
	-1000	0	2000	4000	6000	8000
PACKS OFF	0.3	0.3	0.3	0.4	0.5	0.5

TO2 Stab Trim Setting
20% Thrust Reduction

WEIGHT (1000 KG)	C.G. %MAC						
	12	16	20	24	28	32	36
190	7	7	6 1/2	5 1/2	5	4	3
180	7	7	6 1/2	5 1/2	4 1/2	3 1/2	3
170	7	7	6	5	4 1/2	3 1/2	2 1/2
160	7	6 1/2	6	5	4	3 1/2	2 1/2
150	7	6	5 1/2	4 1/2	4	3	2
140	6 1/2	5 1/2	5	4	3 1/2	2 1/2	1 1/2
130	6	5	4	3 1/2	2 1/2	2	1 1/2
120	5	4 1/2	3 1/2	3	2 1/2	1 1/2	1 1/2
110	4 1/2	4	3 1/2	2 1/2	2	1 1/2	1 1/2
100	4 1/2	3 1/2	3	2	1 1/2	1 1/2	1 1/2

Max Climb %N1

Based on engine bleed for packs on and anti-ice off

TAT (°C)	PRESSURE ALTITUDE (1000 FT)/SPEED (KIAS OR MACH)								
	0	5	10	15	20	25	30	35	40
	250	250	250	290	290	290	290	.78	.78
60	96.5	97.2	97.0	97.4	96.7	95.1	96.1	95.1	94.7
50	97.6	98.7	99.0	99.6	98.9	97.3	98.2	95.0	93.8
40	98.8	99.8	100.4	101.2	101.0	99.3	100.1	97.0	95.8
30	99.1	101.1	101.6	102.4	102.5	101.2	101.9	98.8	97.7
20	97.5	101.3	103.3	103.8	104.1	102.8	103.4	100.5	99.4
10	95.8	99.6	102.9	104.4	105.6	104.6	104.7	102.6	100.9
0	94.2	97.8	101.1	102.6	105.0	106.9	106.5	104.3	102.4
-10	92.5	96.1	99.4	100.8	103.2	105.3	107.1	106.3	104.3
-20	90.8	94.3	97.6	99.0	101.5	103.4	105.1	106.5	106.4
-30	89.1	92.4	95.7	97.1	99.7	101.5	103.2	104.4	104.4
-40	87.3	90.5	93.9	95.2	97.8	99.5	101.2	102.2	102.2
-50	85.5	88.6	91.9	93.3	95.8	97.5	99.1	100.1	100.1

%N1 Adjustments for Engine Bleeds

BLEED CONFIGURATION	PRESSURE ALTITUDE (1000 FT)								
	0	5	10	15	20	25	30	35	40
PACKS OFF	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINE ANTI-ICE ON	-0.6	-0.6	-0.6	-0.6	-0.8	-0.9	-1.1	-1.4	-1.9
ENGINE & WING ANTI-ICE ON	-0.9	-0.9	-1.0	-1.1	-1.3	-1.4	-1.7	-2.2	-2.4

Go-around %N1

Based on engine bleed for packs on, EEC NORM or ALTN and anti-ice on or off

AIRPORT OAT		TAT	AIRPORT PRESSURE ALTITUDE (FT)						
°C	°F	(°C)	-1000	0	2000	4000	6000	8000	9000
55	131	58	106.1	106.1	105.9	105.5	105.1	104.9	104.7
50	122	53	106.8	106.9	106.8	106.5	106.1	105.9	105.7
45	113	48	107.5	107.5	107.5	107.3	107.0	106.9	106.6
40	104	43	108.2	108.2	108.2	108.0	107.9	107.8	107.7
35	95	38	109.0	108.9	109.0	108.8	108.7	108.7	108.6
30	86	33	109.1	109.8	109.8	109.7	109.6	109.7	109.6
25	77	28	108.2	108.9	110.3	110.6	110.5	110.6	110.6
20	68	23	107.3	108.0	109.4	110.6	111.3	111.4	111.3
15	59	18	106.4	107.1	108.5	109.7	111.0	112.0	112.1
10	50	13	105.5	106.2	107.5	108.8	110.0	111.3	112.1
0	32	3	103.6	104.3	105.7	106.9	108.1	109.4	110.1
-10	14	-7	101.7	102.4	103.8	104.9	106.1	107.4	108.1
-20	-4	-17	99.8	100.4	101.8	103.0	104.2	105.4	106.1
-30	-22	-27	97.9	98.5	99.8	101.0	102.2	103.4	104.0
-40	-40	-37	95.9	96.4	97.8	99.0	100.1	101.3	102.0
-50	-58	-47	93.8	94.4	95.8	96.9	98.0	99.2	99.8

%N1 Adjustments for Engine Bleeds

BLEED CONFIGURATION	AIRPORT PRESSURE ALTITUDE (FT)						
	-1000	0	2000	4000	6000	8000	9000
PACKS OFF	0.3	0.3	0.3	0.4	0.5	0.5	0.5

Flight With Unreliable Airspeed / Turbulent Air Penetration

Altitude and/or vertical speed indications may also be unreliable.

Climb (290/.78)

Flaps Up, Set Max Climb Thrust

PRESSURE ALTITUDE (FT)		WEIGHT (1000 KG) 100	120	140	160	180
40000	**PITCH ATT**	**4.5**	**4.0**	**4.0**		
	V/S (FT/MIN)	1800	1200	600		
30000	**PITCH ATT**	**4.5**	**4.0**	**4.0**	**4.0**	**4.0**
	V/S (FT/MIN)	2800	2200	1700	1400	1100
20000	**PITCH ATT**	**7.0**	**6.5**	**6.0**	**6.0**	**6.0**
	V/S (FT/MIN)	4200	3400	2800	2300	1900
10000	**PITCH ATT**	**10.5**	**9.0**	**8.5**	**8.0**	**7.5**
	V/S (FT/MIN)	5600	4500	3800	3200	2700
SEA LEVEL	**PITCH ATT**	**13.5**	**11.5**	**10.5**	**9.5**	**9.5**
	V/S (FT/MIN)	6300	5200	4300	3700	3200

Cruise (.78/290)

Flaps Up, Set Thrust for Level Flight

PRESSURE ALTITUDE (FT)		WEIGHT (1000 KG) 100	120	140	160	180
40000	**PITCH ATT**	**2.0**	**2.5**	**3.5**		
	%N1	86.8	90.4	95.0		
35000	**PITCH ATT**	**1.5**	**2.0**	**2.5**	**3.0**	**3.5**
	%N1	84.3	86.3	88.8	91.9	95.2
30000	**PITCH ATT**	**1.0**	**1.5**	**2.0**	**2.0**	**2.5**
	%N1	83.7	85.2	86.7	88.4	90.3
25000	**PITCH ATT**	**1.0**	**1.5**	**2.0**	**2.5**	**3.0**
	%N1	80.6	82.0	83.3	84.9	86.9
20000	**PITCH ATT**	**1.0**	**1.5**	**2.0**	**2.5**	**3.0**
	%N1	76.7	78.0	79.4	81.0	82.9
15000	**PITCH ATT**	**1.0**	**1.5**	**2.0**	**2.5**	**3.0**
	%N1	72.6	74.0	75.5	77.2	78.9

Descent (.78/290)

Flaps Up, Set Idle Thrust

PRESSURE ALTITUDE (FT)		WEIGHT (1000 KG) 100	120	140	160	180
40000	**PITCH ATT**	**-1.0**	**-0.5**	**0.5**	**1.0**	**1.5**
	V/S (FT/MIN)	-2500	-2400	-2500	-2500	-2800
30000	**PITCH ATT**	**-2.5**	**-1.5**	**-1.0**	**-0.5**	**0.5**
	V/S (FT/MIN)	-2600	-2300	-2100	-2000	-1900
20000	**PITCH ATT**	**-2.5**	**-1.5**	**-1.0**	**0.0**	**0.5**
	V/S (FT/MIN)	-2400	-2100	-1900	-1800	-1700
10000	**PITCH ATT**	**-2.5**	**-1.5**	**-1.0**	**0.0**	**0.5**
	V/S (FT/MIN)	-2100	-1900	-1700	-1600	-1500
SEA LEVEL	**PITCH ATT**	**-3.0**	**-2.0**	**-1.0**	**-0.5**	**0.5**
	V/S (FT/MIN)	-1900	-1700	-1600	-1500	-1400

Flight With Unreliable Airspeed / Turbulent Air Penetration

Altitude and/or vertical speed indications may also be unreliable.

Holding (VREF30 + 80)

Flaps Up, Set Thrust for Level Flight

PRESSURE ALTITUDE (FT)		WEIGHT (1000 KG) 100	120	140	160	180
10000	**PITCH ATT**	**4.0**	**4.5**	**5.0**	**5.0**	**5.0**
	%N1	57.4	61.7	65.6	68.9	72.2
	KIAS	199	211	222	236	251
5000	**PITCH ATT**	**4.0**	**4.5**	**5.0**	**5.0**	**5.0**
	%N1	53.6	57.5	61.2	65.1	68.1
	KIAS	199	211	222	236	251

Terminal Area (5000 FT)

Set Thrust for Level Flight

FLAP POSITION (VREF + INCREMENT)		WEIGHT (1000 KG) 100	120	140	160	180
FLAPS UP (VREF 30 + 80) (GEAR UP)	**PITCH ATT**	**4.0**	**4.5**	**5.0**	**5.0**	**5.0**
	%N1	54.6	58.8	62.9	66.7	69.6
	KIAS	199	211	222	236	251
FLAPS 1 (VREF 30 + 60) (GEAR UP)	**PITCH ATT**	**6.0**	**6.5**	**6.5**	**6.5**	**6.5**
	%N1	56.6	61.6	65.8	69.4	72.9
	KIAS	179	191	202	216	231
FLAPS 5 (VREF 30 + 40) (GEAR UP)	**PITCH ATT**	**4.5**	**4.5**	**5.0**	**4.5**	**4.5**
	%N1	57	62.3	66.2	70.0	73.7
	KIAS	159	171	182	196	211
FLAPS 15 (VREF 30 + 20) (GEAR UP)	**PITCH ATT**	**5.5**	**5.5**	**6.0**	**6.0**	**5.5**
	%N1	58.4	63.5	67.8	71.8	75.1
	KIAS	139	151	162	176	191
FLAPS 20 (VREF 30 + 20) (GEAR DOWN)	**PITCH ATT**	**4.0**	**4.5**	**4.5**	**4.0**	**3.5**
	%N1	65.7	71.2	75.4	79.8	83.5
	KIAS	139	151	162	176	191

Final Approach (1500 FT)

Gear Down, Set Thrust for a 3° Glideslope

FLAP POSITION (VREF + INCREMENT)		WEIGHT (1000 KG) 100	120	140	160	180
FLAPS 25 (VREF 25 + 10)	**PITCH ATT**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
	%N1	52.4	57.0	61.2	64.4	67.5
	KIAS	133	145	156	166	176
FLAPS 30 (VREF 30 + 10)	**PITCH ATT**	**0.5**	**0.5**	**0.5**	**0.0**	
	%N1	56.5	61.5	65.5	70.2	
	KIAS	129	141	153	166	

Performance Inflight — Chapter PI
All Engine — Section 11

Long Range Cruise Maximum Operating Altitude
ISA + 10°C and Below

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)				
			1.20 (33°)	1.25 (36°)	1.30 (39°)	1.40 (44°)	1.50 (48°)
190	29600	-3	34400	33500	32700	31100	29700
185	30200	-5	35000	34100	33300	31700	30200
180	30800	-6	35500	34700	33900	32300	30800
175	31400	-7	36100	35300	34500	32900	31500
170	32000	-9	36700	35900	35100	33500	32100
165	32700	-10	37400	36500	35700	34200	32700
160	33300	-12	38000	37100	36300	34800	33400
155	34000	-13	38700	37800	37000	35500	34100
150	34700	-15	39300	38500	37700	36200	34700
145	35400	-16	40000	39200	38400	36900	35500
140	36100	-18	40800	39900	39100	37600	36200
135	36900	-18	41500	40700	39900	38300	36900
130	37700	-18	42300	41500	40700	39100	37700
125	38500	-18	43100	42300	41500	39900	38500
120	39300	-18	43100	43100	42300	40800	39400
115	40200	-18	43100	43100	43100	41700	40300
110	41100	-18	43100	43100	43100	42600	41200
105	42100	-18	43100	43100	43100	43100	42200
100	43100	-18	43100	43100	43100	43100	43100

ISA + 15°C

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)				
			1.20 (33°)	1.25 (36°)	1.30 (39°)	1.40 (44°)	1.50 (48°)
190	29600	2	34400	33500	32700	31100	29700
185	30200	1	35000	34100	33300	31700	30200
180	30800	0	35500	34700	33900	32300	30800
175	31400	-2	36100	35300	34500	32900	31500
170	32000	-3	36700	35900	35100	33500	32100
165	32700	-5	37400	36500	35700	34200	32700
160	33300	-6	38000	37100	36300	34800	33400
155	34000	-8	38700	37800	37000	35500	34100
150	34700	-9	39300	38500	37700	36200	34700
145	35400	-11	40000	39200	38400	36900	35500
140	36100	-12	40800	39900	39100	37600	36200
135	36900	-12	41500	40700	39900	38300	36900
130	37700	-12	42300	41500	40700	39100	37700
125	38500	-12	43100	42300	41500	39900	38500
120	39300	-12	43100	43100	42300	40800	39400
115	40200	-12	43100	43100	43100	41700	40300
110	41100	-12	43100	43100	43100	42600	41200
105	42100	-12	43100	43100	43100	43100	42200
100	43100	-12	43100	43100	43100	43100	43100

Long Range Cruise Maximum Operating Altitude
ISA + 20°C

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)				
			1.20 (33°)	1.25 (36°)	1.30 (39°)	1.40 (44°)	1.50 (48°)
190	29600	8	34400	33500	32700	31100	29700
185	30200	7	34900*	34100	33300	31700	30200
180	30800	5	35500	34700	33900	32300	30800
175	31400	4	36000*	35300	34500	32900	31500
170	32000	2	36500*	35900	35100	33500	32100
165	32700	1	37100*	36500	35700	34200	32700
160	33300	0	37600*	37100	36300	34800	33400
155	34000	-2	38300*	37800	37000	35500	34100
150	34700	-4	38900*	38500	37700	36200	34700
145	35400	-5	39600*	39200	38400	36900	35500
140	36100	-7	40300*	39900	39100	37600	36200
135	36900	-7	41000*	40700	39900	38300	36900
130	37700	-7	41800*	41500	40700	39100	37700
125	38500	-7	42700*	42300	41500	39900	38500
120	39300	-7	43100	43100	42300	40800	39400
115	40200	-7	43100	43100	43100	41700	40300
110	41100	-7	43100	43100	43100	42600	41200
105	42100	-7	43100	43100	43100	43100	42200
100	43100	-7	43100	43100	43100	43100	43100

***Denotes altitude thrust limited in level flight.**

Long Range Cruise Control

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT)										
		23	25	27	29	31	33	35	37	39	41	43
190	%N1	88.2	89.0	90.3	91.5	93.2	95.1	98.1				
	MACH	.750	.769	.789	.794	.796	.797	.797				
	KIAS	328	323	319	308	296	283	271				
	FF/ENG	3049	2957	2931	2873	2857	2886	3011				
180	%N1	87.3	88.0	89.3	90.4	91.8	93.6	95.9	100.1			
	MACH	.742	.756	.780	.792	.795	.796	.797	.796			
	KIAS	324	318	315	307	295	283	271	258			
	FF/ENG	2930	2832	2811	2756	2715	2720	2775	2938			
170	%N1	86.3	87.2	88.0	89.5	90.5	92.2	94.1	97.3			
	MACH	.733	.746	.763	.788	.793	.795	.797	.797			
	KIAS	320	313	308	305	295	283	271	258			
	FF/ENG	2815	2719	2654	2657	2589	2567	2583	2689			
160	%N1	85.1	86.2	87.0	88.2	89.4	90.7	92.5	94.9	99.4		
	MACH	.716	.738	.750	.770	.789	.794	.796	.797	.797		
	KIAS	312	310	302	298	293	282	270	258	247		
	FF/ENG	2668	2611	2532	2500	2477	2429	2423	2473	2625		
150	%N1	83.7	85.0	86.0	86.9	88.3	89.3	90.7	93.0	96.3		
	MACH	.695	.723	.741	.755	.779	.792	.795	.796	.797		
	KIAS	303	303	298	291	289	281	270	258	247		
	FF/ENG	2506	2477	2415	2359	2352	2303	2270	2288	2377		
140	%N1	82.0	83.6	84.8	85.7	86.7	88.2	89.1	91.1	93.9	97.7	
	MACH	.673	.701	.728	.743	.760	.786	.793	.795	.797	.797	
	KIAS	292	293	293	287	281	279	269	258	247	236	
	FF/ENG	2336	2320	2295	2234	2192	2194	2135	2126	2168	2271	
130	%N1	80.1	81.8	83.3	84.5	85.3	86.4	87.7	89.2	91.7	94.5	98.7
	MACH	.650	.677	.705	.732	.746	.764	.788	.793	.796	.797	.797
	KIAS	282	282	283	282	275	270	267	257	246	236	225
	FF/ENG	2168	2155	2143	2121	2063	2026	2013	1974	1985	2033	2139
120	%N1	78.1	79.8	81.4	82.9	84.1	84.9	85.9	87.5	89.6	92.1	95.1
	MACH	.626	.652	.680	.709	.734	.748	.768	.789	.794	.796	.797
	KIAS	271	271	272	272	271	264	260	256	246	235	225
	FF/ENG	2002	1992	1981	1972	1953	1898	1862	1848	1828	1843	1894
110	%N1	76.0	77.6	79.3	80.9	82.4	83.6	84.4	85.8	87.7	89.8	92.4
	MACH	.601	.626	.652	.680	.710	.735	.749	.770	.790	.794	.796
	KIAS	259	260	260	261	261	259	253	249	244	235	225
	FF/ENG	1841	1832	1822	1813	1809	1790	1737	1708	1700	1683	1699
100	%N1	73.8	75.3	76.9	78.6	80.2	81.7	83.0	84.1	85.8	87.7	89.8
	MACH	.576	.599	.624	.650	.679	.709	.735	.749	.770	.790	.794
	KIAS	248	248	248	248	249	249	248	241	238	233	224
	FF/ENG	1689	1677	1665	1656	1651	1653	1630	1589	1565	1554	1538

Shaded area approximates optimum altitude.

Long Range Cruise Enroute Fuel and Time - Low Altitudes

Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
286	264	244	227	213	200	191	182	174	167	160
572	527	488	455	426	400	382	365	349	336	323
860	793	733	683	639	600	573	549	526	505	486
1148	1059	979	911	853	800	764	732	701	673	648
1438	1325	1224	1139	1066	1000	955	914	877	842	811
1730	1593	1472	1369	1280	1200	1147	1097	1052	1010	973
2022	1861	1718	1598	1493	1400	1338	1280	1227	1179	1135
2316	2131	1966	1827	1707	1600	1529	1463	1402	1347	1296
2612	2402	2215	2058	1922	1800	1720	1646	1578	1515	1458
2909	2673	2464	2288	2136	2000	1911	1828	1752	1682	1619

Reference Fuel And Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		20		24		28	
	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)
200	2.6	0:40	2.3	0:39	1.9	0:37	1.7	0:36	1.5	0:35
400	5.4	1:17	4.9	1:13	4.3	1:08	3.9	1:05	3.5	1:03
600	8.3	1:53	7.5	1:47	6.7	1:40	6.1	1:34	5.6	1:30
800	11.0	2:30	10.1	2:22	9.0	2:11	8.3	2:04	7.6	1:58
1000	13.8	3:07	12.7	2:57	11.3	2:43	10.5	2:34	9.6	2:26
1200	16.5	3:45	15.2	3:32	13.6	3:15	12.6	3:04	11.6	2:54
1400	19.2	4:23	17.8	4:08	15.9	3:48	14.8	3:34	13.6	3:22
1600	21.9	5:01	20.3	4:44	18.1	4:20	16.9	4:05	15.6	3:50
1800	24.5	5:40	22.7	5:20	20.4	4:53	19.0	4:35	17.5	4:19
2000	27.1	6:19	25.2	5:57	22.6	5:26	21.0	5:06	19.5	4:48

Fuel Required Adjustment (1000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)				
	100	120	140	160	180
2	-0.1	-0.1	0.0	0.1	0.2
4	-0.4	-0.2	0.0	0.2	0.5
6	-0.8	-0.4	0.0	0.4	0.8
8	-1.1	-0.5	0.0	0.5	1.1
10	-1.3	-0.7	0.0	0.7	1.4
12	-1.6	-0.8	0.0	0.8	1.7
14	-1.9	-1.0	0.0	0.9	1.9
16	-2.2	-1.1	0.0	1.1	2.2
18	-2.5	-1.2	0.0	1.2	2.5
20	-2.7	-1.4	0.0	1.4	2.8
22	-3.0	-1.5	0.0	1.5	3.1
24	-3.3	-1.7	0.0	1.7	3.4
26	-3.6	-1.8	0.0	1.8	3.7
28	-3.8	-2.0	0.0	2.0	4.0

Long Range Cruise Enroute Fuel and Time - High Altitudes
Ground to Air Miles Conversion

AIR DISTANCE (NM) HEADWIND COMPONENT (KTS)					GROUND DISTANCE (NM)	AIR DISTANCE (NM) TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
1306	1231	1163	1103	1049	1000	957	918	881	848	817
1956	1845	1744	1655	1574	1500	1436	1377	1323	1273	1227
2610	2462	2327	2207	2099	2000	1916	1837	1764	1698	1637
3267	3080	2910	2760	2624	2500	2395	2297	2206	2123	2047
3928	3702	3496	3314	3150	3000	2874	2756	2648	2548	2456
4593	4327	4084	3870	3677	3500	3353	3216	3089	2971	2864
5262	4955	4675	4427	4204	4000	3831	3674	3529	3395	3272
5936	5586	5267	4985	4732	4500	4309	4132	3968	3817	3679
6615	6220	5861	5544	5260	5000	4787	4589	4406	4238	4085
7299	6858	6458	6104	5789	5500	5265	5047	4845	4659	4490
7987	7499	7056	6666	6318	6000	5743	5504	5283	5080	4895

Reference Fuel And Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	29		31		33		35		37	
	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)
1000	9.4	2:25	9.1	2:24	8.8	2:21	8.5	2:20	8.4	2:20
1500	14.3	3:35	13.7	3:32	13.3	3:29	12.9	3:26	12.7	3:26
2000	19.1	4:45	18.4	4:41	17.8	4:37	17.3	4:32	17.0	4:32
2500	23.7	5:57	22.9	5:51	22.2	5:46	21.5	5:40	21.1	5:38
3000	28.4	7:10	27.4	7:01	26.5	6:55	25.7	6:48	25.1	6:44
3500	32.9	8:25	31.7	8:14	30.7	8:05	29.7	7:58	29.1	7:52
4000	37.3	9:40	36.1	9:26	34.9	9:15	33.8	9:07	33.0	8:59
4500	41.6	10:59	40.2	10:41	38.9	10:28	37.7	10:17	36.7	10:08
5000	45.9	12:17	44.4	11:56	43.0	11:40	41.6	11:28	40.5	11:17
5500	50.0	13:39	48.4	13:15	46.9	12:55	45.4	12:40	44.1	12:28
6000	54.1	15:00	52.4	14:33	50.8	14:10	49.1	13:51	47.8	13:38

Fuel Required Adjustment (1000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)				
	100	120	140	160	180
5	-0.6	-0.3	0.0	0.7	1.6
10	-1.4	-0.7	0.0	1.4	3.2
15	-2.2	-1.1	0.0	2.1	4.7
20	-3.0	-1.4	0.0	2.7	6.1
25	-3.8	-1.8	0.0	3.3	7.4
30	-4.6	-2.2	0.0	3.8	8.5
35	-5.5	-2.6	0.0	4.3	9.6
40	-6.3	-3.1	0.0	4.7	10.5
45	-7.2	-3.5	0.0	5.0	11.3
50	-8.1	-3.9	0.0	5.3	12.0
55	-9.1	-4.3	0.0	5.6	12.6

Long Range Cruise Wind-Altitude Trade

PRESSURE ALTITUDE (1000 FT)	CRUISE WEIGHT (1000 KG)									
	190	180	170	160	150	140	130	120	110	100
43						74	36	13	1	0
41					58	28	10	1	0	8
39			75	43	20	6	0	1	8	21
37	85	53	29	13	3	0	2	9	21	37
35	35	18	6	1	0	3	11	22	37	54
33	9	2	0	1	5	13	24	38	54	72
31	0	0	3	8	17	28	40	55	71	89
29	1	6	12	21	31	43	57	72	88	106
27	9	17	25	36	47	60	74	89	105	121
25	22	30	40	52	64	77	90	105	120	135
23	36	46	56	68	80	93	106	120	134	148

The above wind factor table is for calculation of wind required to maintain present range capability at new pressure altitude, i.e., break-even wind.

Method:

1. **Read wind factors for present and new altitudes from table.**
2. **Determine difference (new altitude wind factor minus present altitude wind factor); This difference may be negative or positive.**
3. **Break-even wind at new altitude is present altitude wind plus difference from step 2.**

Descent at .78/290/250

PRESSURE ALT (1000 FT)	5	10	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43
DISTANCE (NM)	22	41	62	69	77	84	91	98	106	113	120	126	132	137	143	150	157
TIME (MINUTES)	8	12	16	17	18	19	20	21	22	23	24	25	26	27	28	28	29

Holding

Flaps Up

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)								
		1500	5000	10000	15000	20000	25000	30000	35000	40000
190	%N1	67.0	69.5	73.9	78.2	82.3	86.5	90.9		
	KIAS	259	259	259	259	259	259	259		
	FF/ENG	2760	2730	2700	2680	2670	2690	2720		
180	%N1	65.4	68.1	72.2	76.8	81.0	85.1	89.4		
	KIAS	251	251	251	251	251	251	251		
	FF/ENG	2620	2590	2560	2530	2520	2530	2560		
170	%N1	63.7	66.7	70.6	75.2	79.4	83.5	87.9		
	KIAS	244	244	244	244	244	244	244		
	FF/ENG	2490	2450	2420	2390	2370	2380	2400		
160	%N1	61.9	65.1	68.9	73.5	77.8	81.9	86.2	90.9	
	KIAS	236	236	236	236	236	236	236	239	
	FF/ENG	2350	2310	2270	2250	2230	2220	2250	2300	
150	%N1	60.1	63.1	67.2	71.5	76.0	80.3	84.5	89.0	
	KIAS	228	228	228	228	228	228	228	231	
	FF/ENG	2220	2170	2130	2100	2090	2080	2090	2130	
140	%N1	58.3	61.2	65.6	69.6	74.2	78.6	82.8	87.2	
	KIAS	222	222	222	222	222	222	222	222	
	FF/ENG	2090	2050	2000	1970	1950	1940	1940	1970	
130	%N1	56.6	59.4	63.8	67.7	72.4	76.7	80.9	85.3	
	KIAS	217	217	217	217	217	217	217	217	
	FF/ENG	1970	1930	1880	1850	1830	1820	1810	1820	
120	%N1	54.9	57.5	61.7	65.8	70.2	74.8	79.0	83.3	89.4
	KIAS	211	211	211	211	211	211	211	211	211
	FF/ENG	1850	1810	1760	1730	1700	1700	1680	1680	1750
110	%N1	53.1	55.6	59.6	64.0	68.0	72.8	77.1	81.3	87.2
	KIAS	205	205	205	205	205	205	205	205	205
	FF/ENG	1730	1700	1650	1610	1580	1570	1550	1560	1600
100	%N1	51.3	53.6	57.4	61.8	65.8	70.5	74.8	79.1	84.9
	KIAS	199	199	199	199	199	199	199	199	199
	FF/ENG	1610	1580	1530	1500	1460	1450	1430	1440	1470

This table includes 5% additional fuel for holding in a racetrack pattern.

Intentionally
Blank

Performance Inflight — Chapter PI
Advisory Information — Section 12

ADVISORY INFORMATION

Normal Configuration Landing Distance
Flaps 25
Dry Runway

	LANDING DISTANCE AND ADJUSTMENT (FT)											
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ PER 10 KTS		SLOPE ADJ PER 1%		TEMP ADJ PER 10°C		APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	150000 KG LANDING WEIGHT	PER 5000 KG ABV/ BLW 150000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD WIND	TAIL WIND	DOWN HILL	UP HILL	ABV ISA	BLW ISA	PER 10 KTS ABOVE VREF25	ONE REV	NO REV
MAX MANUAL	3200	110/-60	80	-130	440	50	-40	80	-70	250	80	170
MAX AUTO	5370	130/-130	150	-250	840	0	0	160	-160	600	0	0
AUTOBRAKE 4	5540	140/-140	160	-260	880	0	0	160	-160	630	0	0
AUTOBRAKE 3	6370	160/-160	190	-300	1040	0	-20	190	-190	710	0	0
AUTOBRAKE 2	7090	190/-190	220	-350	1190	50	-120	220	-210	630	110	110
AUTOBRAKE 1	7740	220/-220	250	-390	1360	170	-220	250	-230	580	480	620

Good Reported Braking Action

MAX MANUAL	4400	110/-100	120	-210	720	120	-110	120	-110	340	260	580
MAX AUTO	5380	130/-130	150	-250	860	20	0	160	-160	600	20	80
AUTOBRAKE 4	5540	140/-140	160	-260	880	10	0	160	-160	630	10	50
AUTOBRAKE 3	6370	160/-160	190	-300	1040	0	-20	190	-190	710	0	0

Medium Reported Braking Action

MAX MANUAL	6030	170/-160	190	-330	1190	300	-230	180	-170	440	690	1660
MAX AUTO	6060	170/-160	190	-330	1190	260	-160	190	-170	570	600	1580
AUTOBRAKE 4	6130	170/-160	190	-330	1200	240	-140	190	-180	610	530	1510
AUTOBRAKE 3	6670	180/-170	200	-350	1260	160	-100	200	-200	710	350	1100

Poor Reported Braking Action

MAX MANUAL	7790	240/-230	260	-480	1830	660	-440	250	-220	520	1450	3870
MAX AUTO	7790	240/-230	260	-480	1820	660	-440	250	-220	510	1460	3890
AUTOBRAKE 4	7790	240/-230	260	-480	1820	670	-430	250	-220	520	1460	3890
AUTOBRAKE 3	7870	240/-220	260	-480	1840	610	-360	250	-230	660	1330	3760

Reference distance assumes sea level, standard day, no wind or slope, VREF25 approach speed and 2 engine reverse thrust.
Reference distance for manual braking is applicable for auto spoilers only, for manual spoilers operation increase landing distance by 400 ft.
Reference distance for auto braking is applicable for auto or manual spoilers.
Includes distance from 50 ft above threshold (1000 ft of air distance).
Actual (unfactored) distances are shown.

ADVISORY INFORMATION

Normal Configuration Landing Distance
Flaps 30
Dry Runway

	LANDING DISTANCE AND ADJUSTMENT (FT)											
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ PER 10 KTS		SLOPE ADJ PER 1%		TEMP ADJ PER 10°C		APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	150000 KG LANDING WEIGHT	PER 5000 KG ABV/ BLW 150000 KG	PER 1000 FT ABV SEA LEVEL	HEAD WIND	TAIL WIND	DOWN HILL	UP HILL	ABV ISA	BLW ISA	PER 10 KTS ABV VREF 30	ONE REV	NO REV
MAX MANUAL	3150	140/-70	80	-130	440	50	-40	80	-70	250	80	160
MAX AUTO	5220	210/-140	150	-240	830	0	0	150	-150	600	0	0
AUTOBRAKE 4	5380	220/-140	150	-250	870	0	0	160	-160	620	0	0
AUTOBRAKE 3	6180	260/-170	180	-300	1020	0	-10	190	-190	720	0	0
AUTOBRAKE 2	6930	280/-200	210	-340	1180	40	-110	210	-210	640	80	80
AUTOBRAKE 1	7590	300/-220	240	-390	1350	160	-210	240	-230	580	410	540

Good Reported Braking Action

MAX MANUAL	4340	160/-110	120	-210	720	120	-110	120	-110	350	240	540
MAX AUTO	5230	210/-140	150	-250	850	20	0	150	-150	600	20	80
AUTOBRAKE 4	5390	220/-140	150	-250	870	10	0	160	-160	620	10	50
AUTOBRAKE 3	6180	260/-170	180	-300	1020	0	-10	190	-190	720	0	0

Medium Reported Braking Action

MAX MANUAL	5960	230/-170	190	-330	1190	300	-240	180	-170	450	650	1540
MAX AUTO	5960	250/-170	190	-330	1190	280	-170	180	-170	560	600	1500
AUTOBRAKE 4	6020	250/-170	190	-330	1200	260	-150	190	-180	600	540	1430
AUTOBRAKE 3	6510	280/-180	200	-350	1250	170	-100	200	-190	720	360	1060

Poor Reported Braking Action

MAX MANUAL	7720	310/-230	260	-480	1830	680	-440	250	-220	520	1370	3600
MAX AUTO	7720	310/-230	260	-480	1830	680	-440	250	-220	520	1380	3610
AUTOBRAKE 4	7720	310/-230	260	-480	1830	680	-440	250	-220	520	1380	3610
AUTOBRAKE 3	7750	330/-230	260	-480	1840	640	-360	250	-230	670	1290	3520

Reference distance assumes sea level, standard day, no wind or slope, VREF30 approach speed and 2 engine reverse thrust.
Reference distance for manual braking is applicable for auto spoilers only, for manual spoilers operation increase landing distance by 400 ft.
Reference distance for auto braking is applicable for both auto and manual spoilers.
Includes distance from 50 ft above threshold (1000 ft of air distance).
Actual (unfactored) distances are shown.

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

Dry Runway

		LANDING DISTANCES AND ADJUSTMENTS (FT)								
		REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
LANDING CONFIGURATION	VREF	150000 KG LDG WT	PER 5000 KG ABV/BLW 150000 KG	PER 1000 FT ABV S.L.	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 10 KTS ABV VREF	ONE REV	NO REV
AIR/GRD SYS (FLAPS 25)	VREF25	4210	90/-90	100	-170/570	90/-80	110/-110	420	0	0
AIR/GRD SYS (FLAPS 30)	VREF30	4130	160/-100	100	-170/570	90/-80	110/-110	440	0	0
ALL FLAPS AND SLATS UP LANDING	VREF30+50	4530	260/-110	130	-170/570	80/-70	130/-120	320	200	440
ANTI-SKID OFF (FLAPS 25)	VREF25	5920	160/-150	160	-290/1010	190/-160	160/-150	440	410	960
ANTI-SKID OFF (FLAPS 30)	VREF30	5770	230/-160	160	-290/1010	190/-160	160/-150	450	380	880
ENGINE FAILURE (FLAPS 20)	VREF20	3460	150/-80	90	-140/470	60/-50	90/-90	280	0	110
HYD SYS PRESS (C ONLY) (FLAPS 20)	VREF20	4140	110/-100	100	-160/530	70/-60	100/-100	380	140	300
HYD SYS PRESS (L ONLY) (FLAPS 25)	VREF25	3350	90/-80	80	-130/460	50/-50	80/-80	290	100	200
HYD SYS PRESS (L ONLY) (FLAPS 30)	VREF30	3300	130/-80	80	-130/460	60/-50	80/-80	300	90	190
HYD SYS PRESS (R ONLY) (FLAPS 25)	VREF25	3680	90/-90	90	-150/530	70/-60	90/-90	310	140	300
HYD SYS PRESS (R ONLY) (FLAPS 30)	VREF30	3620	140/-90	90	-150/530	70/-70	90/-90	330	130	280
HYD SYS PRESS (L AND C) (FLAPS 20)	VREF30+20	4890	190/-110	130	-180/600	100/-90	130/-130	510	230	510
HYD SYS PRESS (L AND R) (FLAPS 20)	VREF30+20	4570	180/-110	130	-180/610	110/-90	130/-120	420	260	570
HYD SYS PRESS (R AND C) (FLAPS 20)	VREF30+20	5800	240/-150	170	-230/780	160/-140	170/-160	580	430	990

***Reference distance assumes sea level, standard day with no wind or slope.**
Actual (unfactored) distances are shown.
Includes distance from 50 ft above runway threshold (1000 ft of air distance).
Assumes max manual braking and maximum reverse thrust when available on operating engine(s).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

Dry Runway

		LANDING DISTANCES AND ADJUSTMENTS (FT)								
		REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
LANDING CONFIGURATION	VREF	150000 KG LDG WT	PER 5000 KG ABV/BLW 150000 KG	PER 1000 FT ABV S.L.	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 10 KTS ABV VREF	ONE REV	NO REV
LE SLAT ASYM (FLAPS > 20)	VREF30+20	3670	180/-80	90	-140/480	60/-50	90/-90	270	120	260
LE SLAT ASYM (FLAPS = 20)	VREF30+30	4140	170/-90	110	-150/520	70/-60	110/-110	310	160	340
LE SLAT ASYM (5 < FLAPS < 20)	VREF30+40	4440	170/-100	120	-160/540	80/-70	120/-120	320	180	390
LE SLAT DISAGREE (FLAPS > 20)	VREF20	3390	140/-80	80	-130/450	50/-50	80/-80	260	100	220
LE SLAT DISAGREE - ALTN FLAP EXT ACOMPLISHED (FLAPS = 20)	VREF20	3390	140/-80	80	-130/450	50/-50	80/-80	260	100	220
LE SLAT DISAGREE - ALTN FLAP EXT FAILED (FLAPS = 20)	VREF30+30	3940	180/-90	100	-150/500	60/-60	100/-100	280	140	290
REVERSER UNLOCKED (FLAPS 20)	VREF30+30	4260	180/-100	110	-160/540	80/-70	120/-110	330	0	180
TE FLAP ASYM (FLAPS ≥ 20)	VREF20	3390	140/-80	80	-130/450	50/-50	80/-80	260	100	220
TE FLAP ASYM (5 < FLAPS < 20)	VREF30+20	3670	180/-80	90	-140/480	60/-50	90/-90	270	120	260
TE FLAP ASYM (FLAPS ≤ 5)	VREF30+30	3890	210/-90	100	-150/490	60/-50	100/-100	270	130	290
TE FLAP DISAGREE (FLAPS ≥ 20)	VREF20	3390	140/-80	80	-130/450	50/-50	80/-80	260	100	220
TE FLAP DISAGREE (5 < FLAPS < 20)	VREF30+20	3670	180/-80	90	-140/480	60/-50	90/-90	270	120	260
TE FLAP DISAGREE (FLAPS ≤ 5)	VREF30+30	3890	210/-90	100	-150/490	60/-50	100/-100	270	130	290

***Reference distance assumes sea level, standard day with no wind or slope.**
Actual (unfactored) distances are shown.
Includes distance from 50 ft above runway threshold (1000 ft of air distance).
Assumes max manual braking and maximum reverse thrust when available on operating engine(s).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

Good Reported Braking Action

		LANDING DISTANCES AND ADJUSTMENTS (FT)								
		REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
LANDING CONFIGURATION	VREF	150000 KG LDG WT	PER 5000 KG ABV/BLW 150000 KG	PER 1000 FT ABV S.L.	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 10 KTS ABV VREF	ONE REV	NO REV
AIR/GRD SYS (FLAPS 25)	VREF25	6240	150/-150	180	-300/1010	270/-220	180/-180	620	0	0
AIR/GRD SYS (FLAPS 30)	VREF30	6090	250/-150	180	-300/1010	280/-230	180/-180	640	0	0
ALL FLAPS AND SLATS UP LANDING	VREF30+50	6220	220/-160	190	-250/860	160/-150	190/-180	380	530	1220
ANTI-SKID OFF (FLAPS 25)	VREF25	6660	190/-180	190	-350/1240	290/-230	190/-180	490	630	1530
ANTI-SKID OFF (FLAPS 30)	VREF30	6500	260/-180	190	-350/1240	290/-230	190/-180	490	590	1410
ENGINE FAILURE (FLAPS 20)	VREF20	4980	150/-130	140	-230/800	160/-140	140/-140	410	0	410
HYD SYS PRESS (C ONLY) (FLAPS 20)	VREF20	5600	170/-150	160	-250/840	170/-150	160/-150	510	430	1010
HYD SYS PRESS (L ONLY) (FLAPS 25)	VREF25	4620	130/-120	130	-220/750	140/-120	130/-120	390	300	680
HYD SYS PRESS (L ONLY) (FLAPS 30)	VREF30	4550	190/-120	130	-220/750	140/-120	130/-120	400	280	640
HYD SYS PRESS (R ONLY) (FLAPS 25)	VREF25	4620	130/-120	130	-220/750	140/-120	130/-120	390	300	680
HYD SYS PRESS (R ONLY) (FLAPS 30)	VREF30	4550	190/-120	130	-220/750	140/-120	130/-120	400	280	640
HYD SYS PRESS (L AND C) (FLAPS 20)	VREF30+20	6580	280/-180	200	-280/940	230/-190	200/-190	640	650	1560
HYD SYS PRESS (L AND R) (FLAPS 20)	VREF30+20	5760	240/-160	180	-250/860	190/-170	180/-170	510	530	1250
HYD SYS PRESS (R AND C) (FLAPS 20)	VREF30+20	6580	280/-180	200	-280/940	230/-190	200/-190	640	650	1560

***Reference distance assumes sea level, standard day with no wind or slope.**
Actual (unfactored) distances are shown.
Includes distance from 50 ft above runway threshold (1000 ft of air distance).
Assumes max manual braking and maximum reverse thrust when available on operating engine(s).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

Good Reported Braking Action

		LANDING DISTANCES AND ADJUSTMENTS (FT)								
		REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
LANDING CONFIGURATION	VREF	150000 KG LDG WT	PER 5000 KG ABV/BLW 150000 KG	PER 1000 FT ABV S.L.	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 10 KTS ABV VREF	ONE REV	NO REV
LE SLAT ASYM (FLAPS > 20)	VREF30+20	5130	200/-130	150	-230/790	150/-130	150/-140	380	380	860
LE SLAT ASYM (FLAPS = 20)	VREF30+30	5770	220/-150	170	-250/840	170/-150	170/-170	420	470	1080
LE SLAT ASYM (5 < FLAPS < 20)	VREF30+40	6180	230/-160	190	-260/870	180/-160	190/-180	430	520	1190
LE SLAT DISAGREE (FLAPS > 20)	VREF20	4730	140/-130	130	-220/750	130/-120	130/-130	370	330	750
LE SLAT DISAGREE - ALTN FLAP EXT ACOMPLISHED (FLAPS = 20)	VREF20	4730	140/-130	130	-220/750	130/-120	130/-130	370	330	750
LE SLAT DISAGREE - ALTN FLAP EXT FAILED (FLAPS = 20)	VREF30+30	5500	200/-140	160	-240/810	150/-140	160/-160	380	420	950
REVERSER UNLOCKED (FLAPS 20)	VREF30+30	6160	230/-160	180	-270/900	210/-180	190/-180	470	0	590
TE FLAP ASYM (FLAPS ≥ 20)	VREF20	4730	140/-130	130	-220/750	130/-120	130/-130	370	330	750
TE FLAP ASYM (5 < FLAPS < 20)	VREF30+20	5140	200/-140	150	-230/790	140/-130	150/-140	380	380	880
TE FLAP ASYM (FLAPS ≤ 5)	VREF30+30	5470	200/-140	160	-230/810	150/-130	160/-150	370	430	980
TE FLAP DISAGREE (FLAPS ≥ 20)	VREF20	4730	140/-130	130	-220/750	130/-120	130/-130	370	330	750
TE FLAP DISAGREE (5 < FLAPS < 20)	VREF30+20	5140	200/-140	150	-230/790	140/-130	150/-140	380	380	880
TE FLAP DISAGREE (FLAPS ≤ 5)	VREF30+30	5470	200/-140	160	-230/810	150/-130	160/-150	370	430	980

***Reference distance assumes sea level, standard day with no wind or slope.**
Actual (unfactored) distances are shown.
Includes distance from 50 ft above runway threshold (1000 ft of air distance).
Assumes max manual braking and maximum reverse thrust when available on operating engine(s).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

Medium Reported Braking Action

		LANDING DISTANCES AND ADJUSTMENTS (FT)								
		REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
LANDING CONFIGURATION	VREF	150000 KG LDG WT	PER 5000 KG ABV/BLW 150000 KG	PER 1000 FT ABV S.L.	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 10 KTS ABV VREF	ONE REV	NO REV
AIR/GRD SYS (FLAPS 25)	VREF25	9940	240/-230	310	-560/1950	1000/-670	320/-320	870	0	0
AIR/GRD SYS (FLAPS 30)	VREF30	9650	370/-230	310	-550/1940	1000/-670	320/-320	870	0	0
ALL FLAPS AND SLATS UP LANDING	VREF30+50	8820	340/-250	300	-400/1400	410/-330	300/-270	520	1430	3670
ANTI-SKID OFF (FLAPS 25)	VREF25	8370	260/-250	260	-500/1870	640/-440	250/-230	560	1370	3680
ANTI-SKID OFF (FLAPS 30)	VREF30	8180	350/-250	260	-500/1870	650/-440	250/-230	560	1290	3390
ENGINE FAILURE (FLAPS 20)	VREF20	7250	240/-220	230	-390/1360	440/-340	230/-220	560	0	1250
HYD SYS PRESS (C ONLY) (FLAPS 20)	VREF20	7520	260/-230	240	-380/1340	400/-310	240/-220	630	1120	2890
HYD SYS PRESS (L ONLY) (FLAPS 25)	VREF25	6320	190/-190	200	-340/1220	330/-260	200/-180	490	780	1900
HYD SYS PRESS (L ONLY) (FLAPS 30)	VREF30	6220	280/-190	200	-340/1220	340/-260	200/-180	500	740	1780
HYD SYS PRESS (R ONLY) (FLAPS 25)	VREF25	6320	190/-190	200	-340/1220	330/-260	200/-180	490	780	1900
HYD SYS PRESS (R ONLY) (FLAPS 30)	VREF30	6220	280/-190	200	-340/1220	340/-260	200/-180	500	740	1780
HYD SYS PRESS (L AND C) (FLAPS 20)	VREF30+20	8720	390/-260	290	-420/1460	500/-390	290/-260	740	1530	4090
HYD SYS PRESS (L AND R) (FLAPS 20)	VREF30+20	7850	350/-240	270	-390/1370	430/-340	260/-240	620	1300	3370
HYD SYS PRESS (R AND C) (FLAPS 20)	VREF30+20	8720	390/-260	290	-420/1460	500/-390	290/-260	740	1530	4090

***Reference distance assumes sea level, standard day with no wind or slope.**
Actual (unfactored) distances are shown.
Includes distance from 50 ft above runway threshold (1000 ft of air distance).
Assumes max manual braking and maximum reverse thrust when available on operating engine(s).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

Medium Reported Braking Action

		LANDING DISTANCES AND ADJUSTMENTS (FT)								
		REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
LANDING CONFIGURATION	VREF	150000 KG LDG WT	PER 5000 KG ABV/ BLW 150000 KG	PER 1000 FT ABV S.L.	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 10 KTS ABV VREF	ONE REV	NO REV
LE SLAT ASYM (FLAPS > 20)	VREF30+20	7070	290/-210	230	-360/1280	350/-280	230/-210	490	980	2430
LE SLAT ASYM (FLAPS = 20)	VREF30+30	7900	320/-230	260	-380/1350	390/-320	260/-240	530	1170	2930
LE SLAT ASYM (5 < FLAPS < 20)	VREF30+40	8430	340/-250	290	-400/1380	410/-330	280/-260	540	1340	3430
LE SLAT DISAGREE (FLAPS > 20)	VREF20	6540	220/-200	210	-340/1230	330/-260	200/-190	490	880	2200
LE SLAT DISAGREE - ALTN FLAP EXT ACOMPLISHED (FLAPS = 20)	VREF20	6540	220/-200	210	-340/1230	330/-260	200/-190	490	880	2200
LE SLAT DISAGREE - ALTN FLAP EXT FAILED (FLAPS = 20)	VREF30+30	7550	300/-220	250	-370/1310	360/-290	250/-230	490	1050	2620
REVERSER UNLOCKED (FLAPS 20)	VREF30+30	8860	360/-260	290	-430/1510	530/-420	290/-280	610	0	1680
TE FLAP ASYM (FLAPS ≥ 20)	VREF20	6540	220/-200	210	-340/1230	330/-260	200/-190	490	880	2200
TE FLAP ASYM (5 < FLAPS < 20)	VREF30+20	7120	300/-210	230	-360/1280	350/-280	230/-210	490	1010	2540
TE FLAP ASYM (FLAPS ≤ 5)	VREF30+30	7590	310/-220	250	-370/1310	360/-290	250/-230	490	1110	2810
TE FLAP DISAGREE (FLAPS ≥ 20)	VREF20	6540	220/-200	210	-340/1230	330/-260	200/-190	490	880	2200
TE FLAP DISAGREE (5 < FLAPS < 20)	VREF30+20	7120	300/-210	230	-360/1280	350/-280	230/-210	490	1010	2540
TE FLAP DISAGREE (FLAPS ≤ 5)	VREF30+30	7590	310/-220	250	-370/1310	360/-290	250/-230	490	1110	2810

***Reference distance assumes sea level, standard day with no wind or slope.**
Actual (unfactored) distances are shown.
Includes distance from 50 ft above runway threshold (1000 ft of air distance).
Assumes max manual braking and maximum reverse thrust when available on operating engine(s).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

Poor Reported Braking Action

		LANDING DISTANCES AND ADJUSTMENTS (FT)								
		REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
LANDING CONFIGURATION	VREF	150000 KG LDG WT	PER 5000 KG ABV/ BLW 150000 KG	PER 1000 FT ABV S.L.	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 10 KTS ABV VREF	ONE REV	NO REV
AIR/GRD SYS (FLAPS 25)	VREF25	16490	320/-200	570	-1120/4230	6080/-2020	600/-590	1090	0	0
AIR/GRD SYS (FLAPS 30)	VREF30	15920	480/-200	550	-1100/4180	5960/-1970	580/-570	1080	0	0
ALL FLAPS AND SLATS UP LANDING	VREF30+50	11600	480/-370	430	-590/2140	900/-630	410/-370	640	3020	8970
ANTI-SKID OFF (FLAPS 25)	VREF25	10950	380/-360	370	-800/3310	3040/-940	350/-310	630	3540	14250
ANTI-SKID OFF (FLAPS 30)	VREF30	10760	480/-360	360	-800/3310	3040/-950	350/-310	630	3380	13380
ENGINE FAILURE (FLAPS 20)	VREF20	9970	360/-320	340	-600/2200	1100/-700	330/-310	690	0	3070
HYD SYS PRESS (C ONLY) (FLAPS 20)	VREF20	9560	360/-310	330	-550/2030	840/-570	320/-290	710	2280	6740
HYD SYS PRESS (L ONLY) (FLAPS 25)	VREF25	8130	280/-260	280	-500/1870	710/-480	270/-240	560	1610	4380
HYD SYS PRESS (L ONLY) (FLAPS 30)	VREF30	8030	370/-270	280	-500/1870	730/-490	270/-240	570	1530	4080
HYD SYS PRESS (R ONLY) (FLAPS 25)	VREF25	8130	280/-260	280	-500/1870	710/-480	270/-240	560	1610	4380
HYD SYS PRESS (R ONLY) (FLAPS 30)	VREF30	8030	370/-270	280	-500/1870	730/-490	270/-240	570	1530	4080
HYD SYS PRESS (L AND C) (FLAPS 20)	VREF30+20	10910	510/-360	400	-600/2160	990/-670	380/-340	800	2910	8920
HYD SYS PRESS (L AND R) (FLAPS 20)	VREF30+20	10000	460/-330	360	-560/2060	890/-610	350/-310	690	2540	7490
HYD SYS PRESS (R AND C) (FLAPS 20)	VREF30+20	10910	510/-360	400	-600/2160	990/-670	380/-340	800	2910	8920

***Reference distance assumes sea level, standard day with no wind or slope.**
Actual (unfactored) distances are shown.
Includes distance from 50 ft above runway threshold (1000 ft of air distance).
Assumes max manual braking and maximum reverse thrust when available on operating engine(s).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

Poor Reported Braking Action

		LANDING DISTANCES AND ADJUSTMENTS (FT)								
		REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
LANDING CONFIGURATION	VREF	150000 KG LDG WT	PER 5000 KG ABV/ BLW 150000 KG	PER 1000 FT ABV S.L.	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 10 KTS ABV VREF	ONE REV	NO REV
LE SLAT ASYM (FLAPS > 20)	VREF30+20	9120	400/-290	320	-530/1950	760/-520	310/-280	570	2010	5610
LE SLAT ASYM (FLAPS = 20)	VREF30+30	10100	430/-320	360	-560/2040	820/-570	350/-320	600	2310	6530
LE SLAT ASYM (5 < FLAPS < 20)	VREF30+40	10880	460/-350	400	-570/2100	870/-610	380/-340	630	2700	7890
LE SLAT DISAGREE (FLAPS > 20)	VREF20	8500	320/-280	290	-510/1900	730/-500	280/-260	580	1860	5230
LE SLAT DISAGREE - ALTN FLAP EXT ACOMPLISHED (FLAPS = 20)	VREF20	8500	320/-280	290	-510/1900	730/-500	280/-260	580	1860	5230
LE SLAT DISAGREE - ALTN FLAP EXT FAILED (FLAPS = 20)	VREF30+30	9680	410/-310	340	-540/1990	780/-540	330/-300	560	2120	5910
REVERSER UNLOCKED (FLAPS 20)	VREF30+30	11960	500/-380	420	-660/2380	1260/-830	410/-390	730	0	3880
TE FLAP ASYM (FLAPS ≥ 20)	VREF20	8500	320/-280	290	-510/1900	730/-500	280/-260	580	1860	5230
TE FLAP ASYM (5 < FLAPS < 20)	VREF30+20	9250	410/-300	330	-530/1960	760/-520	320/-280	590	2160	6210
TE FLAP ASYM (FLAPS ≤ 5)	VREF30+30	9820	420/-310	350	-540/2000	780/-540	340/-300	580	2290	6540
TE FLAP DISAGREE (FLAPS ≥ 20)	VREF20	8500	320/-280	290	-510/1900	730/-500	280/-260	580	1860	5230
TE FLAP DISAGREE (5 < FLAPS < 20)	VREF30+20	9250	410/-300	330	-530/1960	760/-520	320/-280	590	2160	6210
TE FLAP DISAGREE (FLAPS ≤ 5)	VREF30+30	9820	420/-310	350	-540/2000	780/-540	340/-300	580	2290	6540

***Reference distance assumes sea level, standard day with no wind or slope.**
Actual (unfactored) distances are shown.
Includes distance from 50 ft above runway threshold (1000 ft of air distance).
Assumes max manual braking and maximum reverse thrust when available on operating engine(s).

ADVISORY INFORMATION

Recommended Brake Cooling Schedule

Reference Brake Energy Per Brake (Millions of Foot Pounds)

		BRAKES ON SPEED (KIAS)*																	
		80			100			120			140			160			180		
WEIGHT (1000 KG)	OAT (°C)	PRESSURE ALTITUDE (1000 FT)																	
		0	2	4	0	2	4	0	2	4	0	2	4	0	2	4	0	2	4
180	0	15.1	16.1	17.0	22.8	24.3	25.8	31.8	33.9	35.9	41.8	44.6	47.4	52.7	56.3	59.9			
	10	15.7	16.6	17.6	23.6	25.1	26.6	32.9	35.0	37.2	43.2	46.1	49.1	54.5	58.3	62.0			
	20	16.2	17.2	18.2	24.4	26.0	27.5	34.0	36.2	38.5	44.7	47.7	50.7	56.4	60.3	64.2			
	30	16.7	17.7	18.7	25.2	26.8	28.4	35.0	37.4	39.7	46.1	49.2	52.3	58.2	62.2	66.2			
	40	16.9	18.0	19.0	25.6	27.3	29.0	35.8	38.2	40.5	47.2	50.4	53.6	59.6	63.7	67.9			
160	0	13.7	14.5	15.3	20.6	21.9	23.2	28.5	30.4	32.3	37.5	40.0	42.5	47.2	50.4	53.6	57.6	61.6	65.6
	10	14.1	15.0	15.9	21.3	22.6	24.0	29.5	31.5	33.4	38.8	41.4	44.0	48.9	52.2	55.5	59.6	63.8	67.9
	20	14.6	15.5	16.4	22.0	23.4	24.8	30.5	32.5	34.5	40.1	42.8	45.4	50.5	54.0	57.4	61.7	65.9	70.2
	30	15.0	16.0	16.9	22.7	24.1	25.5	31.5	33.5	35.6	41.3	44.1	46.9	52.1	55.7	59.3	63.7	68.1	72.5
	40	15.3	16.2	17.2	23.1	24.5	26.0	32.1	34.2	36.3	42.3	45.1	48.0	53.4	57.0	60.7	65.2	69.8	74.3
140	0	12.2	13.0	13.7	18.3	19.4	20.6	25.3	26.9	28.6	33.1	35.3	37.4	41.5	44.3	47.1	50.6	54.0	57.5
	10	12.7	13.4	14.2	18.9	20.1	21.3	26.2	27.9	29.5	34.2	36.5	38.8	43.0	45.9	48.8	52.4	56.0	59.6
	20	13.1	13.9	14.6	19.6	20.8	22.0	27.0	28.8	30.5	35.4	37.7	40.1	44.4	47.4	50.5	54.1	57.8	61.6
	30	13.5	14.3	15.1	20.2	21.4	22.7	27.9	29.7	31.5	36.5	38.9	41.3	45.9	49.0	52.1	55.9	59.7	63.6
	40	13.7	14.5	15.3	20.5	21.8	23.1	28.4	30.3	32.1	37.3	39.8	42.2	46.9	50.1	53.3	57.2	61.2	65.1
120	0	10.8	11.5	12.1	16.0	17.0	18.0	22.0	23.4	24.8	28.6	30.5	32.3	35.7	38.1	40.5	43.3	46.2	49.1
	10	11.2	11.9	12.5	16.6	17.6	18.6	22.8	24.2	25.7	29.6	31.5	33.4	37.0	39.4	41.9	44.8	47.8	50.9
	20	11.6	12.2	12.9	17.1	18.2	19.3	23.5	25.0	26.5	30.6	32.6	34.6	38.2	40.7	43.3	46.3	49.4	52.6
	30	11.9	12.6	13.3	17.7	18.8	19.9	24.2	25.8	27.3	31.5	33.6	35.7	39.4	42.0	44.7	47.8	51.0	54.3
	40	12.1	12.8	13.5	18.0	19.1	20.2	24.7	26.3	27.9	32.2	34.3	36.4	40.3	43.0	45.7	48.9	52.2	55.6
100	0	9.4	10.0	10.5	13.8	14.6	15.5	18.7	19.8	21.0	24.0	25.5	27.1	29.7	31.6	33.6	35.7	38.0	40.4
	10	9.8	10.3	10.9	14.3	15.1	16.0	19.3	20.5	21.7	24.8	26.4	28.0	30.7	32.7	34.7	36.9	39.4	41.8
	20	10.1	10.7	11.2	14.7	15.6	16.5	20.0	21.2	22.5	25.7	27.3	29.0	31.7	33.8	35.9	38.2	40.7	43.2
	30	10.4	11.0	11.6	15.2	16.1	17.0	20.6	21.9	23.2	26.5	28.2	29.9	32.7	34.9	37.0	39.4	42.0	44.6
	40	10.5	11.1	11.7	15.4	16.4	17.3	20.9	22.3	23.6	27.0	28.7	30.5	33.4	35.6	37.8	40.2	42.9	45.6

***To correct for wind, enter table with the brakes on speed minus one half the headwind or plus 1.5 times the tailwind.**

If ground speed is used for brakes on speed, ignore wind, altitude, and OAT effects.

Adjusted Brake Energy Per Brake (Millions of Foot Pounds)

No Reverse Thrust

		REFERENCE BRAKE ENERGY PER BRAKE (MILLIONS OF FOOT POUNDS)											
EVENT		5	10	15	20	25	30	35	40	45	50	55	60
RTO MAX MAN		5.0	10.0	15.0	20.0	25.0	30.0	35.0	40.0	45.0	50.0	55.0	60.0
LANDING	MAX MAN	1.0	6.1	11.2	16.1	21.0	25.8	30.5	35.2	39.8	44.5	49.1	53.8
	MAX AUTO	1.7	6.1	10.4	14.7	18.9	23.1	27.3	31.5	35.8	40.0	44.3	48.7
	AUTOBRAKE 4	1.9	6.0	10.1	14.1	18.1	22.0	26.0	29.9	33.8	37.8	41.8	45.8
	AUTOBRAKE 3	1.8	5.7	9.5	13.2	17.0	20.7	24.3	28.0	31.6	35.3	39.0	42.8
	AUTOBRAKE 2	1.7	5.4	9.0	12.5	15.9	19.3	22.7	26.1	29.4	32.8	36.2	39.7
	AUTOBRAKE 1	1.7	5.0	8.2	11.3	14.4	17.4	20.3	23.3	26.2	29.1	32.1	35.0

ADVISORY INFORMATION

Recommended Brake Cooling Schedule

Two Engines Reverse Thrust

		REFERENCE BRAKE ENERGY PER BRAKE (MILLIONS OF FOOT POUNDS)											
EVENT		5	10	15	20	25	30	35	40	45	50	55	60
LANDING	MAX MAN	0.0	5.0	9.9	14.6	19.2	23.8	28.2	32.6	37.0	41.3	45.6	49.9
LANDING	MAX AUTO	0.2	3.7	7.3	10.8	14.3	17.9	21.5	25.1	28.7	32.4	36.2	40.0
LANDING	AUTOBRAKE 4	0.0	2.9	6.0	9.0	12.1	15.1	18.2	21.3	24.5	27.7	30.9	34.2
LANDING	AUTOBRAKE 3	0.0	1.8	4.3	6.9	9.5	12.1	14.8	17.4	20.1	23.9	25.7	28.6
LANDING	AUTOBRAKE 2	0.0	0.7	2.8	4.8	6.9	8.9	11.0	13.1	15.3	17.6	19.9	22.2
LANDING	AUTOBRAKE 1	0.0	0.4	1.8	3.2	4.6	6.0	7.5	9.0	10.5	12.1	13.8	15.5

Cooling Time (Minutes)

Category "C" and "D" Brakes

	ADJUSTED BRAKE ENERGY PER BRAKE (MILLIONS OF FOOT POUNDS)									
	14 & BELOW	15	16	18	20	24	28	34	35 TO 42	43 & ABOVE
	BRAKE TEMPERATURE MONITOR SYSTEM INDICATION ON EICAS									
	UP TO 1	1	1	2	2	3	4	5	5 TO 6	7 & ABOVE
INFLIGHT GEAR DOWN	NO SPECIAL PROCEDURE REQUIRED	1	1	2	2	3	4	6	CAUTION	FUSE PLUG MELT ZONE
GROUND		11	15	19	24	34	44	59		

Observe maximum quick turnaround limit.
Table shows energy per brake added by a single stop with all brakes operating. Energy is assumed to be equally distributed among the operating brakes. Total energy is the sum of residual energy plus energy added.
Add 1.0 million foot pounds per brake for each taxi mile.
For one brake deactivated, increase brake energy by 15 percent.
When in caution zone, wheel fuse plugs may melt. Delay takeoff and inspect after one hour. If overheat occurs after takeoff, extend gear soon for at least 6 minutes.
When in fuse plug melt zone, clear runway immediately. Unless required, do not set parking brake. Do not approach gear or attempt to taxi for one hour. Tire, wheel and brake replacement may be required.
If overheat occurs after takeoff, extend gear soon for at least 10 minutes.
Brake temperature monitor system (BTMS) indication on EICAS may be used 10 to 15 minutes after airplane has come to a complete stop, or inflight with gear retracted, to determine recommended cooling schedule.

ENGINE INOP

Initial Max Continuous %N1

Based on .80M, packs on or off and APU on

TAT (°C)	PRESSURE ALTITUDE (1000 FT)							
	29	31	33	35	37	39	41	43
20	103.8	103.4	102.5					
15	104.4	104.0	103.3	102.3	101.1	100.8	100.8	100.8
10	105.2	104.6	104.0	103.2	101.9	101.4	101.4	101.4
5	106.1	105.5	104.7	103.9	102.6	102.1	102.2	102.2
0	107.1	106.4	105.6	104.7	103.3	102.9	102.9	102.9
-5	106.9	107.5	106.6	105.7	104.3	103.9	103.9	103.9
-10	106.0	107.1	107.7	106.7	105.3	104.9	104.9	104.9
-15	105.1	106.2	107.1	107.8	106.5	106.2	106.2	106.2
-20	104.2	105.3	106.2	106.9	106.6	106.4	106.4	106.4
-25	103.2	104.3	105.3	105.8	105.8	105.6	105.6	105.6
-30	102.3	103.3	104.3	104.7	104.7	104.7	104.7	104.7
-35	101.3	102.4	103.3	103.6	103.6	103.6	103.6	103.6
-40	100.3	101.3	102.3	102.6	102.6	102.6	102.6	102.6

ENGINE INOP

Max Continuous %N1

37000 FT to 27000 FT Pressure Altitudes

Based on engine bleed for packs on or off and anti-ice off

37000 FT PRESS ALT		TAT (°C)												
KIAS	M	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10	15	20
200	.63	102.6	103.6	104.7	105.8	106.9	105.8	104.8	104.1	103.3	101.8	98.8	95.7	
220	.69	102.6	103.6	104.7	105.8	106.9	105.9	104.8	104.0	103.3	102.4	100.4	97.5	
240	.74	102.6	103.6	104.7	105.8	106.9	106.1	105.0	104.0	103.3	102.5	101.7	99.4	
260	.80	102.6	103.6	104.7	105.8	106.6	106.5	105.3	104.3	103.3	102.6	101.9	101.1	
35000 FT PRESS ALT		TAT (°C)												
KIAS	M	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10	15	20
200	.60	102.6	103.6	104.7	105.8	106.9	107.2	106.2	105.5	104.7	103.2	100.2	97.1	
220	.66	102.6	103.6	104.7	105.8	106.9	107.3	106.2	105.4	104.7	103.8	101.8	98.8	
240	.71	102.6	103.6	104.7	105.8	106.9	107.5	106.4	105.3	104.6	104.0	102.9	100.5	
260	.77	102.6	103.6	104.7	105.8	106.9	107.7	106.6	105.6	104.5	103.9	103.2	102.1	
33000 FT PRESS ALT		TAT (°C)												
KIAS	M	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10	15	20
200	.58	102.6	103.6	104.7	105.8	106.9	107.9	107.2	106.5	105.8	104.9	102.6	99.6	
220	.63	102.6	103.6	104.7	105.8	106.9	107.9	107.3	106.3	105.7	105.0	104.1	101.2	
240	.68	102.6	103.6	104.7	105.8	106.9	107.9	107.4	106.4	105.5	104.9	104.1	102.7	
260	.74	102.6	103.6	104.7	105.8	106.9	107.9	107.4	106.5	105.5	104.7	104.1	103.3	
31000 FT PRESS ALT		TAT (°C)												
KIAS	M	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10	15	20
200	.55	102.6	103.6	104.7	105.8	106.8	107.9	108.1	107.2	106.6	106.0	105.0	102.0	
220	.61	102.6	103.6	104.7	105.8	106.9	107.9	108.2	107.3	106.6	106.0	105.3	103.5	
240	.66	102.6	103.6	104.7	105.8	106.9	107.9	108.2	107.3	106.4	105.7	105.1	104.4	
260	.71	102.6	103.6	104.7	105.8	106.9	107.9	108.3	107.3	106.4	105.5	104.9	104.3	
29000 FT PRESS ALT		TAT (°C)												
KIAS	M	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10	15	20
200	.53	102.6	103.6	104.7	105.8	106.8	107.9	108.4	107.5	106.8	106.1	105.5	103.6	100.7
220	.58	102.6	103.6	104.7	105.8	106.9	107.9	108.5	107.7	106.7	106.1	105.5	104.9	102.1
240	.63	102.6	103.6	104.7	105.8	106.9	107.9	108.7	107.7	106.8	106.0	105.4	104.8	103.5
260	.68	102.6	103.6	104.7	105.8	106.9	107.9	108.8	107.7	106.8	105.9	105.3	104.7	104.0
27000 FT PRESS ALT		TAT (°C)												
KIAS	M	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10	15	20
200	.51	102.6	103.6	104.7	105.8	106.8	107.9	108.2	107.2	106.3	105.6	104.8	104.1	101.4
220	.56	102.6	103.6	104.7	105.8	106.8	107.9	108.4	107.4	106.4	105.6	104.9	104.2	102.7
240	.60	102.6	103.6	104.7	105.8	106.9	107.9	108.6	107.6	106.7	105.7	105.0	104.3	103.6
260	.65	102.2	103.2	104.2	105.1	106.1	107.0	107.9	107.8	106.8	105.9	105.0	104.3	103.6

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESSURE ALTITUDE (1000 FT)					
	27	29	31	33	35	37
ENGINE ANTI-ICE ON	-0.8	-0.9	-1.0	-1.1	-1.2	-1.4
ENGINE & WING ANTI-ICE ON	-1.7	-1.9	-2.1	-2.3	-2.5	-2.9

ENGINE INOP

Max Continuous %N1

25000 FT to 16000 FT Pressure Altitudes

Based on engine bleed for packs on or off and anti-ice off

25000 FT PRESS ALT		TAT (°C)														
KIAS	M	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10	15	20	25	30
200	.49	102.6	103.6	104.7	105.8	106.8	107.8	107.8	106.9	105.9	104.9	104.1	103.3	101.8	99.0	
220	.53	102.3	103.3	104.3	105.3	106.2	107.1	107.9	107.1	106.1	105.0	104.2	103.4	102.7	100.3	
240	.58	101.6	102.6	103.6	104.5	105.5	106.4	107.2	107.2	106.3	105.3	104.3	103.6	102.8	101.5	
260	.63	100.8	101.8	102.8	103.8	104.7	105.6	106.5	107.3	106.6	105.6	104.6	103.8	103.0	102.2	
24000 FT PRESS ALT		TAT (°C)														
KIAS	M	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10	15	20	25	30
200	.48	102.6	103.6	104.7	105.8	106.8	107.9	108.4	107.6	106.6	105.6	104.9	104.1	103.2	100.5	
220	.52	102.3	103.3	104.3	105.3	106.2	107.2	108.0	107.7	106.8	105.8	104.9	104.1	103.4	101.6	
240	.57	101.6	102.6	103.6	104.5	105.5	106.4	107.3	107.8	107.0	106.0	105.0	104.2	103.5	102.7	
260	.61	100.8	101.8	102.8	103.7	104.7	105.6	106.5	107.4	107.1	106.2	105.2	104.4	103.6	102.8	
22000 FT PRESS ALT		TAT (°C)														
KIAS	M	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10	15	20	25	30
200	.46	102.6	103.6	104.7	105.8	106.8	107.9	108.9	109.8	108.9	107.9	106.9	106.1	105.2	103.7	
220	.50	102.6	103.6	104.7	105.8	106.8	107.9	108.9	109.8	109.0	108.0	107.0	106.1	105.3	104.4	
240	.55	102.6	103.6	104.7	105.7	106.6	107.6	108.5	109.4	109.2	108.2	107.2	106.3	105.4	104.6	
260	.59	102.0	103.0	104.0	105.0	105.9	106.9	107.8	108.7	109.3	108.5	107.5	106.5	105.6	104.8	
20000 FT PRESS ALT		TAT (°C)														
KIAS	M	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10	15	20	25	30
200	.44	102.6	103.6	104.7	105.8	106.8	107.9	108.9	109.9	110.8	109.8	108.8	107.9	106.9	106.1	104.0
220	.48	102.6	103.6	104.7	105.8	106.8	107.9	108.9	109.9	110.8	109.9	108.9	108.0	107.0	106.1	104.8
240	.53	102.6	103.6	104.7	105.8	106.8	107.9	108.9	109.9	110.8	110.1	109.1	108.1	107.2	106.2	105.4
260	.57	102.4	103.4	104.4	105.4	106.4	107.4	108.3	109.3	110.2	110.1	109.3	108.3	107.4	106.4	105.6
18000 FT PRESS ALT		TAT (°C)														
KIAS	M	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10	15	20	25	30
200	.42	102.6	103.6	104.7	105.8	106.8	107.9	108.9	109.9	110.9	110.4	109.4	108.4	107.5	106.7	105.6
220	.46	102.6	103.6	104.7	105.8	106.8	107.9	108.9	109.9	110.9	110.3	109.3	108.3	107.4	106.6	105.7
240	.51	102.3	103.3	104.3	105.3	106.3	107.2	108.2	109.1	110.1	110.2	109.4	108.4	107.4	106.6	105.7
260	.55	101.6	102.6	103.6	104.6	105.6	106.6	107.5	108.5	109.4	110.3	109.5	108.6	107.6	106.7	105.8
16000 FT PRESS ALT		TAT (°C)														
KIAS	M	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10	15	20	25	30
200	.41	100.9	102.0	103.0	104.1	105.1	106.2	107.2	108.2	109.1	110.1	109.5	108.6	107.7	106.9	106.1
220	.45	100.6	101.7	102.7	103.7	104.8	105.8	106.8	107.8	108.8	109.8	109.4	108.5	107.6	106.8	105.9
240	.49	100.3	101.3	102.3	103.4	104.4	105.4	106.4	107.4	108.4	109.4	109.4	108.5	107.5	106.7	105.9
260	.53	99.9	101.0	102.0	103.0	104.0	105.0	106.1	107.1	108.0	109.0	109.5	108.6	107.7	106.8	106.0

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESSURE ALTITUDE (1000 FT)					
	16	18	20	22	24	25
ENGINE ANTI-ICE ON	-0.4	-0.4	-0.5	-0.6	-0.7	-0.7
ENGINE & WING ANTI-ICE ON	-1.1	-1.1	-1.2	-1.4	-1.5	-1.5

ENGINE INOP

Max Continuous %N1

14000 FT to 5000 FT Pressure Altitudes

Based on engine bleed for packs on or off and anti-ice off

14000 FT PRESS ALT		TAT (°C)														
KIAS	M	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10	15	20	25	30
200	.39	101.1	102.1	103.1	104.2	105.2	106.3	107.3	108.3	109.3	110.2	109.4	108.5	107.6	106.8	106.1
220	.43	100.8	101.8	102.8	103.9	104.8	105.8	106.8	107.7	108.6	109.6	109.4	108.4	107.6	106.7	106.0
240	.47	100.2	101.2	102.2	103.2	104.1	105.1	106.0	107.0	107.9	108.9	109.4	108.4	107.5	106.6	105.9
260	.51	99.5	100.5	101.5	102.5	103.4	104.4	105.3	106.2	107.2	108.1	109.1	108.4	107.5	106.7	105.9
12000 FT PRESS ALT		TAT (°C)														
KIAS	M	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10	15	20	25	30
200	.38	100.0	101.0	101.9	102.9	103.9	104.8	105.8	106.7	107.7	108.6	109.2	108.2	107.4	106.6	105.8
220	.41	99.4	100.4	101.4	102.4	103.4	104.3	105.3	106.2	107.1	108.1	109.0	108.3	107.4	106.6	105.8
240	.45	98.9	99.9	100.9	101.9	102.8	103.8	104.7	105.6	106.6	107.5	108.4	108.4	107.5	106.7	105.9
260	.49	98.4	99.4	100.3	101.3	102.3	103.2	104.1	105.1	106.0	106.9	107.8	108.5	107.6	106.8	105.9
10000 FT PRESS ALT		TAT (°C)														
KIAS	M	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10	15	20	25	30
200	.36	98.2	99.2	100.2	101.2	102.1	103.1	104.0	104.9	105.8	106.8	107.7	107.8	107.0	106.2	105.4
220	.40	97.7	98.7	99.7	100.7	101.6	102.6	103.5	104.4	105.4	106.3	107.2	107.8	107.0	106.2	105.4
240	.43	97.4	98.4	99.3	100.3	101.3	102.2	103.1	104.1	105.0	105.9	106.8	107.7	107.2	106.4	105.6
260	.47	97.0	98.0	99.0	99.9	100.9	101.8	102.7	103.7	104.6	105.5	106.4	107.3	107.4	106.6	105.8
5000 FT PRESS ALT		TAT (°C)														
KIAS	M	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10	15	20	25	30
200	.33	95.5	96.5	97.5	98.4	99.4	100.3	101.2	102.1	103.1	104.0	104.8	105.7	106.6	106.4	105.7
220	.36	95.1	96.1	97.1	98.0	99.0	99.9	100.8	101.7	102.7	103.6	104.4	105.3	106.2	106.4	105.7
240	.40	94.7	95.7	96.7	97.6	98.6	99.5	100.4	101.3	102.2	103.1	104.0	104.9	105.8	106.4	105.7
260	.43	94.4	95.4	96.4	97.3	98.3	99.2	100.1	101.0	101.9	102.8	103.7	104.6	105.5	106.3	105.9

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESSURE ALTITUDE (1000 FT)			
	5	10	12	14
ENGINE ANTI-ICE ON	-0.6	-0.5	-0.5	-0.6
ENGINE & WING ANTI-ICE ON	-1.2	-1.1	-1.2	-1.2

ENGINE INOP

MAX CONTINUOUS THRUST

Driftdown Speed/Level Off Altitude

100 ft/min residual rate of climb

WEIGHT (1000 KG)		OPTIMUM DRIFTDOWN SPEED (KIAS)	LEVEL OFF ALTITUDE (FT)		
START DRIFT DOWN	LEVEL OFF		ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
190	184	278	19900	18900	17400
180	175	270	21100	20400	19400
170	165	263	22400	21600	20800
160	155	255	23700	22900	22000
150	145	247	25100	24300	23300
140	135	239	26700	26100	24700
130	126	231	28400	28100	27100
120	116	222	30200	30200	29600
110	107	213	32000	32000	31600
100	97	203	34000	33900	33700

Includes APU fuel burn.

ENGINE INOP

MAX CONTINUOUS THRUST

Driftdown/LRC Cruise Range Capability

Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
272	254	237	223	211	200	189	180	172	164	158
545	508	476	447	422	400	379	361	344	329	315
818	762	714	671	633	600	569	542	517	494	473
1091	1017	952	895	845	800	759	722	689	659	631
1364	1272	1191	1119	1056	1000	949	903	861	823	789
1639	1527	1429	1344	1267	1200	1138	1083	1033	988	946
1913	1782	1668	1568	1479	1400	1328	1264	1205	1152	1103
2188	2038	1907	1792	1690	1600	1518	1444	1377	1316	1260
2464	2294	2147	2017	1902	1800	1707	1624	1549	1480	1417

Driftdown/Cruise Fuel and Time

AIR DIST (NM)	FUEL REQUIRED (1000 KG)										TIME (HR:MIN)
	WEIGHT AT START OF DRIFTDOWN (1000 KG)										
	100	110	120	130	140	150	160	170	180	190	
200	1.5	1.6	1.7	1.9	2.0	2.1	2.3	2.3	2.5	2.6	0:32
400	3.2	3.5	3.8	4.1	4.4	4.7	5.0	5.2	5.5	5.8	1:04
600	4.9	5.3	5.8	6.3	6.7	7.1	7.6	7.9	8.4	8.9	1:36
800	6.5	7.1	7.7	8.3	8.9	9.5	10.1	10.6	11.2	11.8	2:08
1000	8.1	8.9	9.6	10.4	11.1	11.8	12.6	13.2	14.0	14.7	2:40
1200	9.7	10.6	11.5	12.4	13.3	14.1	15.0	15.8	16.7	17.6	3:13
1400	11.3	12.3	13.3	14.4	15.4	16.4	17.4	18.4	19.4	20.5	3:45
1600	12.8	14.0	15.2	16.4	17.5	18.7	19.8	20.9	22.1	23.3	4:18
1800	14.3	15.6	17.0	18.3	19.6	20.9	22.2	23.4	24.7	26.0	4:51

Includes APU fuel burn.
Driftdown at optimum driftdown speed and cruise at Long Range Cruise speed.

ENGINE INOP

MAX CONTINUOUS THRUST

Long Range Cruise Altitude Capability

100 ft/min residual rate of climb

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
190	17800	16200	13700
185	18700	17200	14800
180	19500	18200	15900
175	20300	19200	17100
170	20900	20100	18300
165	21600	20700	19600
160	22200	21400	20400
155	22900	22000	21000
150	23600	22700	21700
145	24300	23400	22300
140	25000	24100	23000
135	25900	24900	23700
130	26900	26000	24400
125	27900	27200	25300
120	28900	28400	26900
115	29900	29700	28400
110	30800	30700	30000
105	31800	31700	31100
100	32800	32700	32200

With engine anti-ice on, decrease altitude capability by 1400 ft.
With engine and wing anti-ice on, decrease altitude capability by 2900 ft.

ENGINE INOP

MAX CONTINUOUS THRUST

Long Range Cruise Control

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT)								
		10	14	18	21	23	25	27	29	31
190	%N1	96.4	99.8	104.2						
	MACH	.554	.587	.625						
	KIAS	308	303	299						
	FF/ENG	5791	5827	5977						
180	%N1	94.8	98.2	102.2						
	MACH	.543	.576	.612						
	KIAS	301	297	292						
	FF/ENG	5465	5488	5597						
170	%N1	93.3	96.6	100.2	103.8					
	MACH	.531	.564	.599	.628					
	KIAS	294	291	286	283					
	FF/ENG	5142	5170	5231	5349					
160	%N1	91.5	94.8	98.3	101.5	104.2				
	MACH	.517	.551	.585	.614	.634				
	KIAS	286	284	279	276	274				
	FF/ENG	4813	4842	4873	4961	5060				
150	%N1	89.8	93.0	96.4	99.3	101.5				
	MACH	.503	.538	.572	.599	.618				
	KIAS	279	276	272	269	267				
	FF/ENG	4500	4522	4540	4594	4659				
140	%N1	87.9	91.1	94.4	97.1	99.2	101.6			
	MACH	.489	.522	.558	.583	.603	.623			
	KIAS	271	268	265	262	260	258			
	FF/ENG	4189	4195	4221	4241	4286	4356			
130	%N1	85.8	89.0	92.3	94.9	96.8	98.9	101.5		
	MACH	.474	.506	.542	.568	.586	.606	.626		
	KIAS	262	260	258	255	253	251	249		
	FF/ENG	3883	3878	3898	3915	3932	3975	4049		
120	%N1	83.7	86.9	90.2	92.7	94.4	96.3	98.5	101.2	
	MACH	.459	.490	.524	.551	.569	.587	.607	.628	
	KIAS	254	251	249	247	245	243	241	239	
	FF/ENG	3586	3569	3578	3593	3606	3621	3664	3736	
110	%N1	81.5	84.5	87.8	90.3	92.0	93.8	95.7	97.9	100.8
	MACH	.442	.473	.505	.533	.551	.569	.588	.608	.629
	KIAS	244	242	240	238	237	235	233	231	229
	FF/ENG	3290	3266	3262	3276	3285	3296	3309	3350	3417
100	%N1	78.6	82.1	85.3	87.7	89.4	91.1	92.9	94.9	97.1
	MACH	.423	.454	.486	.511	.530	.549	.568	.586	.607
	KIAS	234	233	230	229	228	226	225	222	221
	FF/ENG	2985	2971	2955	2955	2967	2976	2986	2997	3035

ENGINE INOP

MAX CONTINUOUS THRUST

Long Range Cruise Diversion Fuel and Time

Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
293	268	247	229	214	200	190	180	172	164	158
589	539	496	459	428	400	380	362	345	330	316
886	811	745	689	642	600	570	542	517	494	474
1184	1083	994	920	856	800	760	723	690	659	632
1483	1356	1244	1151	1071	1000	950	904	861	823	789
1784	1630	1495	1382	1286	1200	1140	1084	1033	987	946
2085	1905	1746	1614	1501	1400	1329	1264	1205	1151	1103
2389	2181	1998	1846	1716	1600	1519	1445	1377	1315	1260
2693	2457	2250	2077	1931	1800	1708	1624	1548	1479	1417

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		18		22		26	
	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)
200	2.5	0:43	2.2	0:41	2.0	0:40	1.8	0:38	1.6	0:37
400	5.2	1:21	4.7	1:18	4.4	1:15	4.1	1:12	3.9	1:09
600	7.8	2:01	7.3	1:55	6.8	1:50	6.5	1:45	6.2	1:41
800	10.5	2:40	9.8	2:33	9.2	2:25	8.8	2:19	8.5	2:13
1000	13.1	3:20	12.3	3:10	11.6	3:01	11.0	2:53	10.7	2:46
1200	15.6	4:00	14.7	3:48	13.9	3:37	13.3	3:28	12.9	3:18
1400	18.2	4:40	17.1	4:27	16.2	4:14	15.5	4:02	15.0	3:51
1600	20.7	5:21	19.5	5:06	18.5	4:50	17.7	4:37	17.2	4:24
1800	23.2	6:02	21.9	5:45	20.8	5:27	19.9	5:12	19.3	4:58

Fuel Required Adjustment (1000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)								
	100	110	120	130	140	150	160	170	180
2	-0.3	-0.2	-0.1	-0.1	0.0	0.1	0.2	0.3	0.4
4	-0.6	-0.5	-0.3	-0.2	0.0	0.2	0.4	0.7	0.9
6	-0.9	-0.7	-0.5	-0.2	0.0	0.3	0.7	1.1	1.5
8	-1.3	-1.0	-0.6	-0.3	0.0	0.5	1.0	1.5	2.0
10	-1.6	-1.2	-0.8	-0.4	0.0	0.6	1.2	1.9	2.6
12	-2.0	-1.5	-1.0	-0.5	0.0	0.7	1.5	2.3	3.1
14	-2.3	-1.7	-1.1	-0.6	0.0	0.8	1.7	2.7	3.6
16	-2.6	-2.0	-1.3	-0.7	0.0	1.0	2.0	3.1	4.1
18	-3.0	-2.2	-1.5	-0.7	0.0	1.1	2.2	3.4	4.7
20	-3.3	-2.5	-1.6	-0.8	0.0	1.2	2.5	3.8	5.2
22	-3.7	-2.7	-1.8	-0.9	0.0	1.3	2.7	4.2	5.7
24	-4.0	-3.0	-2.0	-1.0	0.0	1.4	3.0	4.5	6.2

Includes APU fuel burn.

ENGINE INOP

MAX CONTINUOUS THRUST

Holding

Flaps Up

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)						
		1500	5000	10000	15000	20000	25000	30000
190	%N1	85.2	88.3	92.7	97.7	104.2		
	KIAS	259	259	259	259	259		
	FF/ENG	5090	5110	5190	5350	5680		
180	%N1	83.6	86.6	91.0	95.9	101.7		
	KIAS	251	251	251	251	251		
	FF/ENG	4790	4810	4870	5000	5250		
170	%N1	81.8	84.8	89.2	93.9	99.4		
	KIAS	244	244	244	244	244		
	FF/ENG	4510	4520	4560	4670	4870		
160	%N1	79.7	83.0	87.4	91.9	97.2		
	KIAS	236	236	236	236	236		
	FF/ENG	4230	4230	4260	4330	4490		
150	%N1	77.7	81.0	85.4	89.9	95.0	101.4	
	KIAS	228	228	228	228	228	228	
	FF/ENG	3950	3950	3960	4010	4130	4380	
140	%N1	75.7	78.8	83.4	87.9	92.7	98.5	
	KIAS	222	222	222	222	222	222	
	FF/ENG	3690	3680	3680	3720	3810	3990	
130	%N1	73.7	76.7	81.4	85.9	90.5	95.9	
	KIAS	217	217	217	217	217	217	
	FF/ENG	3440	3420	3420	3440	3510	3650	
120	%N1	71.2	74.5	79.1	83.7	88.2	93.3	100.0
	KIAS	211	211	211	211	211	211	211
	FF/ENG	3190	3170	3170	3180	3220	3320	3530
110	%N1	68.8	72.2	76.7	81.4	85.9	90.8	96.5
	KIAS	205	205	205	205	205	205	205
	FF/ENG	2950	2930	2920	2920	2950	3020	3160
100	%N1	66.4	69.5	74.2	79.0	83.5	88.1	93.4
	KIAS	199	199	199	199	199	199	199
	FF/ENG	2710	2690	2680	2670	2690	2730	2830

This table includes 5% additional fuel for holding in a racetrack pattern.

GEAR DOWN

200 KIAS Max Climb %N1

Based on engine bleed for packs on and anti-ice off

TAT (°C)	PRESSURE ALTITUDE (1000 FT)												
	0	5	10	12	14	16	18	20	22	24	26	28	30
55	96.7	97.4	97.0	97.0	96.6	96.7	97.0	97.1	96.1	95.2	96.3	98.2	99.9
50	97.2	98.3	98.1	98.1	97.8	97.9	98.3	98.3	97.3	96.2	96.2	97.5	99.2
45	97.9	98.8	99.1	99.1	98.9	99.0	99.5	99.5	98.5	97.4	97.4	98.1	98.8
40	98.5	99.3	99.9	100.1	99.9	100.2	100.6	100.7	99.6	98.6	98.5	99.3	99.9
35	99.1	100.0	100.4	100.7	100.9	101.2	101.7	101.8	100.7	99.7	99.6	100.4	101.0
30	99.6	100.6	101.1	101.2	101.4	102.1	102.8	102.9	101.8	100.8	100.7	101.4	102.1
25	98.7	101.4	101.7	101.9	102.0	102.6	103.5	103.9	102.9	101.8	101.7	102.5	103.1
20	97.9	101.9	102.5	102.6	102.7	103.3	104.1	104.6	103.7	102.8	102.7	103.4	104.1
15	97.1	101.0	103.5	103.4	103.4	104.0	104.9	105.3	104.5	103.6	103.6	104.4	105.0
10	96.3	100.2	103.6	104.4	104.2	104.8	105.7	106.2	105.3	104.5	104.4	105.2	105.9
5	95.5	99.3	102.7	103.9	104.9	105.6	106.5	107.0	106.2	105.4	105.3	105.9	106.6
0	94.7	98.4	101.8	103.0	104.0	105.6	107.3	107.8	107.2	106.3	106.2	106.7	107.2
-5	93.8	97.5	100.9	102.1	103.0	104.7	106.7	108.3	108.2	107.6	107.1	107.5	108.0
-10	93.0	96.6	100.0	101.2	102.2	103.7	105.8	107.3	108.2	108.5	108.5	108.5	108.5
-15	92.1	95.7	99.1	100.3	101.2	102.8	104.8	106.4	107.3	107.5	107.5	107.5	107.5
-20	91.3	94.8	98.2	99.3	100.3	102.0	103.9	105.5	106.3	106.5	106.5	106.5	106.5
-25	90.4	93.9	97.3	98.4	99.4	101.0	103.0	104.6	105.4	105.4	105.4	105.4	105.4
-30	89.5	93.0	96.4	97.5	98.5	100.0	102.0	103.7	104.4	104.4	104.4	104.4	104.4
-35	88.6	92.0	95.4	96.5	97.5	99.0	101.1	102.7	103.3	103.3	103.3	103.3	103.3
-40	87.7	91.1	94.5	95.6	96.5	98.1	100.1	101.8	102.2	102.2	102.2	102.2	102.2

%N1 Adjustments for Engine Bleeds

BLEED CONFIGURATION	PRESSURE ALTITUDE (1000 FT)												
	0	5	10	12	14	16	18	20	22	24	26	28	30
PACKS OFF	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINE ANTI-ICE ON	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.7	-0.8	-0.8	-0.9	-1.0	-1.0	-1.1
ENGINE & WING ANTI-ICE ON	-0.9	-0.9	-1.0	-1.0	-1.1	-1.1	-1.2	-1.3	-1.3	-1.4	-1.5	-1.5	-1.7

GEAR DOWN

Long Range Cruise Altitude Capability

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
190	21200	19700	17900
185	22200	20700	19100
180	23200	21600	20200
175	24300	22500	21100
170	25400	23500	22000
165	26400	24400	23000
160	27300	25600	23900
155	28000	26900	24900
150	28800	28200	26300
145	29700	29500	27800
140	30400	30400	29300
135	31200	31200	30500
130	32000	32000	31400
125	32800	32800	32300
120	33700	33600	33300
115	34500	34500	34200
110	35400	35400	35200
105	36300	36300	36100
100	37200	37100	37000

GEAR DOWN

Long Range Cruise Control

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT)										
		10	14	18	21	23	25	27	29	31	33	35
190	%N1	90.5	93.9	97.7	101.1							
	MACH	.472	.508	.546	.577							
	KIAS	261	261	260	259							
	FF/ENG	4585	4622	4709	4821							
180	%N1	89.0	92.3	96.0	99.1	101.6						
	MACH	.461	.495	.534	.563	.584						
	KIAS	255	254	254	253	252						
	FF/ENG	4323	4348	4419	4492	4574						
170	%N1	87.4	90.7	94.2	97.1	99.4	102.0					
	MACH	.449	.483	.520	.550	.571	.591					
	KIAS	248	248	247	246	246	244					
	FF/ENG	4071	4081	4124	4190	4256	4322					
160	%N1	85.7	88.8	92.3	95.2	97.2	99.6	102.4				
	MACH	.437	.469	.506	.536	.555	.577	.596				
	KIAS	241	240	240	240	239	238	236				
	FF/ENG	3822	3813	3844	3901	3938	4011	4071				
150	%N1	83.8	87.1	90.5	93.2	95.1	97.2	99.8	102.9			
	MACH	.424	.456	.491	.520	.540	.561	.583	.602			
	KIAS	234	233	233	232	232	231	231	229			
	FF/ENG	3574	3558	3576	3608	3650	3688	3761	3822			
140	%N1	81.9	85.2	88.4	91.1	93.0	95.0	97.2	99.8	103.2		
	MACH	.411	.442	.476	.504	.524	.544	.565	.587	.607		
	KIAS	227	226	225	225	225	224	224	223	221		
	FF/ENG	3326	3311	3312	3331	3361	3398	3442	3506	3572		
130	%N1	80.0	83.1	86.3	89.0	90.7	92.7	94.7	97.0	99.7		
	MACH	.398	.427	.460	.487	.506	.527	.548	.570	.591		
	KIAS	220	219	218	217	217	217	216	216	214		
	FF/ENG	3100	3066	3053	3068	3081	3112	3144	3194	3248		
120	%N1	77.7	80.9	84.2	86.6	88.4	90.2	92.2	94.2	96.6	99.4	
	MACH	.385	.411	.443	.469	.488	.508	.529	.550	.572	.593	
	KIAS	212	210	210	209	209	209	209	208	207	206	
	FF/ENG	2880	2820	2808	2805	2818	2830	2860	2890	2943	2987	
110	%N1	75.2	78.6	81.8	84.3	85.9	87.8	89.6	91.6	93.6	96.1	99.0
	MACH	.369	.396	.426	.451	.469	.488	.508	.529	.551	.574	.595
	KIAS	203	203	201	201	200	200	200	200	199	199	197
	FF/ENG	2642	2598	2567	2558	2557	2568	2579	2607	2638	2688	2729
100	%N1	72.7	75.9	79.2	81.7	83.4	85.0	86.9	88.7	90.7	92.8	95.3
	MACH	.353	.380	.408	.432	.449	.467	.487	.507	.528	.550	.574
	KIAS	195	194	192	192	192	191	191	191	191	190	190
	FF/ENG	2414	2378	2327	2317	2311	2310	2318	2329	2355	2386	2434

GEAR DOWN

Long Range Cruise Enroute Fuel and Time

Ground to Air Miles Conversion

AIR DISTANCE (NM) HEADWIND COMPONENT (KTS) 100	80	60	40	20	GROUND DISTANCE (NM)	AIR DISTANCE (NM) TAILWIND COMPONENT (KTS) 20	40	60	80	100
322	288	259	236	217	200	189	179	170	161	154
650	580	520	473	434	400	378	357	339	323	308
981	875	784	711	652	600	567	536	509	484	462
1316	1172	1048	950	870	800	755	714	677	644	615
1655	1472	1315	1190	1089	1000	944	893	846	805	768
1998	1774	1583	1431	1308	1200	1132	1071	1015	965	921
2346	2080	1852	1673	1527	1400	1320	1248	1182	1124	1072
2699	2389	2124	1915	1747	1600	1509	1426	1350	1283	1224
3056	2700	2397	2159	1967	1800	1697	1603	1518	1442	1375
3419	3016	2672	2404	2188	2000	1884	1779	1684	1599	1525

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT) 10 FUEL (1000 KG)	10 TIME (HR:MIN)	14 FUEL (1000 KG)	14 TIME (HR:MIN)	18 FUEL (1000 KG)	18 TIME (HR:MIN)	22 FUEL (1000 KG)	22 TIME (HR:MIN)	28 FUEL (1000 KG)	28 TIME (HR:MIN)
200	4.6	0:49	4.2	0:47	3.8	0:45	3.5	0:44	3.1	0:41
400	9.6	1:36	8.9	1:32	8.2	1:27	7.7	1:23	7.1	1:17
600	14.4	2:24	13.4	2:16	12.5	2:09	11.8	2:03	10.9	1:53
800	19.2	3:12	17.9	3:02	16.7	2:52	15.8	2:43	14.7	2:30
1000	23.9	4:01	22.2	3:49	20.9	3:36	19.7	3:24	18.4	3:07
1200	28.4	4:51	26.5	4:36	24.9	4:20	23.5	4:05	22.0	3:44
1400	32.9	5:43	30.7	5:24	28.9	5:05	27.3	4:47	25.5	4:22
1600	37.3	6:35	34.9	6:12	32.8	5:51	30.9	5:30	28.9	5:01
1800	41.6	7:28	38.9	7:02	36.6	6:37	34.5	6:13	32.3	5:40
2000	45.8	8:22	42.9	7:52	40.3	7:24	38.1	6:57	35.6	6:20

Fuel Required Adjustment (1000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG) 100	120	140	160	180
5	-0.7	-0.3	0.0	0.6	1.2
10	-1.5	-0.7	0.0	1.2	2.5
15	-2.3	-1.1	0.0	1.8	3.7
20	-3.1	-1.5	0.0	2.3	4.9
25	-3.9	-1.9	0.0	2.9	6.1
30	-4.7	-2.3	0.0	3.5	7.2
35	-5.5	-2.7	0.0	4.0	8.3
40	-6.3	-3.1	0.0	4.5	9.4
45	-7.0	-3.5	0.0	5.0	10.4
50	-7.8	-3.9	0.0	5.5	11.4

Descent at VREF30 + 70

PRESSURE ALTITUDE (1000 FT)	5	10	15	17	19	21	23	25	27	29	31	33	35
DISTANCE (NM)	17	27	37	41	45	49	54	58	62	66	71	75	79
TIME (MINUTES)	7	9	12	12	13	14	15	16	16	17	18	19	19

GEAR DOWN

Holding

Flaps Up

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)						
		1500	5000	10000	15000	20000	25000	30000
190	%N1	81.7	84.5	88.7	93.1	98.1		
	KIAS	249	249	249	249	249		
	FF/ENG	4500	4480	4490	4540	4690		
180	%N1	79.8	82.9	87.0	91.3	96.1		
	KIAS	241	241	241	241	241		
	FF/ENG	4240	4210	4200	4240	4350		
170	%N1	78.0	81.1	85.3	89.5	94.2	100.0	
	KIAS	234	234	234	234	234	234	
	FF/ENG	4000	3970	3950	3970	4050	4240	
160	%N1	76.1	79.0	83.3	87.6	92.1	97.5	
	KIAS	226	226	226	226	226	226	
	FF/ENG	3740	3710	3680	3690	3740	3880	
150	%N1	74.1	76.9	81.3	85.6	90.0	95.0	102.5
	KIAS	218	218	218	218	218	218	218
	FF/ENG	3480	3450	3420	3410	3450	3540	3790
140	%N1	72.1	75.1	79.5	83.7	88.1	92.9	99.2
	KIAS	212	212	212	212	212	212	212
	FF/ENG	3270	3240	3200	3190	3210	3270	3450
130	%N1	70.2	73.4	77.6	81.9	86.3	90.9	96.5
	KIAS	207	207	207	207	207	207	207
	FF/ENG	3080	3050	3010	2980	2990	3040	3170
120	%N1	68.2	71.3	75.6	80.1	84.4	88.8	94.0
	KIAS	201	201	201	201	201	201	201
	FF/ENG	2880	2850	2810	2780	2780	2810	2900
110	%N1	66.3	69.2	73.6	78.1	82.4	86.8	91.7
	KIAS	195	195	195	195	195	195	195
	FF/ENG	2700	2660	2620	2590	2580	2590	2660
100	%N1	64.2	67.0	71.5	75.7	80.2	84.6	89.3
	KIAS	189	189	189	189	189	189	189
	FF/ENG	2510	2480	2440	2400	2380	2380	2420

This table includes 5% additional fuel for holding in a racetrack pattern.

Intentionally
Blank

Performance Inflight — Chapter PI
Gear Down, Engine Inop — Section 15

GEAR DOWN
ENGINE INOP

MAX CONTINUOUS THRUST

Initial Max Continuous %N1
29000 FT to 10000 FT Pressure Altitudes
Based on engine bleed for packs on or off and anti-ice off

29000 FT PRESS ALT	TAT (°C)											
MACH	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10	15
0.6	102.6	103.6	104.7	105.8	106.8	107.9	108.6	107.7	106.8	106.1	105.5	104.9
0.5	102.6	103.6	104.7	105.8	106.8	107.9	108.4	107.4	106.8	106.1	105.5	102.8
0.4	102.6	103.6	104.7	105.8	106.8	107.9	108.2	107.5	106.8	106.2	103.6	100.5
27000 FT PRESS ALT	TAT (°C)											
MACH	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10	15
0.6	102.6	103.6	104.7	105.8	106.8	107.9	108.6	107.6	106.7	105.7	105.0	104.3
0.5	102.6	103.6	104.7	105.8	106.8	107.9	108.2	107.2	106.3	105.6	104.8	104.0
0.4	102.6	103.6	104.7	105.8	106.8	107.9	108.0	107.0	106.3	105.6	104.7	101.8
25000 FT PRESS ALT	TAT (°C)											
MACH	-35	-30	-25	-20	-15	-10	-5	0	5	10	15	20
0.6	102.3	103.2	104.2	105.2	106.1	106.9	107.3	106.4	105.4	104.4	103.6	102.9
0.5	103.6	104.7	105.8	106.8	107.6	107.8	106.9	105.9	104.9	104.1	103.4	102.1
0.4	103.6	104.7	105.8	106.8	107.9	107.7	106.7	105.7	104.9	104.1	102.8	100.0
23000 FT PRESS ALT	TAT (°C)											
MACH	-30	-25	-20	-15	-10	-5	0	5	10	15	20	25
0.6	103.2	104.2	105.2	106.1	107.0	107.9	108.0	107.2	106.2	105.3	104.5	103.7
0.5	104.7	105.8	106.8	107.8	108.7	108.6	107.7	106.7	105.8	105.0	104.2	102.7
0.4	104.7	105.8	106.8	107.9	108.9	108.6	107.6	106.6	105.8	105.0	103.4	100.8
21000 FT PRESS ALT	TAT (°C)											
MACH	-30	-25	-20	-15	-10	-5	0	5	10	15	20	25
0.6	103.9	104.8	105.8	106.8	107.7	108.6	109.5	109.4	108.5	107.5	106.6	105.7
0.5	104.7	105.8	106.8	107.9	108.9	109.9	109.9	109.0	108.0	107.0	106.1	105.3
0.4	104.7	105.8	106.8	107.9	108.9	109.9	109.8	108.8	107.8	106.9	106.1	104.2
19000 FT PRESS ALT	TAT (°C)											
MACH	-25	-20	-15	-10	-5	0	5	10	15	20	25	30
0.6	104.3	105.3	106.2	107.2	108.1	109.0	110.0	109.6	108.7	107.7	106.8	105.9
0.5	105.8	106.8	107.9	108.9	109.8	110.7	110.1	109.2	108.2	107.3	106.4	105.5
0.4	105.8	106.8	107.9	108.9	109.9	110.9	110.1	109.1	108.2	107.2	106.4	104.3
15000 FT PRESS ALT	TAT (°C)											
MACH	-20	-15	-10	-5	0	5	10	15	20	25	30	35
0.6	102.8	103.8	104.7	105.6	106.6	107.5	108.4	109.2	108.2	107.3	106.4	105.7
0.5	104.3	105.2	106.2	107.1	108.1	109.0	109.4	108.4	107.5	106.7	105.9	105.1
0.4	105.2	106.2	107.2	108.2	109.2	110.2	109.5	108.6	107.7	106.9	106.1	105.1
10000 FT PRESS ALT	TAT (°C)											
MACH	-15	-10	-5	0	5	10	15	20	25	30	35	40
0.6	100.3	101.2	102.1	103.0	103.9	104.8	105.6	106.5	107.4	106.7	106.0	105.2
0.5	101.4	102.4	103.3	104.2	105.1	106.0	106.9	107.5	106.8	106.0	105.2	104.5
0.4	102.6	103.5	104.4	105.4	106.3	107.2	107.8	107.0	106.2	105.4	104.7	104.1

GEAR DOWN
ENGINE INOP

MAX CONTINUOUS THRUST

Driftdown Speed/Level Off Altitude

100 ft/min residual rate of climb

WEIGHT (1000 KG)		OPTIMUM DRIFTDOWN SPEED (KIAS)	LEVEL OFF ALTITUDE (FT)		
START DRIFT DOWN	LEVEL OFF		ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
180	172	239	4900	3000	800
170	163	232	7500	5700	3700
160	153	224	10000	8600	6800
150	144	217	12300	11200	9600
140	134	211	14400	13600	12100
130	125	206	16100	15800	14700
120	115	201	17900	17800	17000
110	106	195	20000	19900	19300
100	96	189	21800	21700	21200

Includes APU fuel burn.

GEAR DOWN
ENGINE INOP
MAX CONTINUOUS THRUST

Long Range Cruise Altitude Capability
100 ft/min residual rate of climb

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
170	3300	300	
165	4800	2100	
160	6400	3800	900
155	8000	5400	2700
150	9400	7100	4400
145	10800	8700	6100
140	12200	10200	8000
135	13600	12100	9600
130	15000	13900	11500
125	16000	15500	13500
120	16900	16800	15400
115	18000	17900	17100
110	19100	19000	18300
105	20200	20100	19600
100	21200	21100	20600
95	22100	22000	21400
90	23100	22900	22300

With engine anti-ice on, decrease altitude capability by 1500 ft.
With engine and wing anti-ice on, decrease altitude capability by 3300 ft.

GEAR DOWN

ENGINE INOP

MAX CONTINUOUS THRUST

Long Range Cruise Control

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT)							
		6	8	10	12	14	16	18	20
160	%N1	101.7	103.7						
	MACH	.398	.409						
	KIAS	237	234						
	FF/ENG	7366	7381						
150	%N1	99.5	101.4	103.5					
	MACH	.389	.400	.410					
	KIAS	231	229	227					
	FF/ENG	6877	6875	6891					
140	%N1	97.4	99.1	101.0	103.2	105.9			
	MACH	.379	.390	.401	.412	.422			
	KIAS	225	223	221	219	216			
	FF/ENG	6405	6388	6386	6399	6425			
130	%N1	95.1	96.8	98.5	100.5	102.7	105.5		
	MACH	.367	.379	.391	.402	.412	.422		
	KIAS	218	217	215	213	211	208		
	FF/ENG	5932	5916	5902	5897	5907	5942		
120	%N1	92.7	94.3	96.0	97.8	99.8	102.0	105.3	
	MACH	.355	.367	.379	.390	.402	.412	.425	
	KIAS	211	210	209	207	205	203	201	
	FF/ENG	5467	5446	5432	5419	5410	5423	5515	
110	%N1	90.2	91.7	93.4	95.1	96.9	98.9	101.3	105.3
	MACH	.342	.353	.365	.377	.389	.401	.413	.430
	KIAS	203	202	201	200	199	197	195	195
	FF/ENG	5011	4985	4964	4952	4940	4929	4975	5146
100	%N1	87.4	89.0	90.6	92.2	94.0	95.8	97.9	100.9
	MACH	.328	.339	.351	.363	.375	.387	.400	.417
	KIAS	195	194	193	192	191	190	189	189
	FF/ENG	4543	4530	4508	4487	4476	4465	4483	4593

GEAR DOWN

ENGINE INOP

MAX CONTINUOUS THRUST

Long Range Cruise Diversion Fuel and Time

Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
164	146	131	118	109	100	94	89	84	79	75
334	296	263	238	218	200	187	175	165	156	148
505	447	398	359	327	300	281	263	247	234	222
677	598	531	479	437	400	374	350	329	311	295
850	751	666	600	546	500	467	438	411	388	368
1024	903	801	720	656	600	560	524	493	465	441
1199	1057	936	841	766	700	653	611	574	541	513
1375	1211	1072	963	876	800	746	698	655	618	586
1553	1366	1208	1084	986	900	839	785	737	695	659
1731	1522	1344	1206	1096	1000	932	872	818	771	731

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)							
	6		10		14		18	
	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)
100	2.4	0:27	2.1	0:27	1.9	0:26	1.7	0:26
200	5.0	0:52	4.6	0:50	4.3	0:49	4.1	0:47
300	7.5	1:17	7.0	1:14	6.6	1:12	6.5	1:09
400	10.1	1:42	9.5	1:38	9.0	1:35	8.8	1:31
500	12.6	2:08	11.9	2:02	11.3	1:58	11.1	1:54
600	15.1	2:33	14.2	2:27	13.6	2:21	13.4	2:16
700	17.6	2:59	16.6	2:51	15.8	2:45	15.6	2:38
800	20.0	3:25	18.9	3:16	18.0	3:08	17.8	3:01
900	22.4	3:51	21.2	3:40	20.2	3:32	19.9	3:24
1000	24.8	4:17	23.4	4:06	22.4	3:56	22.0	3:47

Fuel Required Adjustment (1000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)								
	100	110	120	130	140	150	160	170	180
2	-0.3	-0.2	-0.2	-0.1	0.0	0.1	0.3	0.4	0.5
4	-0.7	-0.5	-0.3	-0.2	0.0	0.3	0.5	0.8	1.1
6	-1.0	-0.7	-0.5	-0.3	0.0	0.4	0.8	1.3	1.7
8	-1.4	-1.0	-0.7	-0.3	0.0	0.5	1.1	1.7	2.3
10	-1.7	-1.3	-0.8	-0.4	0.0	0.7	1.4	2.2	2.9
12	-2.1	-1.5	-1.0	-0.5	0.0	0.8	1.7	2.6	3.5
14	-2.4	-1.8	-1.2	-0.6	0.0	0.9	1.9	3.0	4.1
16	-2.8	-2.1	-1.4	-0.7	0.0	1.1	2.2	3.4	4.6
18	-3.2	-2.3	-1.5	-0.8	0.0	1.2	2.5	3.8	5.2
20	-3.5	-2.6	-1.7	-0.9	0.0	1.4	2.8	4.3	5.8
22	-3.9	-2.9	-1.9	-0.9	0.0	1.5	3.0	4.7	6.3
24	-4.2	-3.1	-2.1	-1.0	0.0	1.6	3.3	5.1	6.9
26	-4.6	-3.4	-2.2	-1.1	0.0	1.8	3.6	5.5	7.4

Includes APU fuel burn.

GEAR DOWN
ENGINE INOP
MAX CONTINUOUS THRUST

Holding
Flaps Up

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)				
		1500	5000	10000	15000	20000
180	%N1	99.6				
	KIAS	241				
	FF/ENG	8240				
170	%N1	97.5	101.1			
	KIAS	234	234			
	FF/ENG	7710	7820			
160	%N1	95.3	98.6			
	KIAS	226	226			
	FF/ENG	7150	7220			
150	%N1	93.0	96.2	101.6		
	KIAS	218	218	218		
	FF/ENG	6610	6650	6820		
140	%N1	91.0	94.0	99.1		
	KIAS	212	212	212		
	FF/ENG	6160	6190	6300		
130	%N1	89.0	92.1	96.8	103.3	
	KIAS	207	207	207	207	
	FF/ENG	5760	5780	5850	6090	
120	%N1	87.0	89.9	94.4	100.1	
	KIAS	201	201	201	201	
	FF/ENG	5350	5360	5400	5550	
110	%N1	84.8	87.7	92.1	97.2	105.3
	KIAS	195	195	195	195	195
	FF/ENG	4960	4960	4990	5080	5400
100	%N1	82.4	85.5	89.7	94.5	100.9
	KIAS	189	189	189	189	189
	FF/ENG	4580	4570	4580	4630	4820

This table includes 5% additional fuel for holding in a racetrack pattern.

Performance Inflight — Chapter PI
Text — Section 16

Introduction

This chapter contains information to supplement performance data from the Flight Management Computer (FMC). In addition, sufficient inflight data is provided to complete a flight with the FMC inoperative. In the event of conflict between data presented in this chapter and that contained in the approved Airplane Flight Manual, the Flight Manual shall always take precedence.

Takeoff Speeds

The speeds presented in the Takeoff Speeds table can be used for all performance conditions except where adjustments must be made to V1 for clearway, stopway, anti-skid inoperative, brakes deactivated, improved climb, contaminated runway situations, brake energy limits, or obstacle clearance with unbalanced V1. These speeds may be used for weights less than or equal to the performance limited weight.

Normal takeoff speeds, V1, VR, and V2, with anti-skid on and all brakes operative, are read from the table by entering with takeoff flap setting, brake release weight and appropriate column. The appropriate column is obtained by entering the Column Reference chart with the airport pressure altitude and the actual temperature or assumed temperature for reduced thrust takeoffs. Slope and wind adjustments to V1 are obtained by entering the V1 Adjustment chart. Adjusted V1 must not exceed VR. These takeoff speeds are not valid when the brake release weight is based on clearway, stopway, improved climb or is limited by tire speed or brake energy.

V1(MCG)

Regulations prohibit scheduling takeoff with a V1 less than minimum V1 for control on the ground, V1(MCG). Therefore compare the adjusted V1 to the V1(MCG). To find V1(MCG) enter the V1(MCG) table with the airport pressure altitude and actual OAT. If the adjusted V1 is less than V1(MCG), set V1 equal to V1(MCG). If VR is less than V1(MCG), set VR equal to V1(MCG), and determine a new V2 by adding the difference between the normal VR and V1(MCG) to the normal V2. No takeoff weight adjustment is necessary provided that the actual field length exceeds the minimum field length.

Clearway and Stopway V1 Adjustments

Takeoff speed adjustments are to be applied to V1 speed when using takeoff weights based on the use of clearway and stopway.

Adjust V1 speed by the amount shown in the table. The adjusted V1 speed must not exceed VR.

Maximum allowable clearway limits are provided for guidance when more precise data is not available.

Stab Trim

To find takeoff stabilizer trim setting, enter Stab Trim Setting table with anticipated brake release weight and center of gravity (C.G. % MAC) and read required stabilizer trim units.

VREF

This table contains flaps 30, 25 and 20 reference speeds for a given weight.

Flap Maneuver Speeds

This table provides the flap speed schedule for recommended maneuver speeds. Using VREF as the basis for the schedule makes it variable as a function of weight and will provide adequate maneuver margin above stall at all weights.

During flap retraction/extension, movement of the flap to the next position should be initiated when within 20 knots of the recommended speed for that position.

Slush/Standing Water Takeoff

Experience has shown that aircraft performance may deteriorate significantly on runways covered with snow, slush, standing water or ice. Therefore, reductions in runway/obstacle limited takeoff weight and revised takeoff speeds are necessary. The tables are intended for guidance in accordance with advisory material and assumes an engine failure at the critical point during the takeoff.

The entire runway is assumed to be completely covered by a contaminant of uniform thickness and density. Therefore this information is conservative when operating under typical colder weather conditions where patches of slush exist and some degree of sanding is common. Takeoffs in slush depths greater than 13 mm (0.5 inches) are not recommended because of possible airplane damage as a result of slush impingement on the airplane structure. The use of assumed temperature for reduced thrust is not allowed on contaminated runways. Interpolation for slush/standing water depths between the values shown is permitted.

Takeoff weight is determined as follows:

1. Determine the field/obstacle limit weight for the takeoff flap setting.

2. Enter the Weight Adjustment table with the field/obstacle limit weight to obtain the weight reduction for the slush/standing water depth and airport pressure altitude.

3. Adjust field length available for temperature by amount shown on chart.

4. Enter the V1(MCG) Limit Weight table with the adjusted field length and pressure altitude to obtain the slush/standing water limit weight with respect to minimum field length required for V1(MCG) speed.

The maximum allowable takeoff weight in slush/standing water is the lesser of the limit weights found in steps 2 and 4.

Takeoff speed determination:

1. Determine takeoff speeds V1, VR and V2 for actual brake release weight using the Takeoff Speeds table in this section.

2. If V1(MCG) limited, set V1=V1(MCG). If not limited by V1(MCG) considerations, enter the V1 Adjustment table with actual brake release weight to determine the V1 reduction to apply to V1 speed. If the adjusted V1 is less than V1(MCG), set V1=V1(MCG).

Slippery Runway Takeoff

Airplane braking action is reported as good, medium or poor, depending on existing runway conditions. If braking action is reported as good, conditions should not be expected to be as good as on clean, dry runways. The value “good” is comparative and is intended to mean that airplanes should not experience braking or directional control difficulties when stopping. Good reported braking action denotes wet runway conditions or runways covered by compact snow. Similarly, poor braking action denotes runways covered with wet ice. Performance is based on reversers operating and a 15 ft. screen height at the end of the runway. The tables provided are used in the same manner as the Slush/Standing Water tables.

Anti-Skid Inoperative

When operating with anti-skid inoperative, the field limit weight and V1 must be reduced to account for the effect on accelerate-stop performance. A simplified method which conservatively accounts for the effects of anti-skid inoperative is to reduce the normal runway/obstacle limited weight and the V1 associated with the reduced weight by the amount shown in the table below.

ANTI-SKID INOPERATIVE ADJUSTMENT		
FIELD LENGTH (FT)	WEIGHT (1000 KG)	V1 ADJUSTMENT (KTS)
6000	-46.6	-44
7000	-46.6	-42
8000	-46.6	-39
9000	-37.9	-37
10000	-27.1	-34
12000	-22.7	-31
14000	-22.7	-29

If the resulting V1 is less than V1(MCG), takeoff is permitted with V1 set equal to V1(MCG) provided the accelerate-stop distance adjusted for wind and slope exceeds approximately 8400 ft.

Detailed analysis for the specific case from the Airplane Flight Manual may yield a less restrictive penalty.

Brakes Deactivated

When operating with brakes deactivated, the field and brake energy limit weights and the V1 and VMBE must be reduced to allow for reduced braking capability. A simplified method which conservatively accounts for the reduced braking capability of one brake deactivated is to reduce the normal runway/obstacle limited weight by 3200 kg and the V1 associated with the reduced weight by the amount shown in the table below.

ONE BRAKE DEACTIVATED SPEED ADJUSTMENT	
FIELD LENGTH (FT)	V1 ADJUSTMENT (KTS)
4000	-2
6000	-2
8000	-2
10000	-2
12000	-2
14000	-2

If the resulting V1 is less than V1(MCG), takeoff is permitted with V1 set equal to V1(MCG) provided the accelerate-stop distance exceeds approximately 3800 ft for one brake deactivated.

Takeoff %N1

To find Max Takeoff %N1 based on normal engine bleed for air conditioning packs on, enter Takeoff %N1 table with airport pressure altitude and airport OAT and read %N1. %N1 adjustments are shown for packs off operation.

Assumed Temperature Reduced Thrust

Regulations permit the use of up to 25% takeoff thrust reduction for operation with assumed temperature reduced thrust. Use of reduced thrust is not allowed on runways contaminated with water, ice, slush or snow. Use of assumed temperature reduced thrust is not recommended if potential windshear conditions exist.

Enter the Minimum Assumed Temperature table with airport pressure altitude and read minimum assumed temperature. If assumed temperature is below this value, use the Takeoff %N1 table to set takeoff thrust. To find assumed temperature reduced thrust, obtain the assumed temperature %N1 by entering the Assumed Temperature Limit %N1 table with actual airport temperature and assumed temperature. If operating with packs off, apply the bleed adjustment shown in the %N1 Adjustment for Engine Bleeds table. Apply the altitude adjustment shown in the %N1 Altitude Adjustment table. Check the resulting value by entering the Minimum Assumed Temperature Limit %N1 table with actual airport temperature and pressure altitude. Use the greater of assumed temperature limit %N1 or minimum %N1 as the assumed temperature reduced thrust %N1. Determine takeoff speeds using the actual takeoff weight and assumed temperature.

Max Climb %N1

This table shows Max Climb %N1 for a 250/290/.78 climb speed schedule, normal engine bleed for packs on and anti-ice off. Enter the table with airport pressure altitude and TAT and read %N1. %N1 adjustments are shown for packs off and anti-ice operation.

Go-around %N1

To find Max Go-around %N1 based on normal engine bleed for packs on, enter the Go-around %N1 table with airport pressure altitude and reported OAT or TAT and read %N1. %N1 adjustments are shown for packs off and anti-ice operation.

Flight with Unreliable Airspeed / Turbulent Air Penetration

Pitch attitude and average %N1 information is provided for use in all phases of flight in the event of unreliable airspeed/Mach indications resulting from blocking or freezing of the pitot system. Loss of radome or turbulent air may also cause unreliable airspeed/Mach indications. The cruise table in this section may also be used for turbulent air penetration.

Pitch attitude is shown in bold type for emphasis since altitude and/or vertical speed indications may also be unreliable.

All Engines

Long Range Cruise Maximum Operating Altitude

These tables provide the maximum operating altitude in the same manner as the FMC. Maximum altitudes are shown for a given cruise weight and maneuver capability. Note that these tables consider both thrust and buffet limits, providing the more limiting of the two. Any data that is thrust limited is denoted by an asterisk and represents only a thrust limited condition in level flight with maximum cruise thrust at 0 ft/min residual rate of climb or maximum climb thrust at 100 ft/min residual rate of climb. Flying above these altitudes with sustained banks in excess of approximately 12° may cause the airplane to lose speed and/or altitude.

Note that optimum altitudes shown in the tables result in buffet related maneuver margins of 1.5g (48° bank) or more. The altitudes shown in the table are limited to the maximum certified altitude of 43100 ft.

Long Range Cruise Control

These tables provide target %N1, Long Range Cruise Mach number, IAS and standard day fuel flow per engine for the airplane weight and pressure altitude. As indicated by the shaded area, at optimum altitude .80M approximates the Long Range Cruise Mach schedule.

APU Operation During Flight

For APU operation during flight, increase fuel flow according to the table in the Engine Inoperative text section.

Long Range Cruise Enroute Fuel and Time

Long Range Cruise Enroute Fuel and Time tables are provided to determine remaining time and fuel required to destination. The data is based on Long Range Cruise and .78/290/250 descent. Tables are presented for low altitudes and high altitudes.

To determine remaining fuel and time required, first enter the Ground to Air Miles Conversion table to convert ground distance and enroute wind to an equivalent still air distance for use with the Reference Fuel and Time tables. Next, enter the Reference Fuel and Time table with air distance from the Ground to Air Miles Conversion table and the desired altitude and read Reference Fuel and Time Required. Lastly, enter the Fuel Required Adjustment Table with the Reference Fuel and the actual weight at checkpoint to obtain fuel required to destination.

Long Range Cruise Wind-Altitude Trade

Wind is a factor which may justify operations considerably below optimum altitude. For example, a favorable wind component may have an effect on ground speed which more than compensates for the loss in air range.

Using this table, it is possible to determine the break-even wind (advantage necessary or disadvantage that can be tolerated) to maintain the same range at another altitude and long range cruise speed. The table makes no allowance for climb or descent time, fuel or distance, and are based on comparing ground fuel mileage.

Descent

Distance and time for descent are shown for a .78/290/250 descent speed schedule. Enter the table with top of descent pressure altitude and read distance in nautical miles and time in minutes. Data is based on flight idle thrust descent in zero wind. Allowances are included for a straight-in approach with gear down and landing flaps at the outer marker.

Holding

Target %N1, indicated airspeed and fuel flow per engine information is tabulated for holding with flaps up based on the FMC optimum holding speed schedule. This is the higher of the maximum endurance speed and the maneuvering speed. Small variations in airspeed will not appreciably affect the overall endurance time. Enter the table with weight and pressure altitude to read %N1, IAS and fuel flow per engine.

Advisory Information

Normal Configuration Landing Distance

Tables are provided as advisory information for normal configuration landing distances on dry runways and slippery runways with good, medium, and poor reported braking action. These values are actual landing distances and do not include the 1.67 regulatory factor. Therefore, they cannot be used to determine the dispatch required landing field length.

To use these tables, determine the reference landing distance for the selected braking configuration. Then adjust the reference distance for landing weight, altitude, wind, slope, temperature, approach speed, and the number of operative thrust reversers to obtain the actual landing distance.

When landing on slippery runways or runways contaminated with ice, snow, slush, or standing water, the reported braking action must be considered. If the surface is affected by water, snow, or ice, and the braking action is reported as "good", conditions should not be expected to be as good as on clean, dry runways. The value "good" is comparative and is intended to mean that airplanes should not experience braking or directional control difficulties when landing. The performance level used to calculate the "good" data is consistent with wet runway testing done on early Boeing jets. The performance level used to calculate "poor" data reflects runways covered with wet ice.

Use of the autobrake system commands the airplane to a constant deceleration rate. In some conditions, such as a runway with "poor" braking action, the airplane may not be able to achieve these deceleration rates. In these cases, runway slope and inoperative reversers influence the stopping distance. Since it cannot be determined quickly when this becomes a factor, it is appropriate to add the effects of slope and inoperative reversers when using the autobrake system.

Non-normal Configuration Landing Distance

Advisory information is provided to support non-normal configurations that affect the landing performance of the airplane. Landing distances and adjustments are provided for dry runways and runways with good, medium, and poor reported braking action.

Enter the table with the applicable non-normal configuration and read the normal approach speed. The reference landing distance is a reference distance from 50 ft above the threshold to stop based on a reference landing weight and speed at sea level, zero wind, and zero slope. Subsequent columns provide adjustments for off-reference landing weight, altitude, wind, slope, temperature, and speed conditions as well as thrust reverser configuration. Each adjustment is independently added to the reference landing distance. Landing distance includes the effects of max manual braking and reverse thrust.

Recommended Brake Cooling Schedule

Advisory information is provided to assist in avoiding the problems associated with hot brakes. For normal operation, most landings are at weights below the AFM quick turnaround limit weight.

Use of the recommended cooling schedule will help avoid brake overheat and fuse plug problems that could result from repeated landing at short time intervals or a rejected takeoff.

Enter the Recommended Brake Cooling Schedule table with the airplane weight, the brakes on speed adjusted for wind and the appropriate temperature and altitude condition. Instructions for applying wind adjustments are included below the table. Linear interpolation may be used to obtain intermediate values. The resulting number is the reference brake energy per brake in millions of foot-pounds, and represents the amount of energy absorbed by each brake during a rejected takeoff.

To determine the energy per brake absorbed during landing, enter the appropriate Adjusted Brake Energy Per Brake table (No Reverse Thrust or 2 Engine Reverse Thrust) with the reference brake energy per brake and the type of braking used during landing (Max Manual, Max Auto, or Autobrake). The resulting number is the adjusted brake energy per brake and represents the energy absorbed in each brake during the landing.

The recommended cooling time is found in the final table by entering with the adjusted brake energy per brake or brake temperature monitor system (BTMS) indication on EICAS. Times are provided for ground cooling and inflight gear down cooling.

If brake temperature monitor indication on EICAS is available, the hottest brake indication 10 to 15 minutes after the airplane has come to a complete stop, or inflight with gear retracted, may be used to determine the recommended cooling schedule by entering at the bottom of the chart. The brake temperature light illuminates when the hottest brake is registering 5 on the EICAS indication and extinguishes as the hottest brake cools with an EICAS indication of 4.

Engine Inoperative

Initial Max Continuous %N1

The Initial Max Continuous %N1 setting for use following an engine failure is shown. The table is based on the typical all engine cruise speed of .80M to provide a target %N1 setting at the start of driftdown. Once driftdown is established, the Max Continuous %N1 table should be used to determine %N1 for the given conditions.

Max Continuous %N1

Power setting is based on one engine operating with packs on or off and all anti-ice bleeds off. Enter the table with pressure altitude and IAS or Mach to read %N1.

It is desirable to maintain engine thrust level within the limits of the Max Cruise Thrust rating. However, where thrust level in excess of Max Cruise rating is required, such as for meeting terrain clearance, ATC altitude assignments, or to attain maximum range capability, it is permissible to use the thrust needed up to the Max Continuous Thrust rating. The Max Continuous Thrust rating is intended primarily for emergency use at the discretion of the pilot and is the maximum thrust that may be used continuously.

Driftdown Speed/Level Off Altitude

The table shows optimum driftdown speed as a function of cruise weight at start of driftdown. Also shown are the approximate weight and pressure altitude at which the airplane will level off considering 100 ft/min residual rate of climb.

The level off altitude is dependent on air temperature (ISA deviation).

Driftdown/LRC Range Capability

This table shows the range capability from the start of driftdown. Driftdown is continued to level off altitude. As weight decreases due to fuel burn, the airplane is accelerated to Long Range Cruise speed. The cruise segment is at a level off altitude which is based on 100 ft/min residual rate of climb.

To determine fuel required, enter the Ground to Air Miles Conversion table with the desired ground distance and adjust for anticipated winds to obtain air distance to destination. Then enter the Driftdown/Cruise Fuel and Time table with air distance and weight at start of driftdown to determine fuel and time required. If altitudes other than the level off altitude are used, fuel and time required may be obtained by using the Engine Inoperative Long Range Cruise Enroute Fuel and Time table.

Long Range Cruise Altitude Capability

The table shows the maximum altitude that can be maintained at a given weight and air temperature (ISA deviation), based on Long Range Cruise speed, Max Continuous thrust, and 100 ft/min residual rate of climb.

Long Range Cruise Control

The table provides target %N1, engine inoperative Long Range Cruise Mach number, IAS and fuel flow for the airplane weight and pressure altitude. The fuel flow values in this table reflect single engine fuel burn.

APU Operation During Flight

For APU operation during flight, increase fuel flow according to the following table. These increments include the APU fuel flow and the effect of increased drag from the APU door.

PRESSURE ALTITUDE (1000 FT)	APU FUEL FLOW PENALTY (KG/HR)					
	GROSS WEIGHT (1000 KG)					
	190	170	150	130	110	90
43					60	55
39				65	60	60
35		75	70	70	65	65
31	75	75	75	75	70	65
27	85	85	80	75	75	70
25	85	85	85	80	75	70
20	95	90	90	85	80	75
15	105	105	95	95	90	85
10	115	115	105	105	100	95
5	125	125	120	115	110	105

Long Range Cruise Diversion Fuel and Time

Tables are provided for crews to determine the fuel and time required to proceed to an alternate airfield with one engine inoperative. The data is based on single engine Long Range Cruise speed and .78/290/250 descent. Enter with Air Distance as determined from the Ground to Air Miles Conversion table and read Fuel and Time required at the cruise pressure altitude. Adjust the fuel obtained for deviation from the reference weight at checkpoint as required by entering the Fuel Required Adjustment table with the fuel required for the reference weight and the actual weight at checkpoint. Read fuel and time required for the actual weight.

Holding

Single engine holding data is provided in the same format as the all engine holding data and is based on the same assumptions.

Gear Down

This section contains performance for airplane operation with the landing gear extended for all phases of flight. The data is based on engine bleeds for normal air conditioning.

NOTE: The Flight Management Computer System (FMCS) does not contain special provisions for operation with landing gear extended. As a result, the FMCS will generate inaccurate enroute speed schedules, display non-conservative predictions of fuel burn, estimated time of arrival (ETA), maximum altitude, and compute overly shallow descent path. To obtain accurate ETA predictions, gear down cruise speed and altitude should be entered on the CLB and CRZ pages. Gear down cruise speed should also be entered on the DES page and a STEP SIZE of zero should be entered on the PERF INIT or CRZ page. Use of the VNAV during descent under these circumstances is not recommended.

Tables for gear down performance in this section are identical in format and used in the same manner as tables for the gear up configuration previously described.

Airplane General, Emergency Equipment, Doors, Windows — Chapter 1

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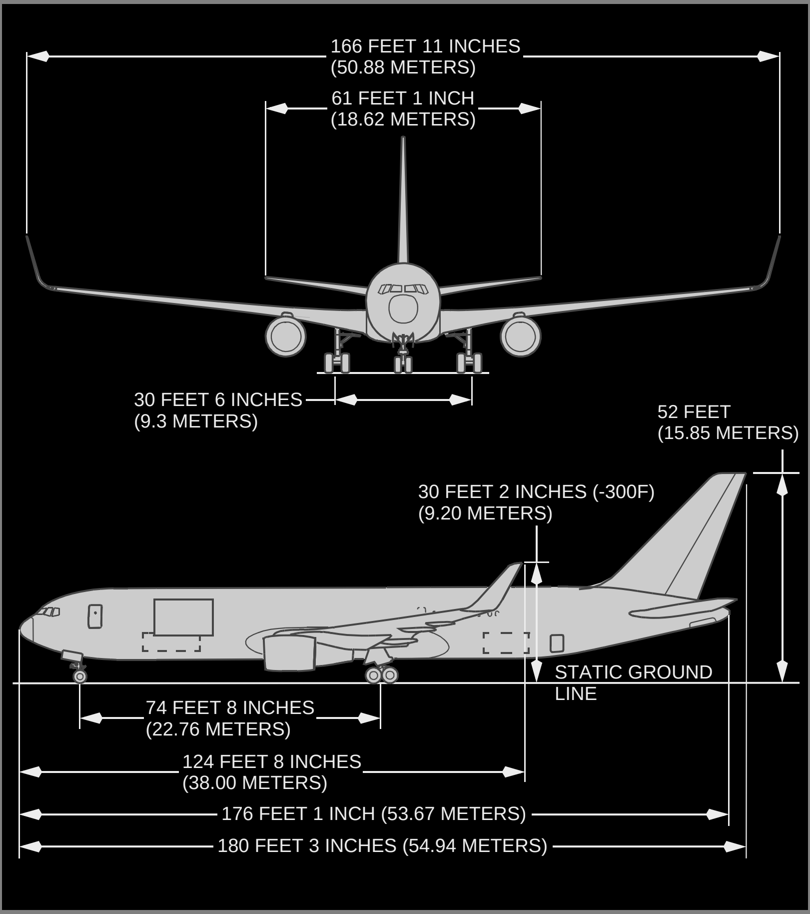
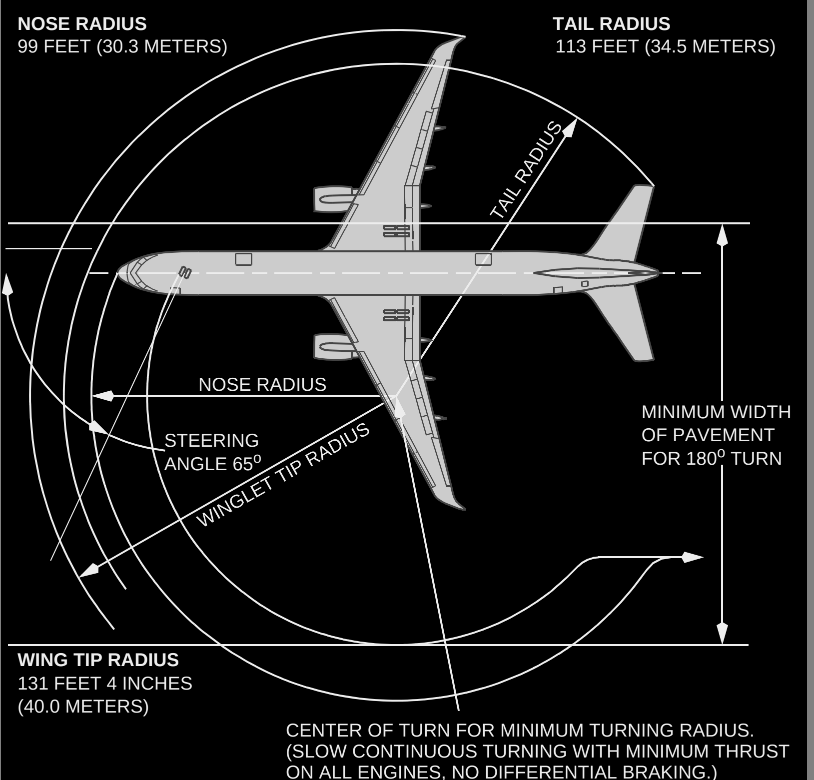
Airplane General, Emergency Equipment, Doors, Windows — Chapter 1
Dimensions — Section 10

Principal Dimensions



Turning Radius

The wing tip swings the largest arc while turning and determines the minimum obstruction clearance path. All other portions of the airplane structure remain within this arc.

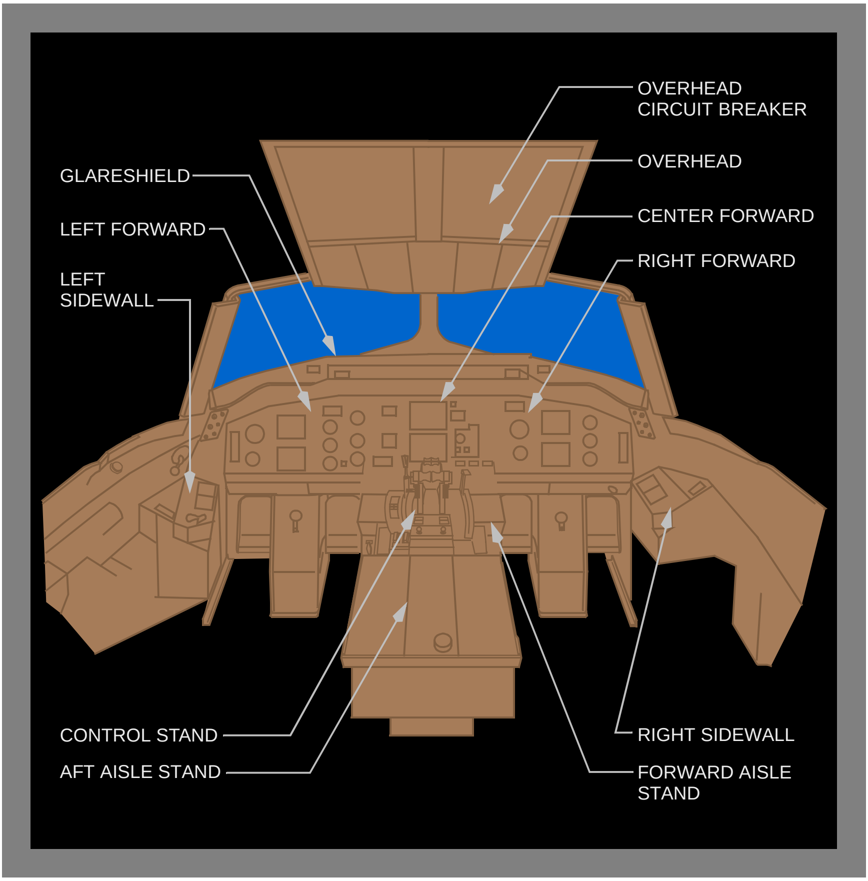


NOTE: MINIMUM WIDTH OF PAVEMENT FOR 180° TURN: 146 FEET (44.6 METERS).

CAUTION: DO NOT ATTEMPT TO MAKE A TURN AWAY FROM AN OBSTACLE WITHIN 26 FEET (8.0 METERS) OF THE WING TIP OR WITHIN 51 FEET (15.6 METERS) OF THE NOSE.

Airplane General, Emergency Equipment, Doors, Windows — Chapter 1
Instrument Panels — Section 20

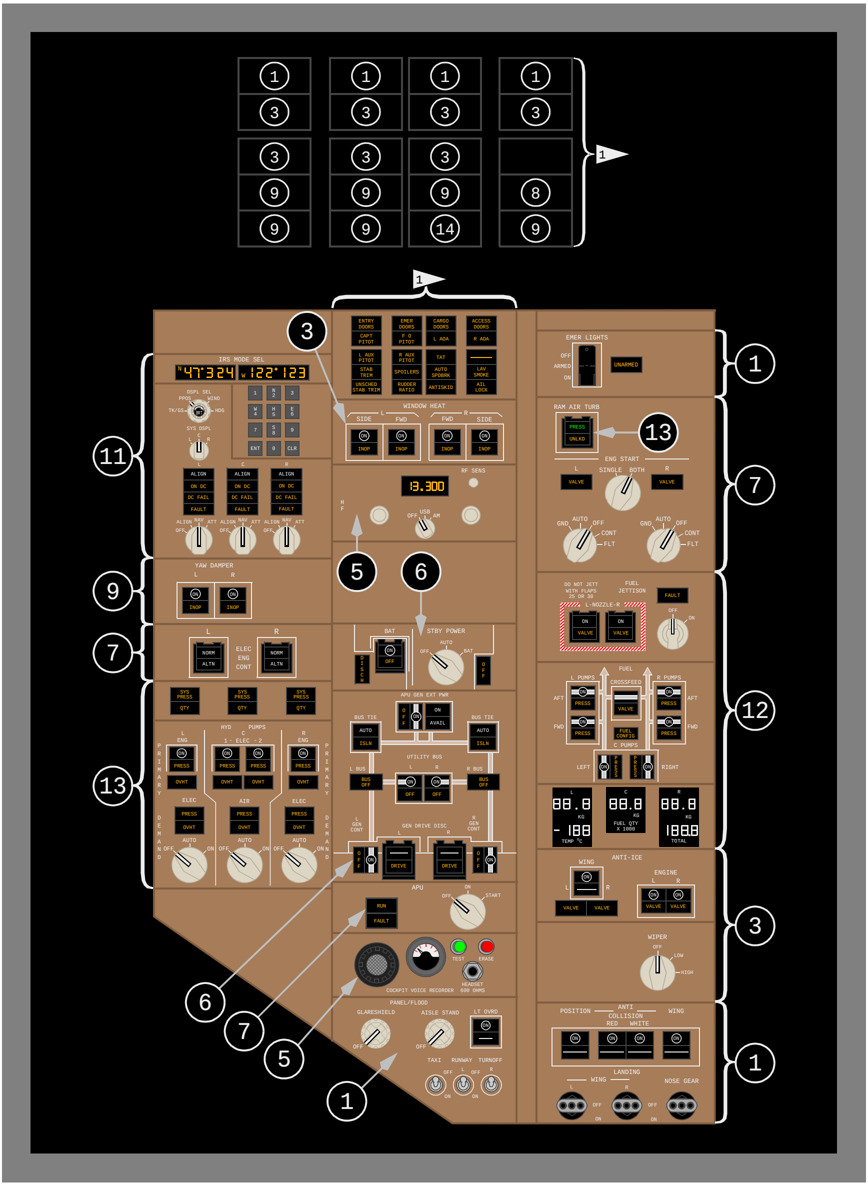
Flight Deck Panels



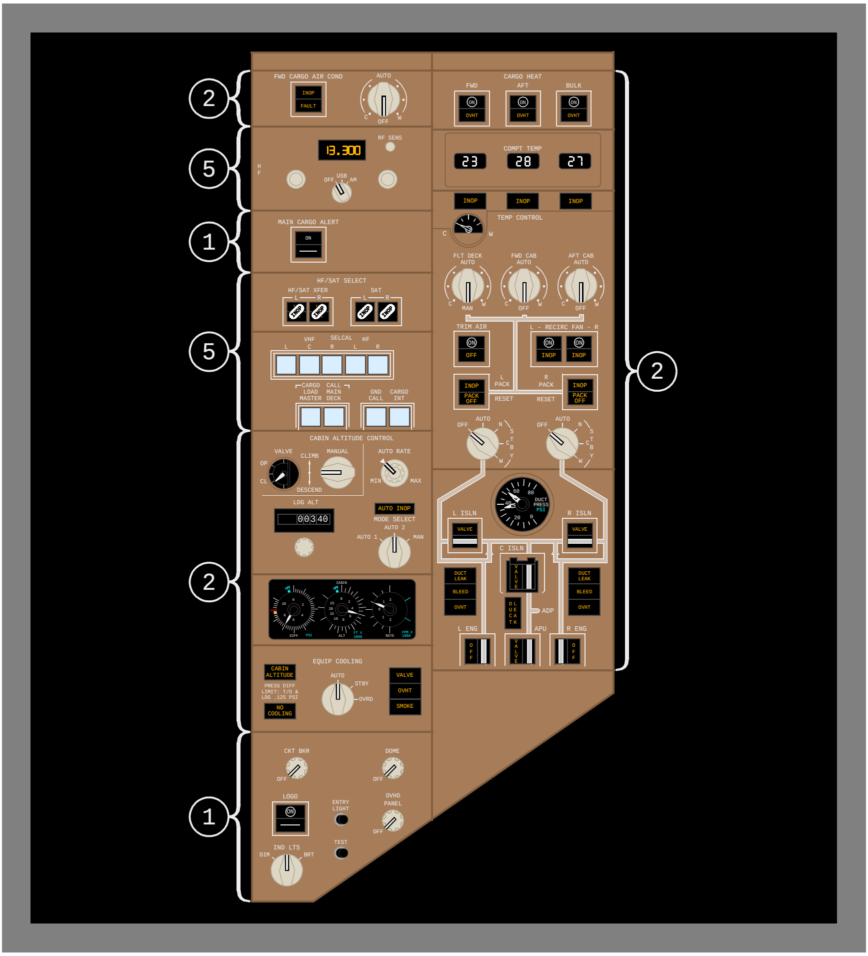
On the following pages, circled numbers refer to chapters where information on the item may be found.

The panels, controls, and indicators shown in this chapter are representative of installed units and may not exactly match the latest configuration. Refer to the appropriate chapter system descriptions for current information.

Left Overhead Panel



Right Overhead Panel



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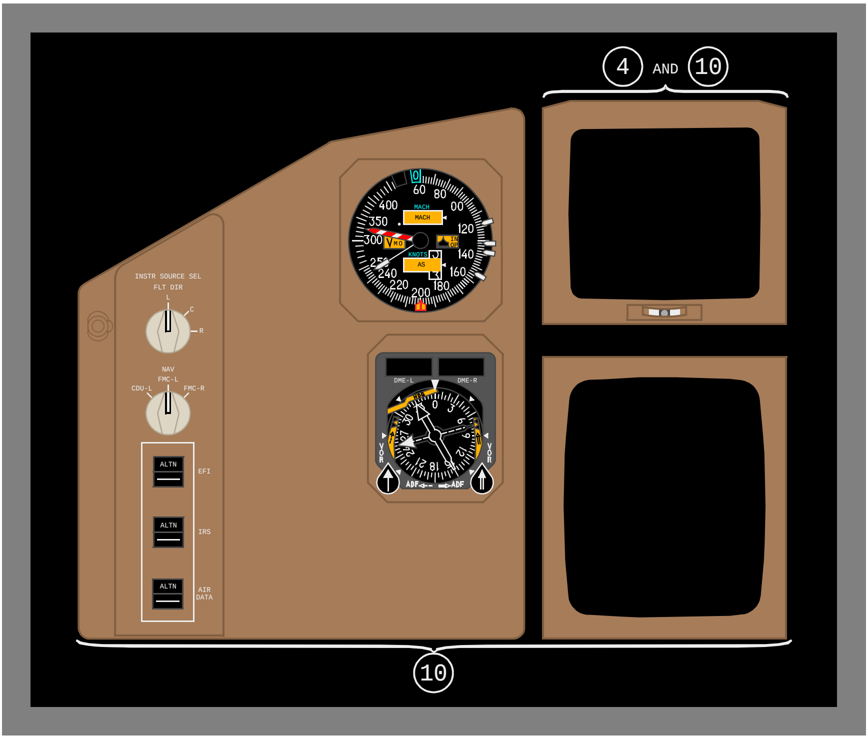
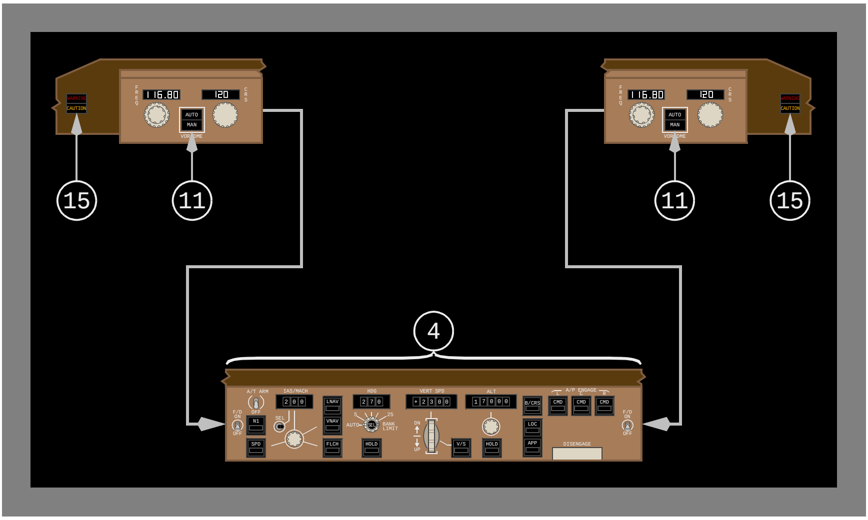
Left Forward Panel

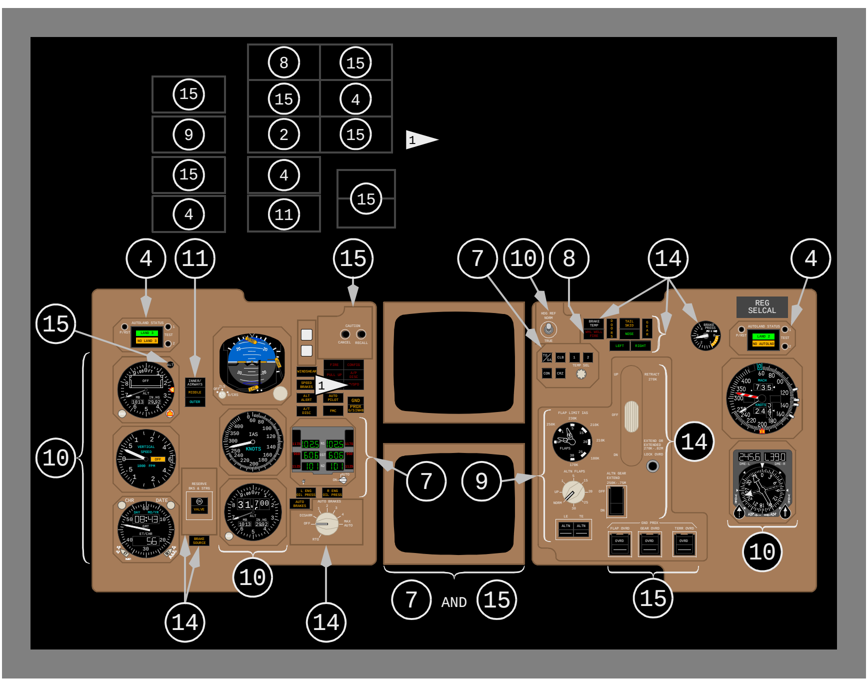


Right Forward Panel

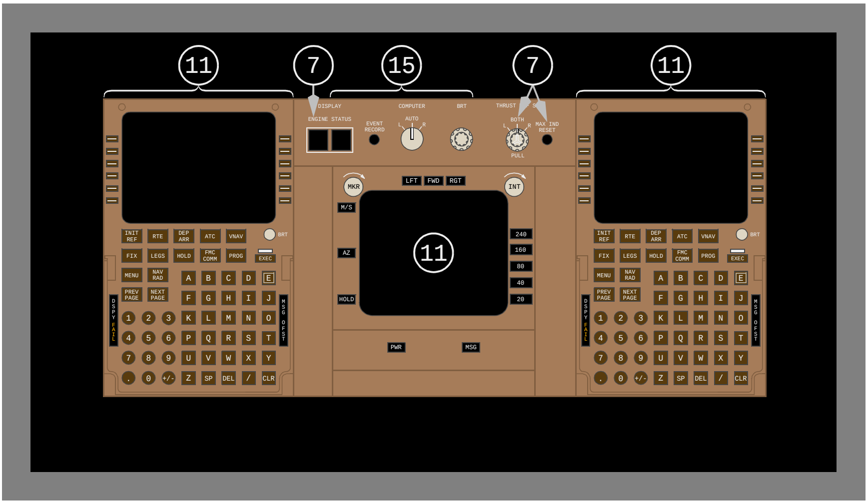
Glareshield Panel



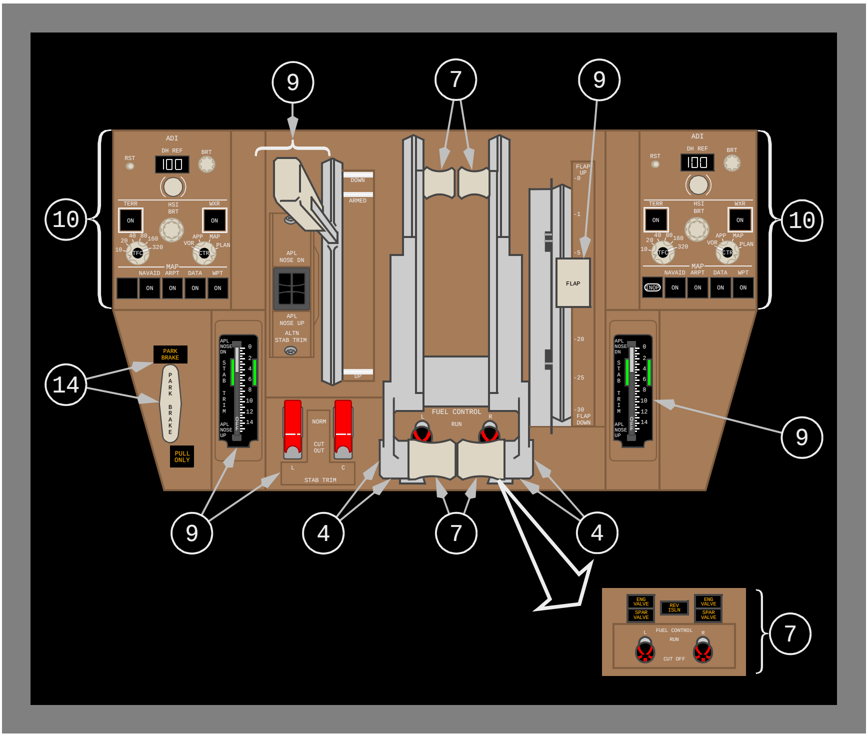
Center Forward Panel



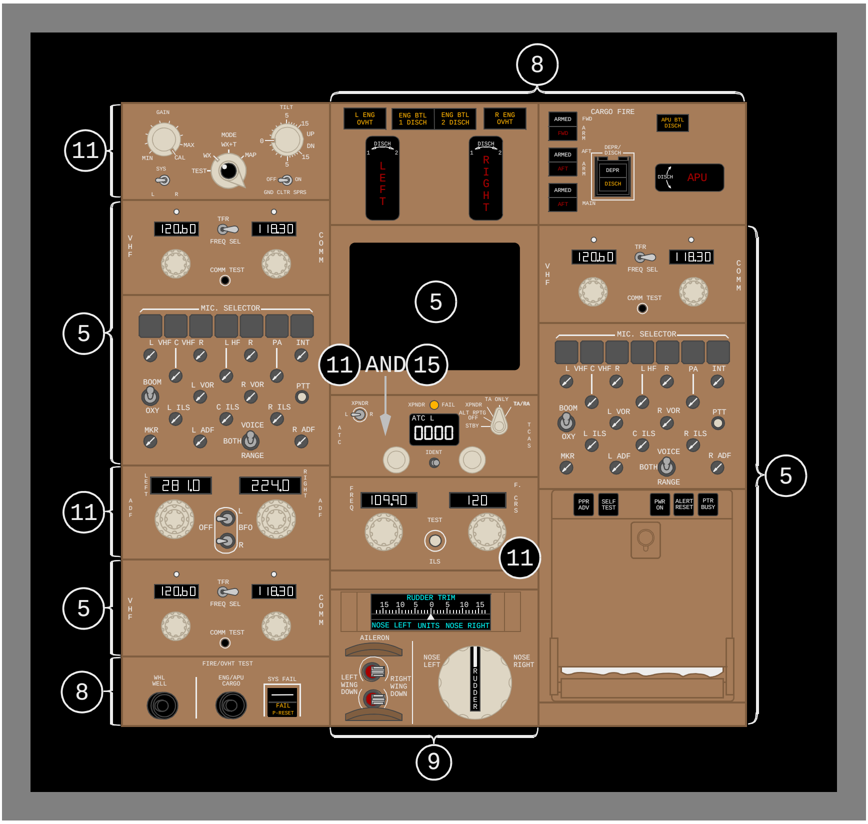
Forward Aisle Stand



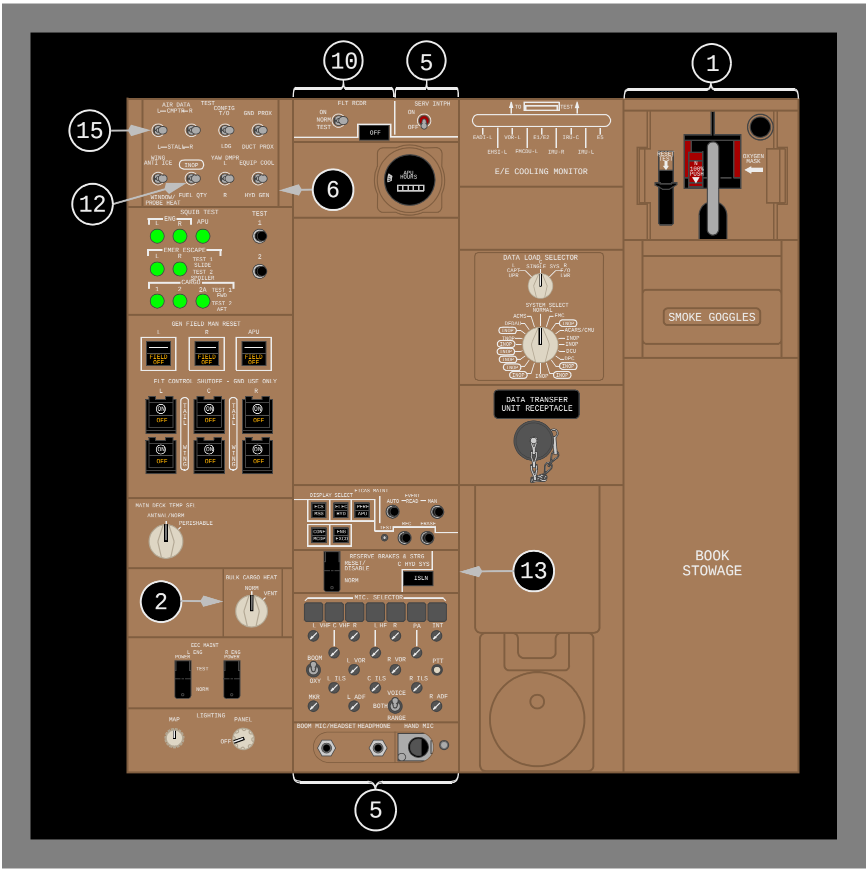
Control Stand



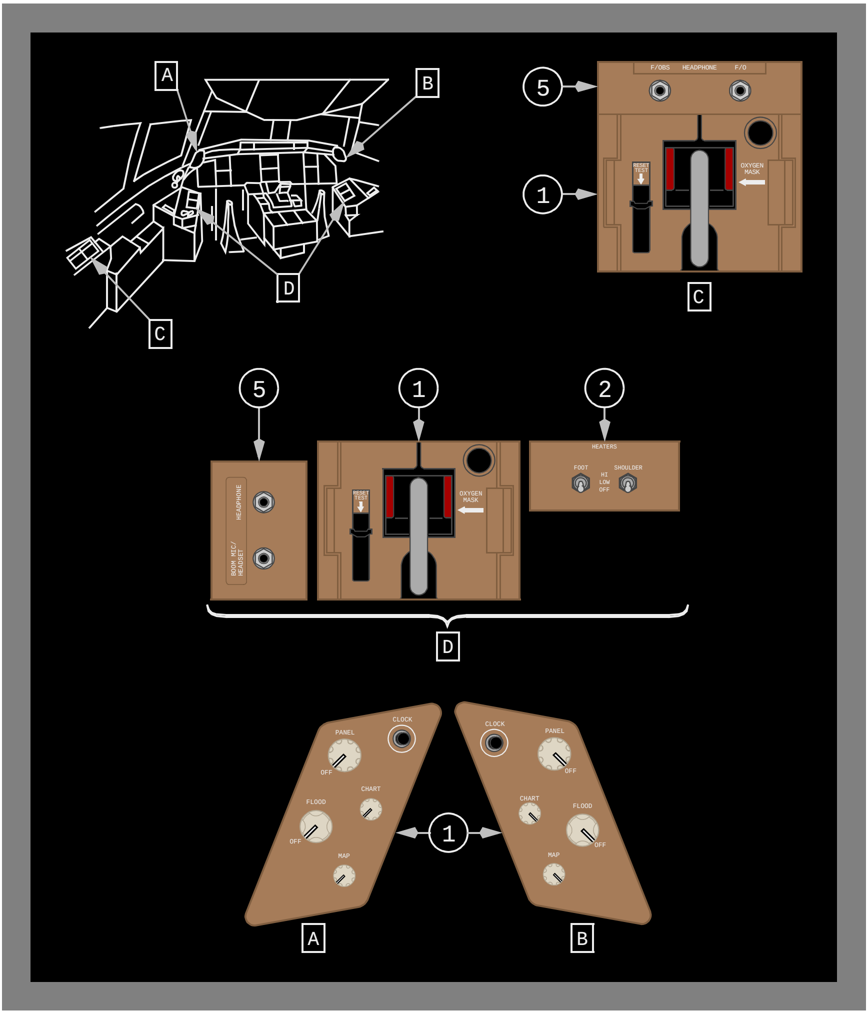
Aft Aisle Stand



Right Sidewall, Accessory Panel



Left, Right Sidewall, and Observer Panels



Push–Button Switches

The airplane has two types of push–button switches: alternate action and momentary action. The switch may contain an indicator light that illuminates to indicate system status or faults. A line indicates there is no label for that portion of the switch.

Note: Maintenance personnel should be contacted for all relamping operations. Unintentional system operation can result from improper relamping.

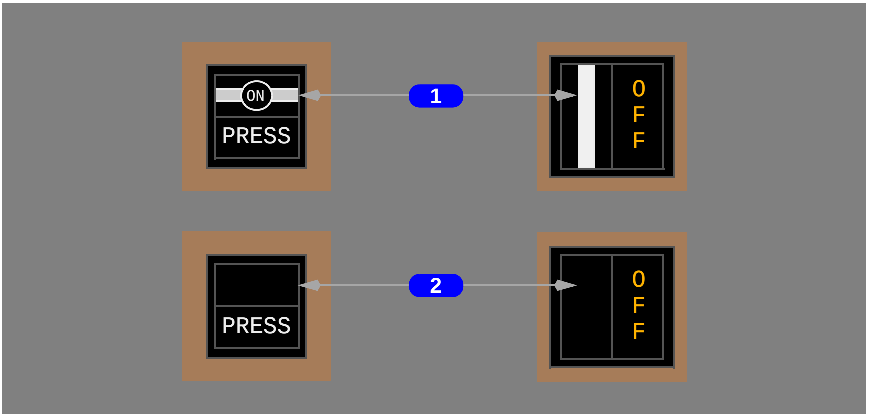
Alternate Action Switches

Alternate action switches have two positions: on and off.

When pushed in and flush with the panel, the switch is on. When the switch is on, a mechanical shutter on one half of the switch opens to show an illuminated legend, such as "ON", "AUTO" or a flow bar.

When pushed out and extended, the switch is off.   When the switch is off, the mechanical shutter closes so the legend is not shown.

Additionally, the other half of many switches has a light to indicate system state, such as "PRESS", "FAIL", "INOP" or "OFF".



1 Switch is ON

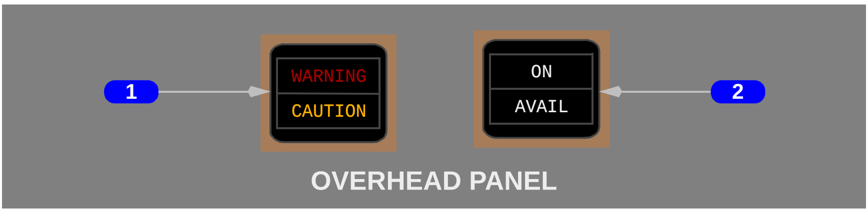
A mechanical shutter opens and a word, symbol or combination is visible.

2 Switch is OFF

A mechanical shutter closes and the ON indication is not visible.

Momentary Action Switches

Momentary action switches are spring loaded to the extended position. They are used to activate or deactivate systems or to reset system logic. The switch display indicates system status.



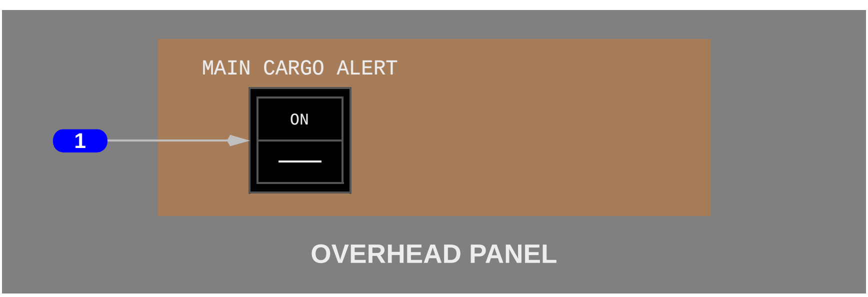
1 Push to Reset

Push – the switch resets the master lights and aural alerts.

2 System Operation

Push – activates or deactivates the system.

Main Deck Cargo Alert System

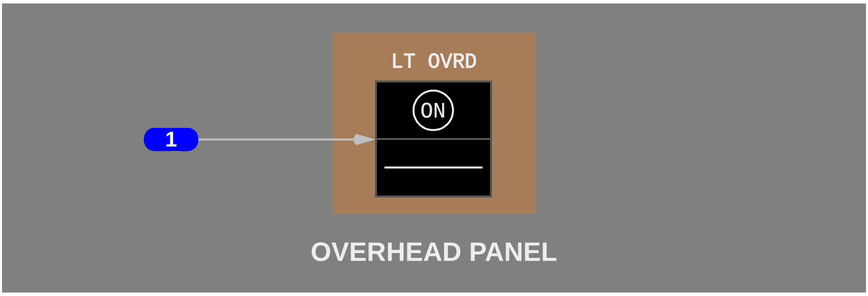


1 MAIN CARGO ALERT Switch

Push –

- flashes cargo area lights for several seconds to alert main cargo deck occupants to return to the flight deck (system is armed only when the cargo area lights are illuminated)
- ON light illuminates to indicate system activation
- ON light extinguishes after several seconds to indicate system deactivation

Lighting
Flight Deck Lighting
Light Override Switch

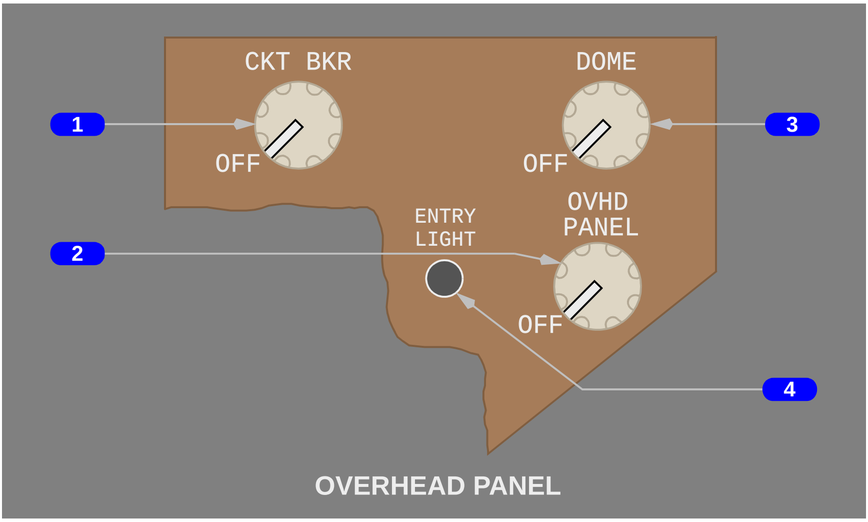


1 Light Override (LT OVRD) Switch

ON – overrides normal controls and illuminates the following lights at maximum brightness:

- forward panel flood lights
- illuminated indicator lights
- glareshield flood lights
- aisle stand flood lights
- dome lights

Circuit Breaker/Overhead Panel and Dome Lights Control



1 Circuit Breaker (CKT BKR) Panel Light Control

Rotate – controls circuit breaker panel light brightness.

2 Overhead (OVHD) Panel Lights Control

Rotate – controls overhead panel light brightness.

3 DOME Lights Control

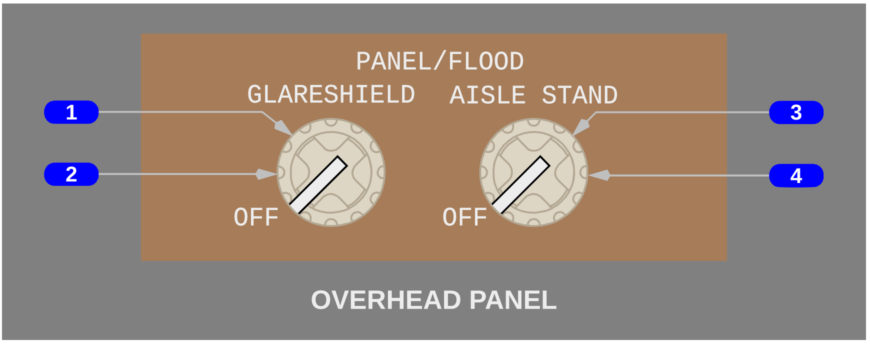
Rotate – controls dome light brightness.

Note: Control is overridden with the Light Override Switch in the ON position.

4 ENTRY LIGHT Switch

Push – controls the illumination of the light above the entry door.

Glareshield Panel/Flood Lights Control



1 GLARESHIELD FLOOD Light Control (inner)

Rotate – controls glareshield flood light brightness.

2 GLARESHIELD PANEL Light Control (outer)

Rotate – controls glareshield panel light brightness.

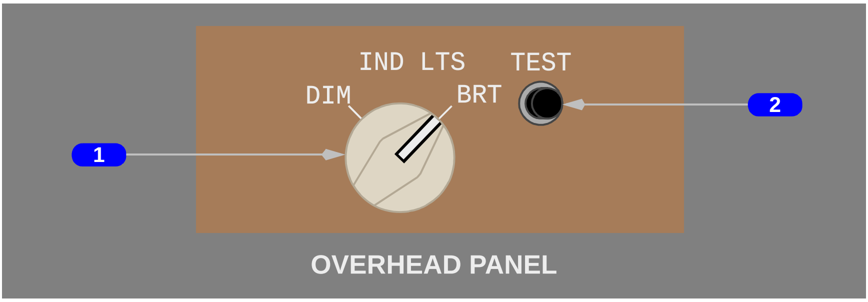
3 AISLE STAND FLOOD Light Control (inner)

Rotate – controls the aisle stand flood light brightness.

4 AISLE STAND PANEL Light Control (outer)

Rotate – controls the aisle stand instrument panel light brightness.

Indicator Lights Switch



1 Indicator Lights (IND LTS) Switch

BRT – sets all illuminated annunciator lights to full brightness.

DIM – sets all illuminated annunciator lights to low brightness.

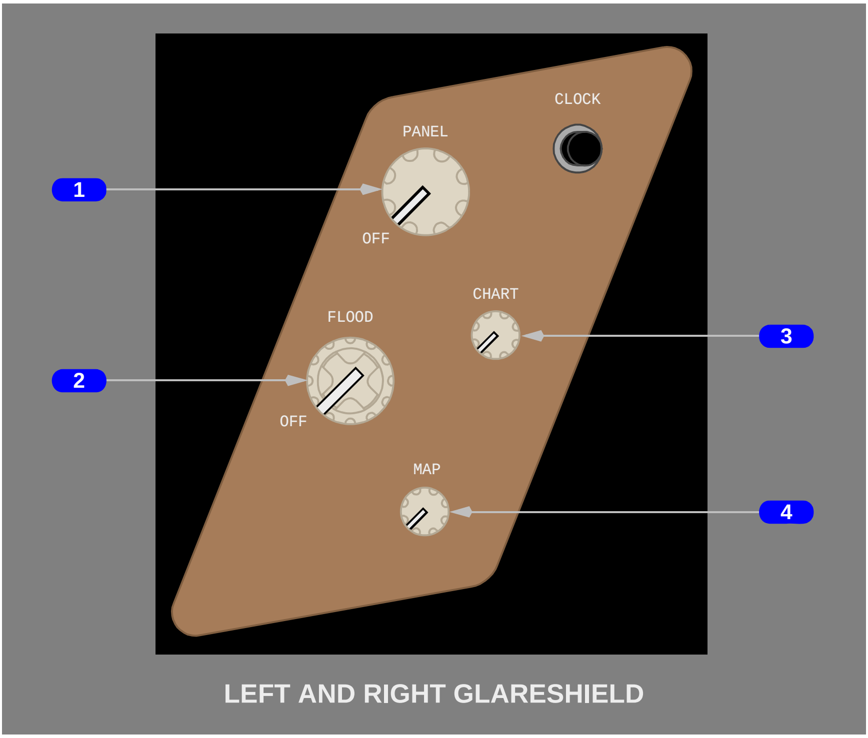
2 Indicator Lights (IND LTS) TEST Switch

Push –

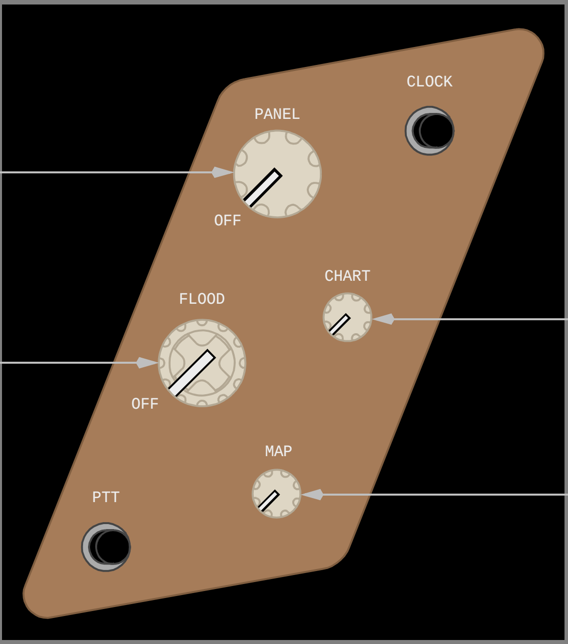
- Initiates an indicator lights test
- Lights illuminate at the intensity selected by the Indicator Lights selector
- Tests the ADI and HSI displays if the airplane is on the ground
- Illuminates the IRS data display characters

Pilot's Lighting Control Panel

N316LA



N422LA through N526LA



LEFT AND RIGHT GLARESHIELD

1 PANEL Light Control

Rotate –

- left controls left forward and center forward instrument panel lights and standby magnetic compass brightness
- right controls right forward panel lights brightness

2 FLOOD Light Control

Rotate –

- left controls left forward and center forward instrument panel flood lights brightness
- right controls right forward instrument panel flood lights brightness

3 CHART Light Control

Pull – on.

Push – off.

Rotate – adjusts chart light brightness.

4 MAP Light Control

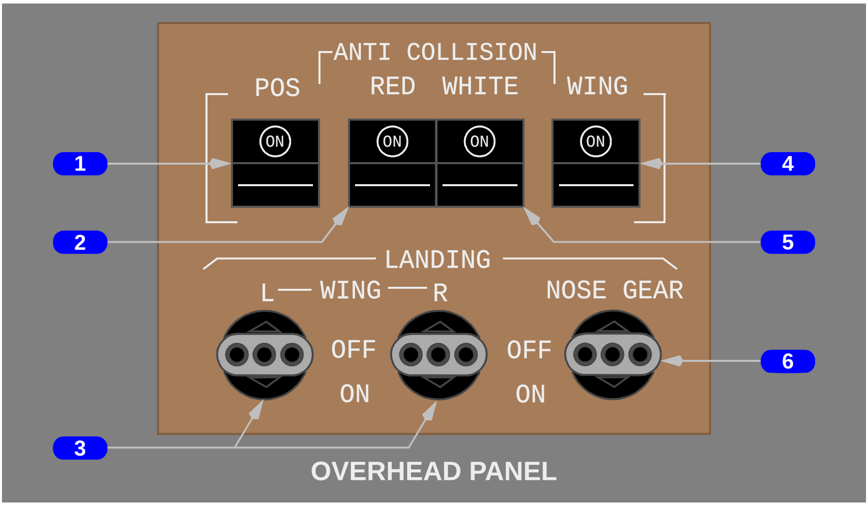
Pull – on.

Push –off.

Rotate – adjusts map light brightness.

Exterior Lighting

Lighting Control Panel



1 Position (POS) Light Switch

ON – the red, green, and white position lights illuminate.

OFF (ON not visible) – the red, green, and white position lights extinguish.

2 ANTI–COLLISION RED Light Switch

ON – the red anti–collision strobe lights on the top and bottom of the fuselage operate.

OFF (ON not visible) – the red anti–collision strobe lights on the top and bottom of the fuselage do not operate.

3 WING LANDING Light Switches

ON – the landing light illuminates.

OFF – the landing light extinguishes.

4 WING Light Switch

ON – the wing leading edge illumination lights illuminate.

OFF – the wing leading edge illumination lights extinguish.

5 ANTI–COLLISION WHITE Light Switch

ON – the white anti–collision strobe lights on tips of each wing operate.

OFF (ON not visible) – the white anti–collision strobe lights on tips of each wing do not operate.

6 NOSE GEAR LANDING Light Switch

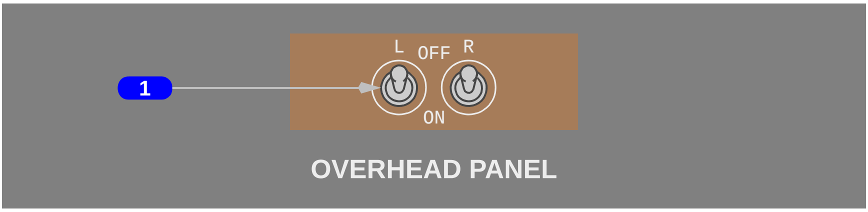
ON – the landing lights illuminate.

OFF – the landing lights extinguish.

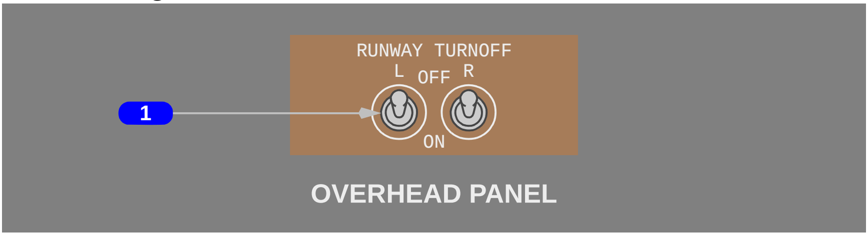
Note: The nose gear landing lights do not illuminate when the nose landing gear is not down and locked.

Runway Turnoff Light Switches

N316LA



N422LA through N526LA

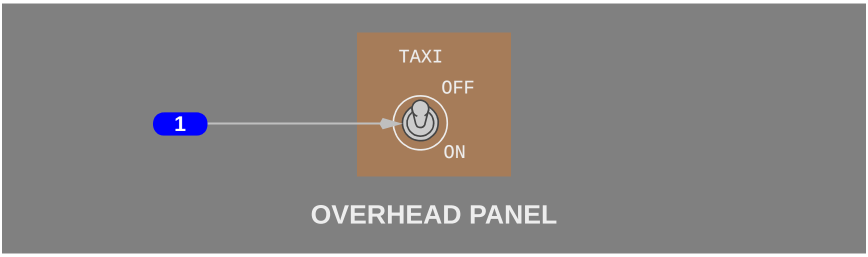


1 RUNWAY TURNOFF Light Switches

ON – the runway turnoff light illuminates.

OFF – the runway turnoff light extinguishes.

Taxi Light Switch
N422LA through N526LA



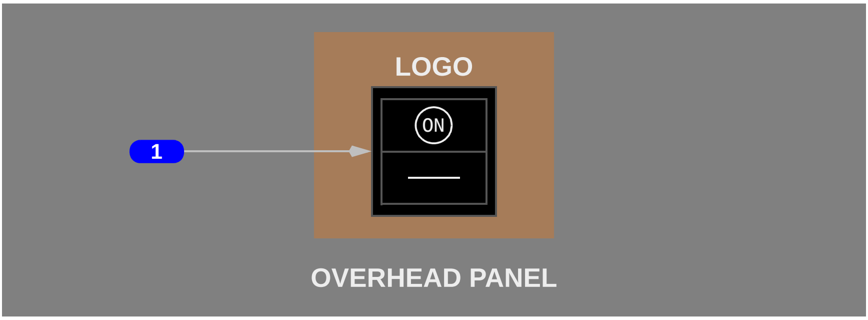
1 TAXI Light Switch

ON – the taxi light illuminates.

OFF – the taxi light extinguishes.

Note: The taxi light does not illuminate when the nose landing gear is not down and locked.

LOGO Lights

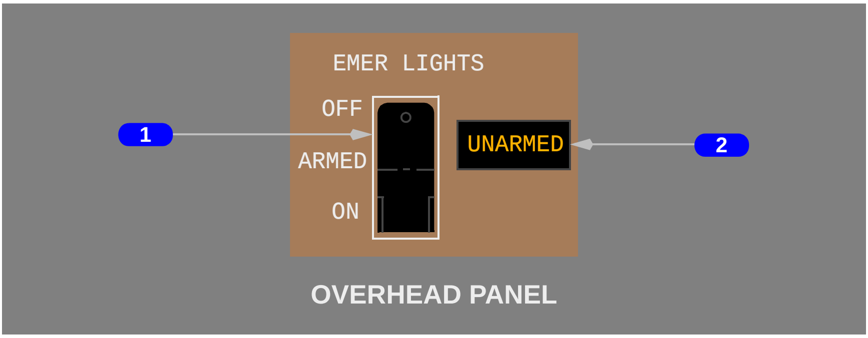


1 LOGO Light Switch

ON – the stabilizer mounted logo lights illuminate the vertical tail surface.

Emergency Lighting Controls

Flight Deck Emergency Lights Switch



1 Emergency (EMER) LIGHTS Switch

OFF – prevents emergency lights system operation if airplane electrical power fails or is turned off.

ARMED – all emergency lights illuminate if airplane electrical power fails or is turned off.

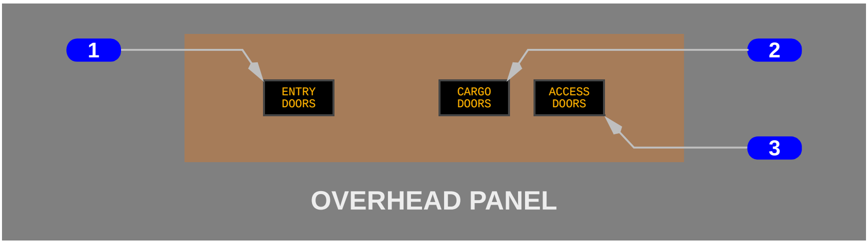
ON – all emergency lights illuminate.

2 Emergency Lights UNARMED Light

Illuminated (amber) – the emergency lighting system has been manually actuated or the emergency lights switch is OFF.

Doors and Windows

Exterior Door Annunciator Lights



1 ENTRY DOORS Light

Illuminated (amber) – entry door is not closed, and latched and locked.

2 CARGO DOORS Light

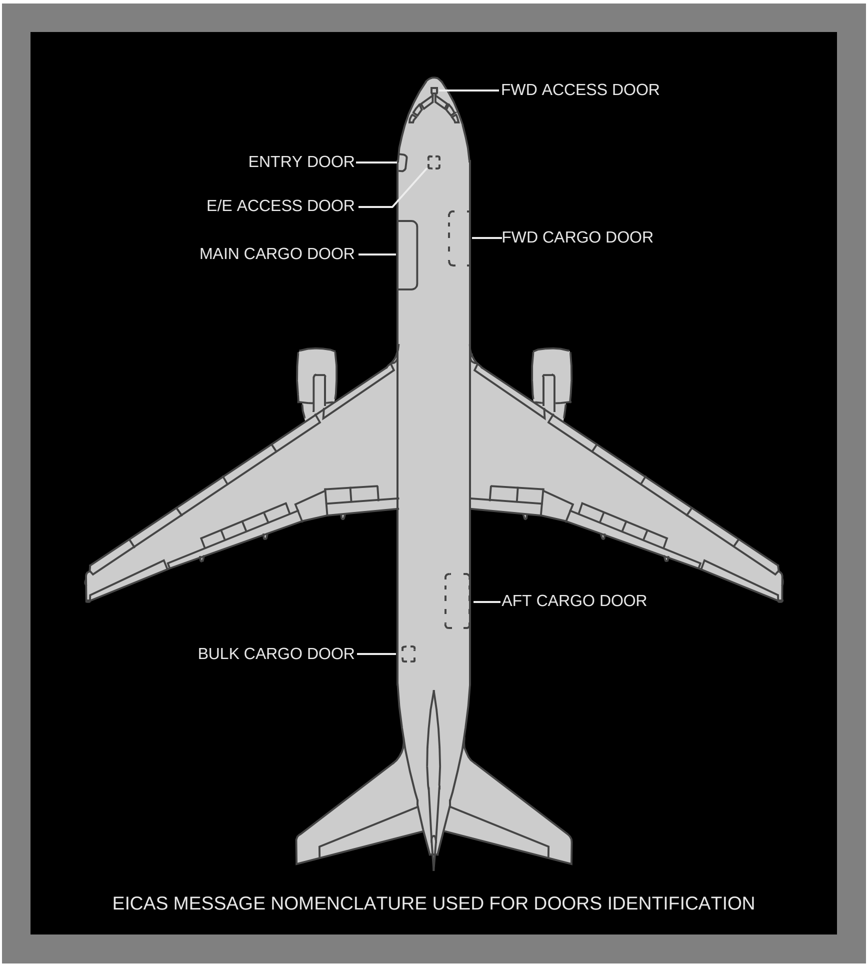
Illuminated (amber) –

- the main cargo door is not closed, latched and locked
- the forward, aft, or bulk cargo door is not closed and locked

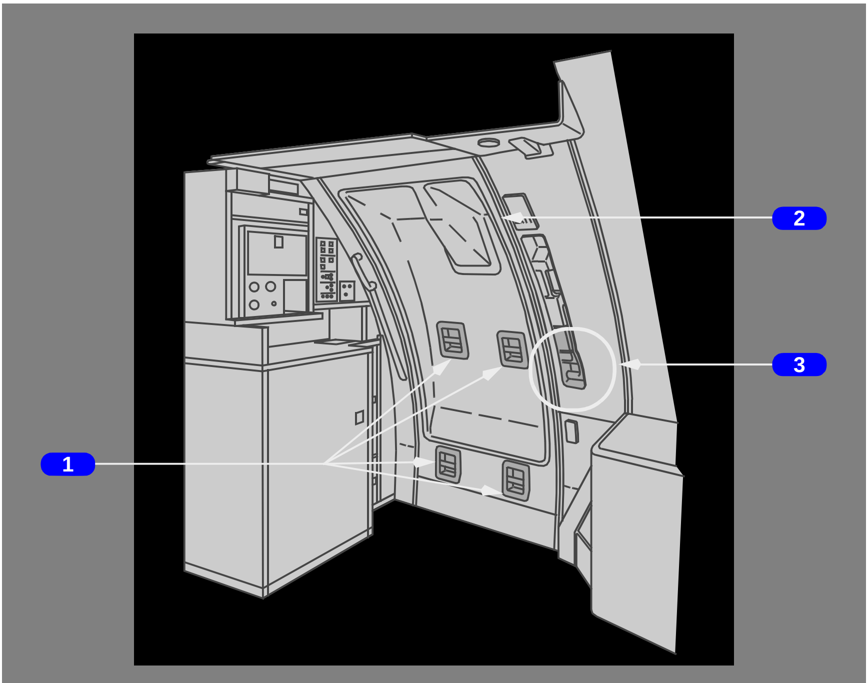
3 ACCESS DOORS Light

Illuminated (amber) – the forward equipment bay or the electrical equipment compartment door is not closed and latched and locked.

Exterior Door Locations



Freighter Entry Door



CREW ENTRY DOOR

1 Assist Handles

Used to raise or lower the door.

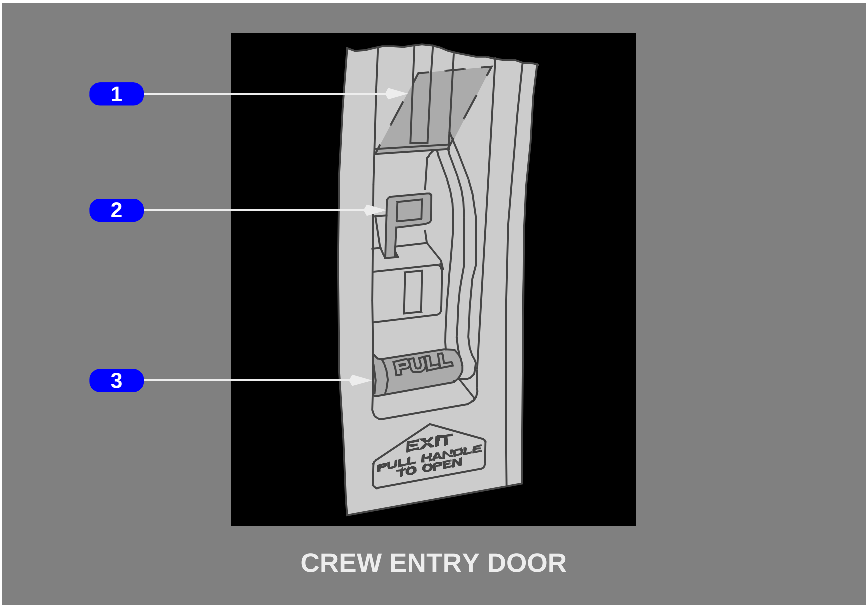
2 Uplatch Release Button (not in view)

Releases uplatch so door can be manually closed.

3 Door Control Panel

See following illustration.

Freighter Door Control Panel



1 Capture Lever Cover

2 Capture Lever

Inboard position (Pull)-Unlatches External Door Handle

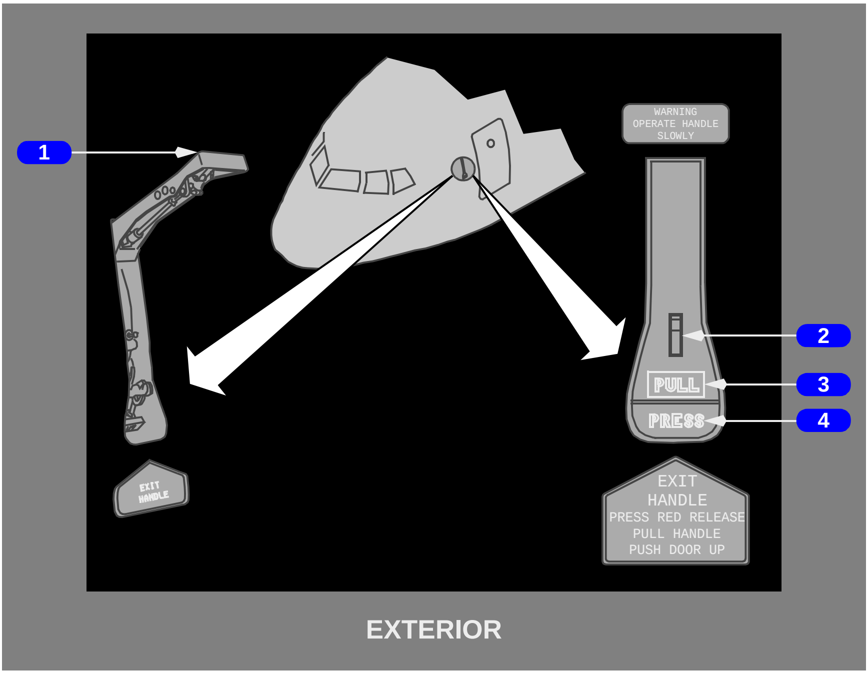
Outboard position (Push) – External Door Handle latched in closed position.

3 Door Operating Handle

To unlock and unseat the door – pull up in the direction of the arrow.

To seat and lock the door– push down in the opposite direction of the arrow.

Exterior Entry Door Controls



1 Exterior Door Handle, Open - Door Unlocked

2 Capture Lever Latch

Pull – locks exterior door handle.

3 Exterior Door Handle, Closed - Door Locked

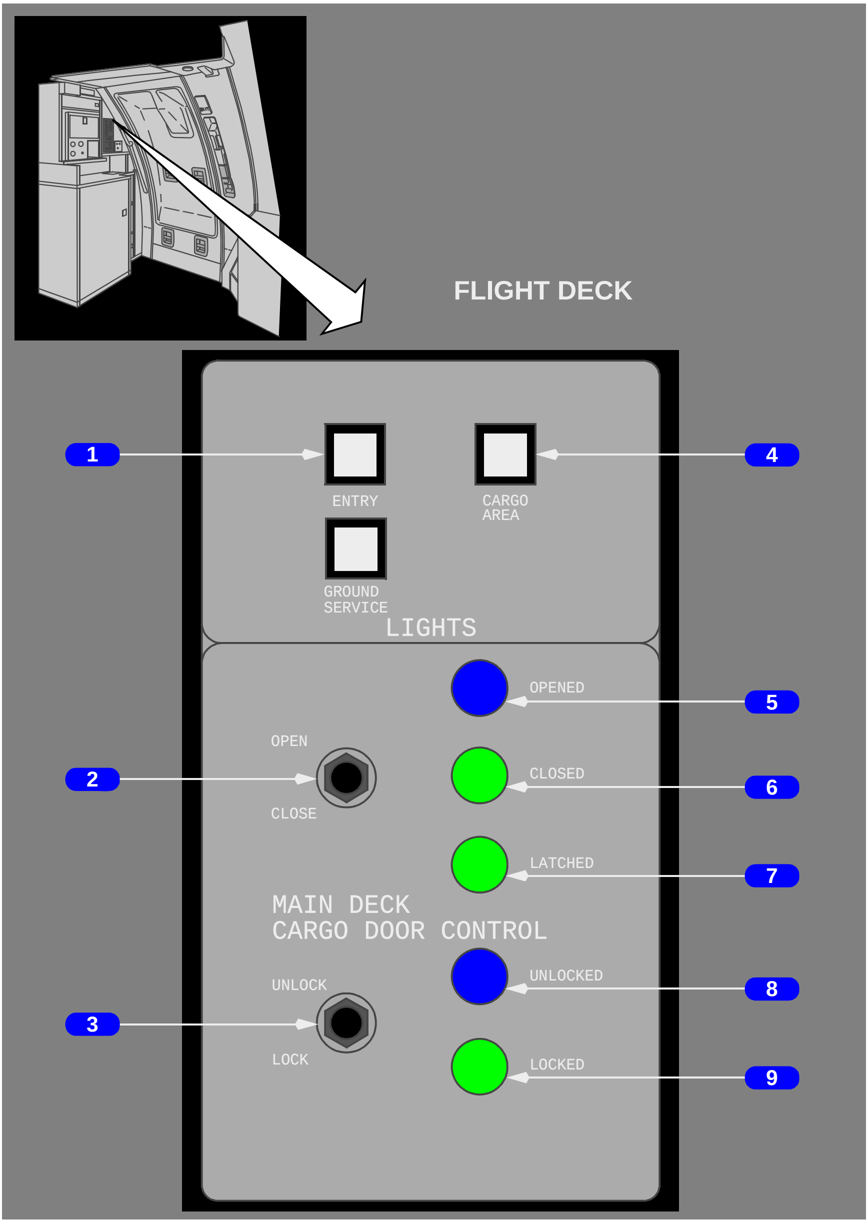
Up – unlocks and unseats the door.

Down - locks and seats the door.

4 Capture Lever

PRESS – unlocks exterior door handle.

Main Cargo Door Control Panel



1 ENTRY Light Switch

Push –

- illuminates flight deck and entry door areas

2 OPEN/CLOSE Switch

Spring–loaded to neutral.

OPEN – opens the main cargo door.

CLOSE – closes and latches the main cargo door.

3 UNLOCK/LOCK Switch

Spring–loaded to neutral.

UNLOCK – unlocks the main cargo door.

LOCK – locks the main cargo door.

4 CARGO AREA Light Switch

Push –

- illuminates lights in main cargo area above each set of pallet locks
- switch illuminates white

5 OPENED Light

Illuminated (blue) – main cargo door is fully opened

6 CLOSED Light

Illuminated (green) – main cargo door is fully closed

7 LATCHED Light

Illuminated (green) – main cargo door is latched

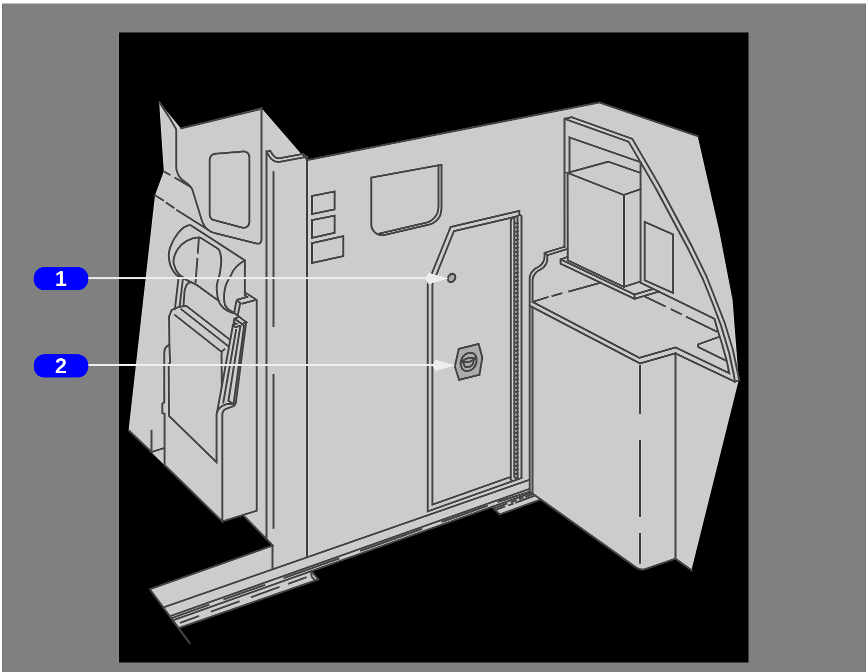
8 UNLOCKED Light

Illuminated (blue) – main cargo door is unlocked

9 LOCKED Light

Illuminated (green) – main cargo door is locked

Main Deck Cargo Access Door



MAIN DECK CARGO ACCESS DOOR

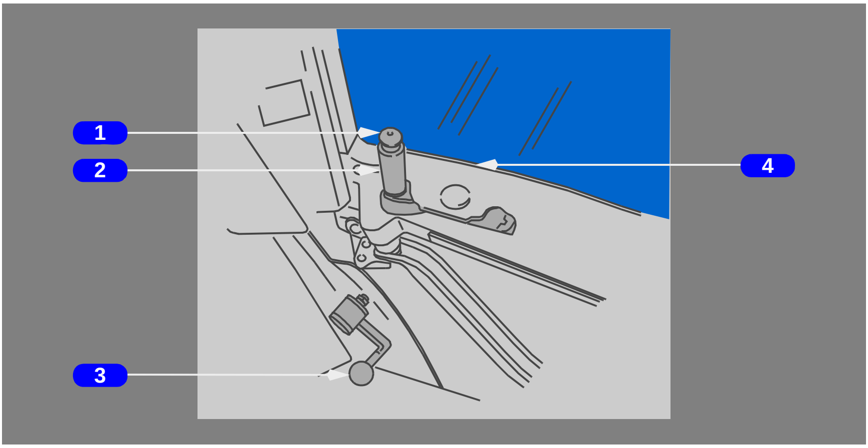
1 Viewport

2 Door Handle

To open–rotate counterclockwise and pull.

To close–rotate counterclockwise, push the door closed, and rotate the handle fully clockwise until the handle stops in the latched position.

Flight Deck Number Two Window



1 Window Lock Release Button

Inoperative.

2 Window Lock Lever

Forward Position– with the window fully closed (WINDOW NOT CLOSED decal not visible), locks the window.

Aft Position– unlocks the window so it can be cranked open.

3 Window Crank

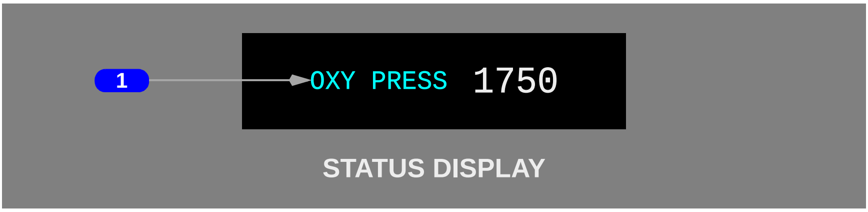
Used to position the window open or closed when the window lock lever is unlocked.

4 WINDOW NOT CLOSED Decal

Visual indication the window is not fully closed.

Oxygen Systems

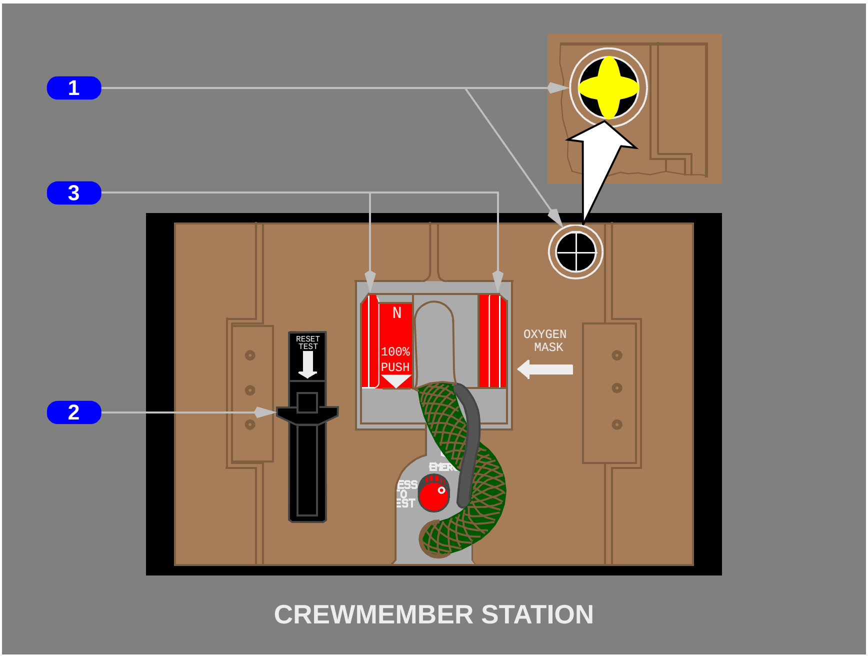
Oxygen Indications



1 **Oxygen Pressure (OXY PRESS) Display**

Displays crew oxygen cylinder pressure (psi).

Oxygen Mask Panel



1 **Oxygen Flow Indicator**

Shows a yellow cross when oxygen flowing.

2 **RESET/TEST Switch**

Push –

- with the left oxygen panel door closed and OXY ON flag not displayed, turns oxygen on momentarily to test the regulator
- with the left oxygen panel door closed and the OXY ON flag displayed, turns oxygen off

3 **Oxygen Mask Release Levers**

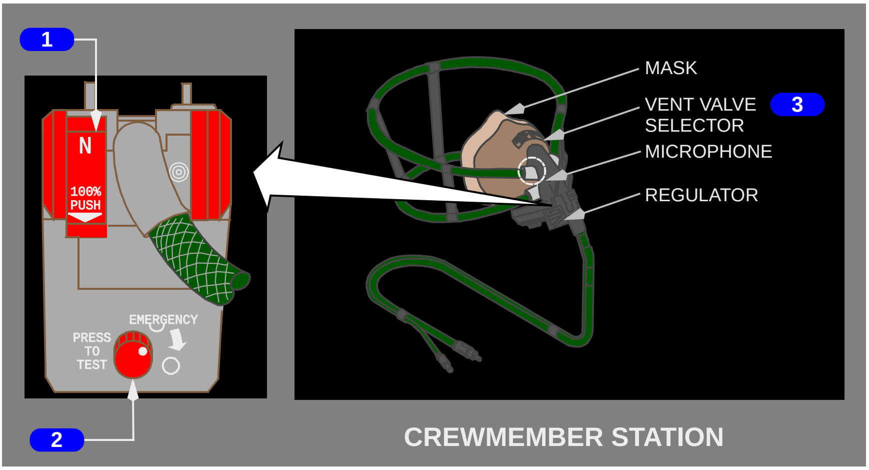
Squeeze and pull –

- unlocks the oxygen panel doors
- releases the mask
- oxygen turns on when the oxygen panel doors open

Squeeze (right lever) – inflates the mask harness.

Release – deflates the mask harness into position on the head and face.

Oxygen Mask and Regulator



1 Normal (N)/100% Switch

N – supplies an air/oxygen mixture on demand (the ratio depends on cabin altitude).

100% – supplies 100% oxygen on demand (not an air/oxygen mixture).

2 Oxygen Mask Emergency/Test Selector

Normal (non-emergency) position - supplies air/oxygen mixture or 100% oxygen on demand, depending upon the position of the Normal/100% switch. Automatically supplies 100% oxygen under pressure when cabin altitude is above a preset value.

EMERGENCY position (rotate in the direction of the arrow) – supplies 100% oxygen under positive pressure at all cabin altitudes (protects against smoke and harmful vapors).

PRESS TO TEST – tests the positive pressure supply to the regulator.

CAUTION: Use of EMER mode depletes oxygen supply at higher rate than 100% or NORM mode. Use EMER mode only as conditions require.

Note: Communications in EMER mode may be difficult. Switch to 100% or NORM mode if conditions allow.

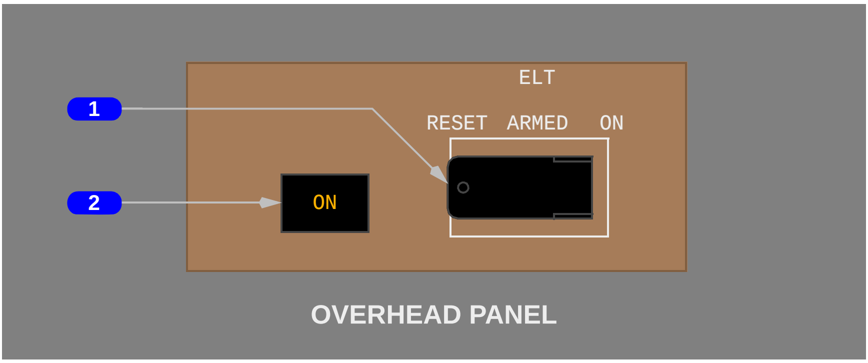
3 Smoke Vent Valve Selector

Up – vent valve closed

Down – vent valve open, allowing oxygen flow to smoke goggles.

Emergency Locator Transmitter

N422LA through N526LA



1 Emergency Locator Transmitter (ELT) Switch

ON – ELT transmits continuously.

ARMED – ELT starts transmitting if high deceleration is sensed.

RESET (spring loaded to ARMED position)

- stops ELT transmition - momentary selection (between 1 and 3 seconds) and release
- initiates self-test - select and hold (more than 3 seconds).

Note: The ELT self-test should only be performed by qualified maintenance personnel.

2 Emergency Locator Transmitter ON Light

Illuminated (amber) – ELT is transmitting.

Airplane General, Emergency Equipment, Doors, Windows — Chapter 1
Systems Description — Section 40

Introduction

This chapter describes miscellaneous airplane systems, including:

- lighting systems
- oxygen systems
- doors and windows
- flight deck seats

Lighting Systems

Lighting systems described in this chapter include:

- exterior lighting
- flight deck lighting
- emergency lighting
- main deck cargo alert system
- main deck cargo lighting

Exterior Lighting

Exterior lighting consists of these lights:

- landing
- runway turnoff
- anti-collision
- navigation (position)
- wing leading edge illumination

N422LA through N526LA

- taxi
- logo

Landing Lights

The landing lights consist of the left, right, and nose gear landing lights. The left and right landing lights are located in the left and right wing root and are optimized for flare and ground roll. The two nose gear–located landing lights are optimized for approach.

The nose gear landing lights are inoperative when the nose landing gear is not down and locked.

Runway Turnoff Lights

Two runway turnoff lights are located in the left and right wing root.

White Anti–collision Lights

When winglets have been installed, white anti–collision strobe lights are located on the outboard tip of each winglet.

Red Anti–collision Lights

The red anti–collision lights are strobe lights located on the top and bottom of the fuselage.

Navigation Lights

On airplanes modified with winglets, the navigation lights are standard red (left forward winglet), green (right forward winglet), and white (inboard trailing edge of both winglets) position lights.

Wing Lights

Wing lights are installed on the fuselage and illuminate the leading edge of the wing.

Taxi Light

N422LA through N526LA

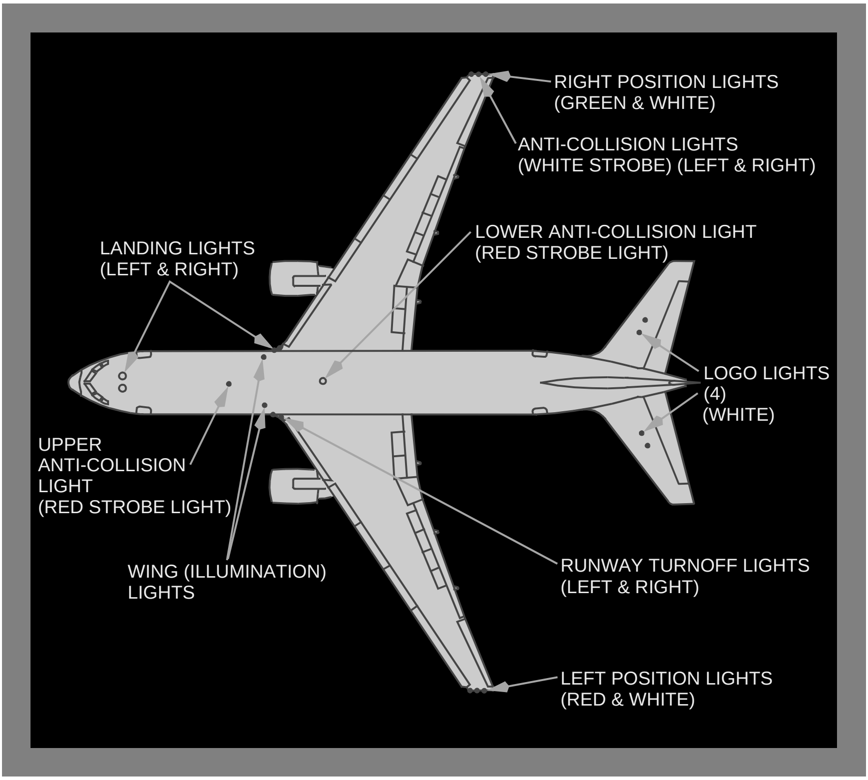
The taxi light is installed on the steerable portion of the nose landing gear. The light is inoperative when the nose landing gear is not down and locked.

Logo Lights

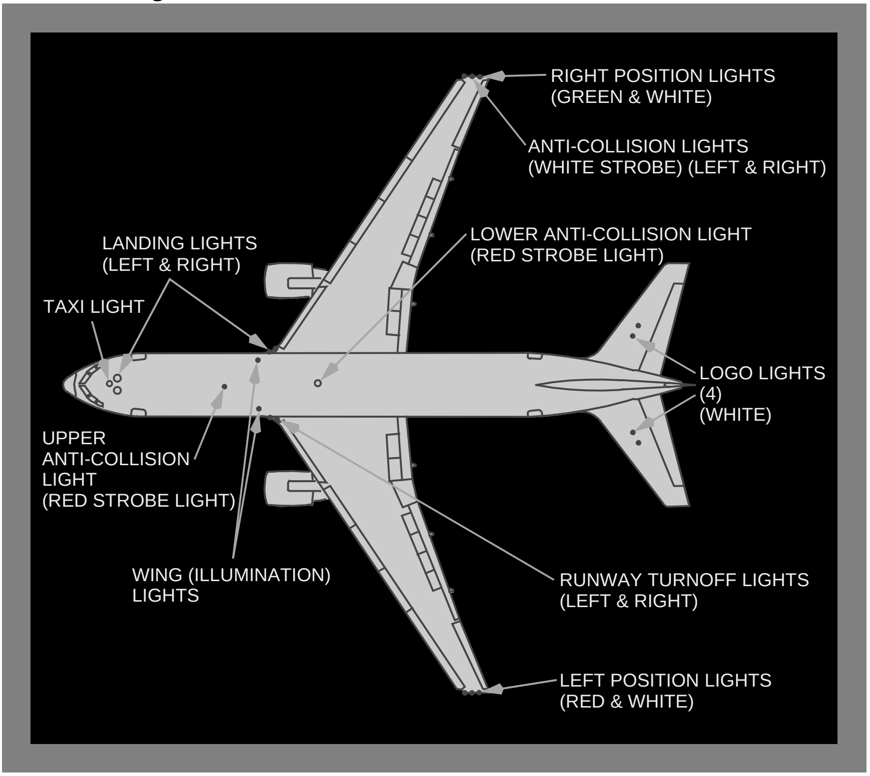
Logo lights are located on the stabilizer to illuminate the logo on the vertical tail surface.

Exterior Lighting Locations

N316LA



N422LA through N526LA



Flight Deck Lighting

Flight deck lighting is provided for panel illumination, area lighting, and localized illumination. Flood lights and light plates provide panel illumination. Dome lights provide flight deck area lighting. Map lights, chart lights, and utility lights provide localized illumination.

Panel and flood lights illuminate the forward panels, glareshield, and aisle stand panels. When the light override switch is ON, the forward panel flood lights, glareshield flood lights, dome lights, aisle stand flood lights, and all illuminated annunciator lights illuminate at full brightness.

If normal electrical power is lost, the standby magnetic compass light, forward panel flood lights, and integral lights for essential instruments on the left forward, center forward, and overhead panels are automatically switched to the Standby AC bus.

Indicator Lights

Indicator Light brightness can be set to DIM or BRT with the indicator lights selector. The system automatically overrides the DIM position and illuminates the indicator lights full bright under the following conditions:

- The ambient flight deck light level increases to a preset crossover light value as detected by system sensors located on the center forward panel
- Loss of equipment cooling air flow as detected in the flight deck or in the forward E/E compartment
- Equipment cooling air overheat as detected in the flight deck or in the forward E/E compartment or at the cooling air supply source.

Emergency Lighting

The flight deck dome, interior and exterior flight crew entry door lights are powered by the emergency lighting system to provide illumination for evacuating the flight deck. The system is controlled by a switch on the Pilots overhead panel. The switch has three positions - OFF, ON and ARMED - and is guarded to the ARMED position. An UNARMED light next to the switch will be illuminated when the switch is not in the ARMED position. With the switch in the ARMED position, all emergency lights, internal and external will illuminate if airplane electrical power is lost or turned off.

The emergency lights are powered by a battery pack. The battery charge is maintained by airplane electrical power when the Emergency Lights Switch is in the OFF or ARMED position and the electrical system is powered.

Main Deck Cargo Alert System

A Main Deck Cargo Alert System is installed in the main deck cargo compartment. The system flashes the cargo area lights for several seconds to alert occupants of the main cargo compartment to return to the flight deck.

The system is armed only when the cargo area lights are illuminated. The system is activated by the MAIN CARGO ALERT switch on the pilot’s Overhead panel. When the switch is pushed, the ON light illuminates to indicate system activation. After several seconds, the ON light extinguishes to indicate the system is deactivated.

Main Deck Cargo Lighting

Main Deck Cargo lights illuminate the area of the main deck cargo area and the main cargo deck door area. There is recessed lighting in the ceiling above each set of pallet locks.

These lights are controlled by the CARGO AREA switch on the Door Control Panel located aft of the crew entry door.

Oxygen Systems

A increased capacity oxygen system is provided for the flight crew and the supernumeraries on the flight deck. Portable oxygen cylinders are located in the flight deck area emergency use.

Flight Crew and Supernumerary Oxygen

The oxygen system uses quick-donning masks and regulators located at each crew station and supernumerary seat. Oxygen pressure is displayed on the lower EICAS status display.

Flight crew and supernumerary masks and regulators are installed in oxygen mask panels near each seat. Squeezing the red oxygen mask release levers releases the mask from stowage. Removing the mask:

- inflates the mask harness
- momentarily displays the yellow oxygen flow indicator

Place the mask over the head and release the levers. The harness will contract fitting the mask to the head and face.

Portable Oxygen Bottles

Two portable oxygen cylinder assemblies are installed. One in the lavatory and one next to supernumerary position provide supplemental breathing when required. The portable oxygen cylinder assembly has a shutoff valve, a pressure gauge and a disposable continuous flow masks.

Doors and Windows

The airplane has one entry door, one main deck cargo access door, one main cargo door, one forward cargo door, one aft cargo door, and one bulk cargo door. It also has electrical equipment and forward equipment bay access doors.

The flight deck number two windows, one on the left and one on the right, can be opened by the flight crew.

An EICAS message is displayed when an entry door, cargo door or access door is not closed and latched and locked.

Main Deck Cargo Access Door

The flight deck door is hinged and opens into the flight deck area. There is a step between the flight deck and the main cargo deck.

Flight Deck Number Two Windows

The flight deck number two windows can be opened from the inside on the ground or in flight. In addition, the right-hand window adjacent to the first officer can be opened from the outside. The flight deck number two windows can be used for emergency evacuation. The Window Lock Release Buttons are inoperative. The Window Lock Lever locks or unlocks the window. Rotating the window crank opens and closes the window.

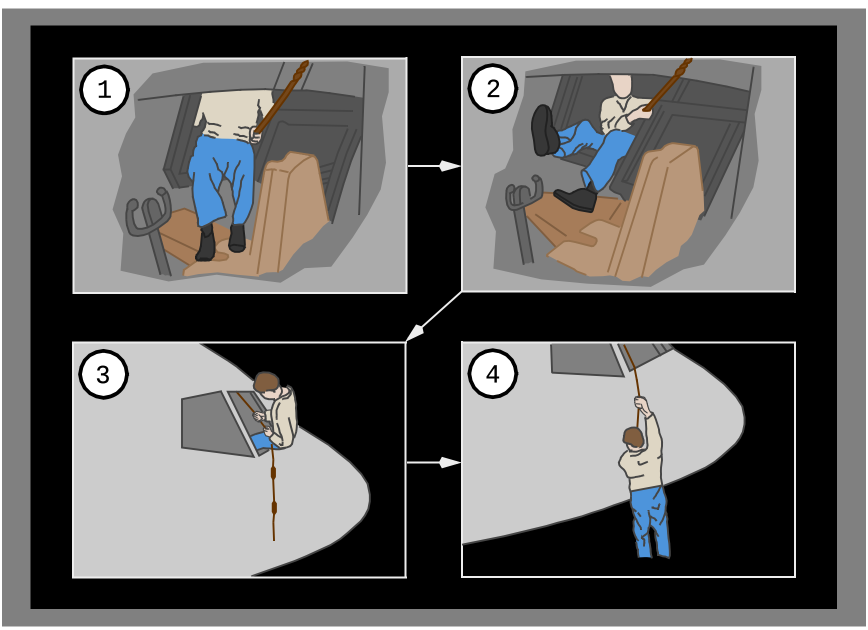
A WINDOW NOT CLOSED placard is visible when the window is open.

The windows can be opened or closed in flight with minor flight deck consequences if the airplane is unpressurized. The force required to move the crank increases with airspeed. With the window open, voice, interphone, and radio audio may not be heard due to high noise levels. Prior communications arrangements with the controlling agency should be established before opening the window. The design provides an area of relatively calm air over the open window. Forward visibility can be maintained by looking out of the open window.

Flight Deck Window Emergency Egress

If the flight deck number two windows must be used for emergency evacuation, exit in accordance with the following illustration.

CAUTION: Ensure the rope is securely fastened to the airplane.



Crew Entry Door

The crew entry door is located on the left side of the airplane. The door is plug type and inward-upward opening. It may be opened or closed manually from inside or outside the airplane. When opened, the door first moves inboard and then upward into the ceiling. The weight of the door is counterbalanced so that very little effort is required for operation. The door is held open by a latch in the upper part of the door frame. In order to close the door it must be initially be raised slightly, push and hold the Uplatch Release Button, then lower the door approximately 2 inches (5 centimeters). Release the button and continue to lower the door.

There is an escape rope installed over the entry door, centered over the upper door frame. It is used the same way as the flight deck window emergency egress is used.

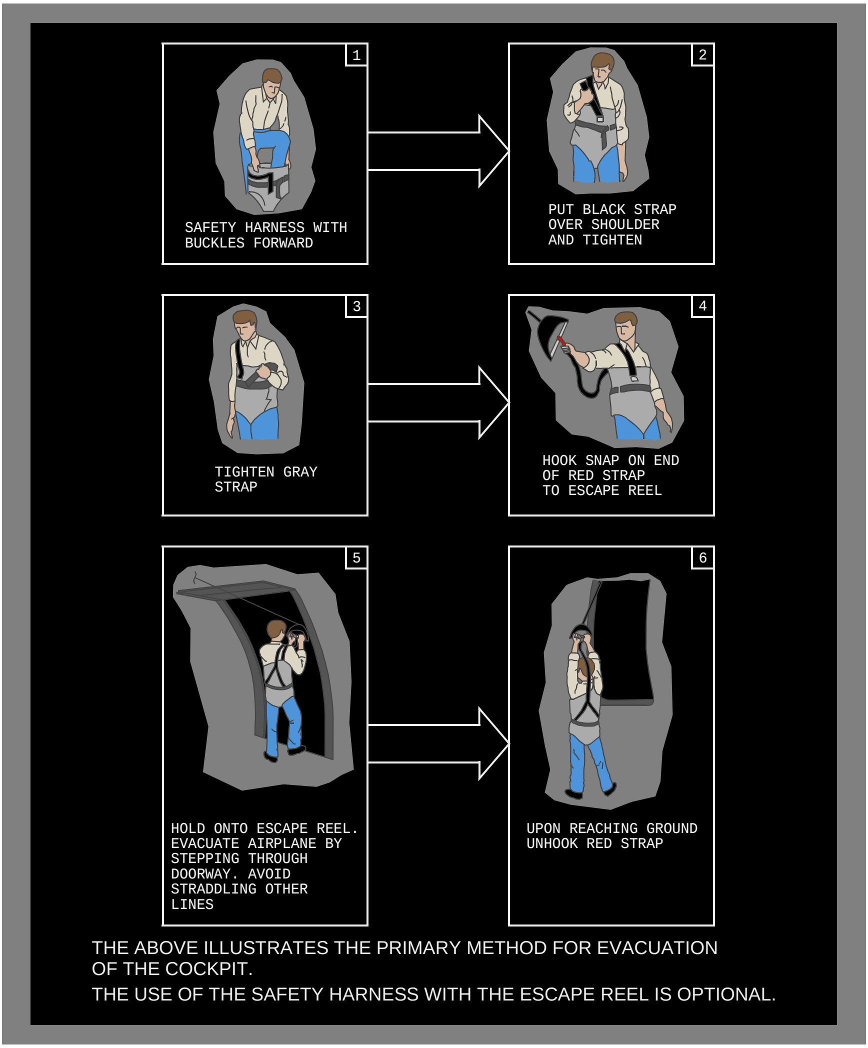
The ENTRY DOORS light illuminates and the EICAS advisory message L FWD ENTRY DOOR displays when the crew entry door is not closed and locked.

WARNING: Stand clear of the door handle, the handle may move as the door is lowered.

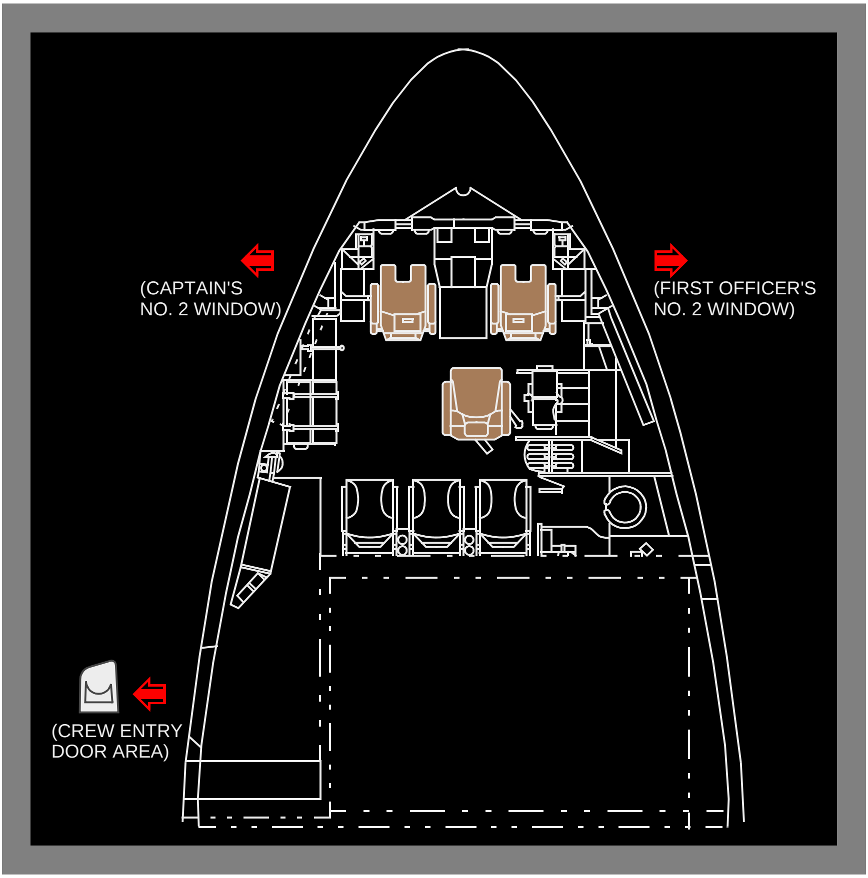
Main Deck Cargo Access Door

Access between the main deck cargo compartment and the flight deck is provided by the main deck cargo access door. The door is hinged and opens inward toward the flight deck side. To unlatch and open the door, rotate the handle located on the center of the door counterclockwise and pull. To close and latch the door, rotate the handle counterclockwise, push the door closed, and rotate the handle fully clockwise until the handle stops in the latched position.

Flight Deck Evacuation – Crew Entry Door



Emergency Exits



Main Cargo Door

Access to the main cargo compartment is provided by the main cargo door on the left side of the airplane. The door is controlled electrically from the ground handling bus.

To operate the door, pull and hold the Lock/Unlock switch to the UNLOCK position until the UNLOCKED light illuminates indicating the door is unlocked and ready to be opened. Then, pull and hold the Open/Close switch in the OPEN position until the OPENED light illuminates indicating the door is fully open.

To close the door, observe the CLOSED light and LATCHED light are extinguished and the UNLOCKED light is illuminated. Then, pull and hold the Open/Close switch in the CLOSE position until the CLOSED and LATCHED lights illuminate. Next, observe the LOCKED light is extinguished. Then, pull and hold the Lock/Unlock switch in the LOCK position until the LOCKED light illuminates.

If the Open/Close switch is released during door movement, the door will stop.

The door can be operated manually from separate controls located near the main deck cargo door. Placards located by the controls provide proper operation information.

Cargo Doors

There are four cargo doors: one AFT cargo, one BULK cargo, one FWD cargo, and one MAIN cargo door. Both AFT and FWD cargo doors are located on the right side of the airplane. The BULK and MAIN cargo door are on the left side of the airplane. The both AFT, FWD and MAIN cargo doors open upward and outward.

Both AFT and FWD cargo doors are normally operated electrically from an exterior or interior fuselage–mounted control panel located with each door. If necessary, the forward and aft cargo doors may be operated manually.

On airplanes with a large forward cargo door, locking is accomplished manually.

CAUTION: Do not operate the cargo doors with winds at the door of more than 40 knots. Do not keep the door open when wind gusts are more than 65 knots. Strong winds can cause damage to the structure of the airplane.

The CARGO DOORS light illuminates and the EICAS caution message AFT CARGO DOOR, FWD CARGO DOOR or MAIN CARGO DOOR displays if the respective door is not closed and latched and locked. An EICAS advisory message BULK CARGO displays if this door is not closed and latched and locked.

Flight Deck Seats

The pilot seats:

- recline
- adjust vertically
- adjust forward and aft
- adjust for thigh support
- adjust for the lumbar region of the back

The seats also have:

- adjustable armrests
- crotch straps
- inertial–reel shoulder harnesses with manual locks
- lap belts
- adjustable headrests

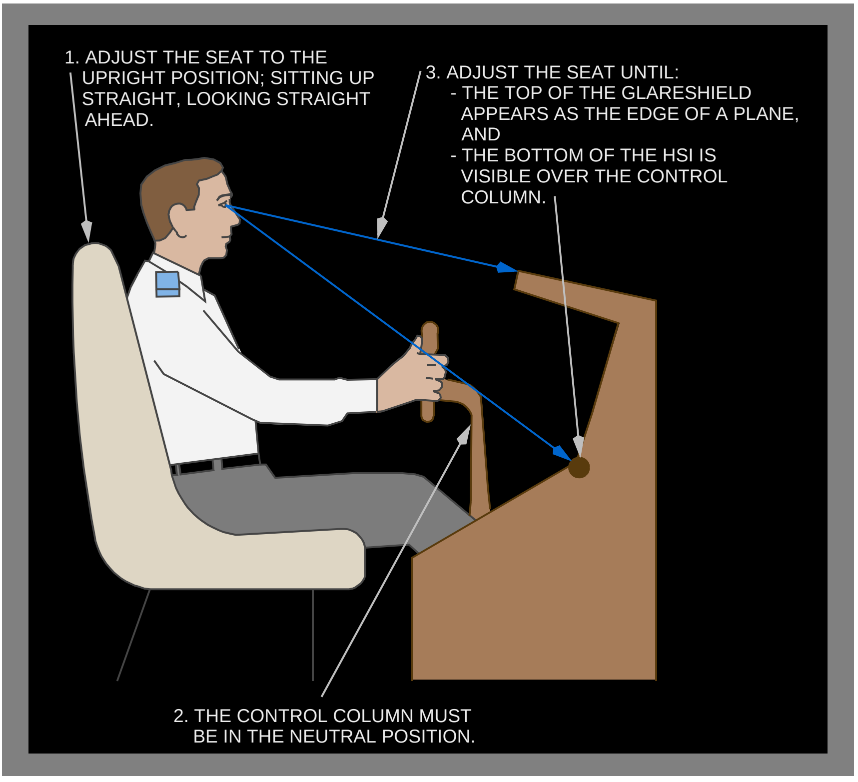
The seats move outboard during the last four inches of travel. Manual controls provide forward, aft, and vertical adjustment.

N422LA through N526LA
Electrical controls provide forward, aft, and vertical adjustment.

Lumbar and thigh pad support can be adjusted using the adjustment hand wheels. Armrest pitch can be adjusted using the control knob under the armrest. The armrests can be stowed vertically for easier seat access.

Adjust the seat to obtain the optimum eye position as shown on the following illustration.

Pilot Seat Adjustment



Airplane General, Emergency Equipment, Doors, Windows — Chapter 1
Emergency Equipment — Section 45

Introduction

This chapter describes miscellaneous airplane systems, including:

- emergency equipment
- emergency equipment locations

Emergency Equipment

Emergency equipment described in this section includes:

- fire extinguishers
- miscellaneous emergency equipment

Fire Extinguishers

Fire extinguishers are located throughout the aircraft. See emergency equipment diagram for location.

The type of fire extinguishers are as follows:

- Halon (BCF)

Halon (BCF) fire extinguishers are located on the flight deck. See emergency equipment diagram for location.

WARNING: **If a fire extinguisher is to be discharged in the flight deck area, all flight crew members must wear oxygen masks and use 100% oxygen with emergency selected.**

CAUTION: **For electrical fires, remove the power source as soon as possible. Avoid discharging directly on persons due to possibility of suffocating effects. Do not discharge too close to fire as the discharge stream may scatter the fire. As with any fire, keep away from the fuel source. Avoid breathing vapors, fumes, and heated smoke as much as possible.**

Halon Fire Extinguishers

Halon fire extinguishers contain a liquefied gas agent under pressure. The extinguisher pressure indicator shows three pressure ranges:

- acceptable
- recharge
- overcharged

A safety pin with a pull ring prevents accidental trigger movement. When released, the liquefied gas agent vaporizes and extinguishes the fire. The extinguisher is effective on all types of fires, but is used primarily on electrical, fuel, and grease fires.

Direction for use of the fire extinguisher is printed on the extinguisher.

Miscellaneous Emergency Equipment

Additional equipment is stowed at strategic locations throughout the airplane. This may include a crash axe, megaphones, flashlights and first aid kits. Life vests are stowed at each crew member station and at each passenger seat.

Emergency Locator Transmitters (ELTs)

Portable ELTs may be installed on the flight deck, as shown in the Emergency Equipment Locations diagram.

N422LA through N526LA
Fixed ELT is installed in left overhead panel.

Fuselage Mounted Emergency Locator Transmitter (ELT)

N422LA through N526LA

An emergency locator transmitter (ELT) is mounted to the top center of the fuselage in the passenger cabin area. The ELT automatically transmits distress signals on 121.5 MHZ, 243 MHZ, and 406 MHZ if a high deceleration is sensed, or if the ELT switch is positioned to ON.

The EICAS advisory message ELT ON is displayed if the transmitter is activated. The ELT can be deactivated by placing the ELT switch to RESET momentarily (between 1 and 3 seconds), then ARMED.

Escape Ropes

Escape ropes are attached to the airplane structure above both number two flight deck windows. The ropes are stowed in compartments above the pilot seats. Prior to dropping the rope out of the window, ensure the rope is attached by pulling down. There is an additional escape rope installed over the crew entry door.

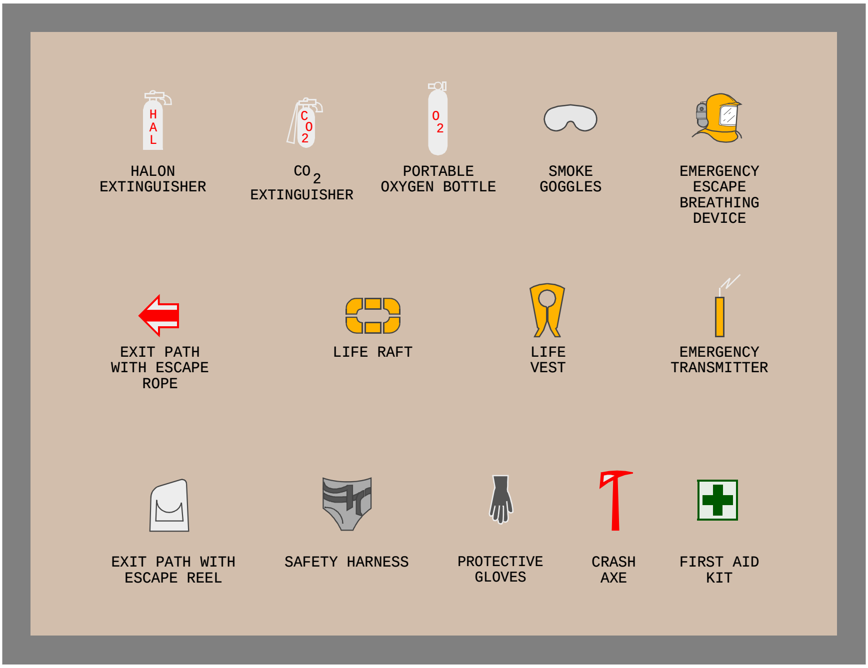
Escape Reels

Escape reels are stowed in a container mounted in the flight crew entry door area. If conditions permit, the reels are used as the primary means for exiting through the entry door during cockpit evacuation. The reels are used by removing them from the holder and departing through the crew entry door while holding the device handle. Inertial reels limit the speed of descent.

Safety Harnesses

Safety harnesses are stowed with the life vests below the supernumerary seats (two per seat). The safety harnesses may be used with the escape reels when exiting through the entry door. The harnesses provide additional security if needed.

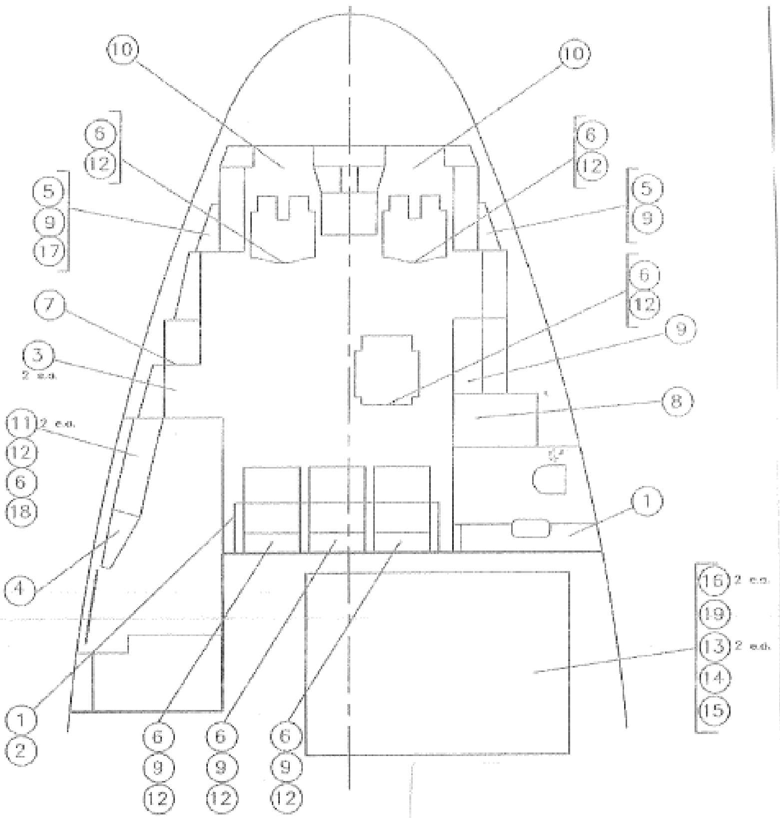
Emergency Equipment Symbols - NOT USED BY FWIA



B767-300F Emergency Equipment Locations Legend

Item	Description	Quantity
1	Portable Oxygen Bottle	2
2	Emergency Locator Transmittor	1
3	Halon Fire Extinguisher	2
4	First Aid Kit	1
5	Flashlight	2
6	Flight Crew Life Vest	7
7	Protective Breathing Equipment	1
8	Crash Axe	1
9	Smoke Googles	6
10	Escape Rope	2
11	Life Raft	2
12	Safety Harness	7
13	Portable Oxygen Bottle with Full Face Mask inside crew rest	2
14	Dangerous Merchandise Kit (not for use in flight)	1
15	Crash Axe inside crew rest	1
16	Flashlight inside crew rest	2
17	Fire Protective Gloves	1
18	Demo Kit (Life Vest & Safety Harness)	1
19	Halon Fire Extinguisher in crew rest	1

B767-300F Emergency Equipment Location Diagram



Intentionally
Blank

Airplane General, Emergency Equipment, Doors, Windows EICAS Messages

The following EICAS messages may be displayed.

Access Doors

Message	Level	Light	Aural	Condition
ACCESS DOORS	Advisory	ACCESS DOORS		Forward equipment bay and electrical equipment compartment access doors are not closed , latched, and locked.
E/E ACCESS DOOR	Advisory	ACCESS DOORS		Electrical equipment access door is not closed, latched, and locked.
FWD ACCESS DOOR	Advisory	ACCESS DOORS		The forward equipment bay access door is not closed, latched, and locked.

Cargo Doors

Message	Level	Light	Aural	Condition
AFT CARGO DOOR	Caution	CARGO DOORS		Cargo door is not closed, latched, and locked.
BULK CARGO DOOR	Advisory	CARGO DOORS		Cargo door is not closed, latched, and locked.
FWD CARGO DOOR	Caution	CARGO DOORS		Cargo door is not closed, latched, and locked.

Message	Level	Light	Aural	Condition
MAIN CARGO DOOR	Caution	CARGO DOORS		Cargo door is not closed, latched, and locked.

Entry Doors

Message	Level	Light	Aural	Condition
L FWD ENT DOOR	Advisory	ENTRY DOORS		Entry door is not closed, latched, and locked.

Emergency Lights

Message	Level	Light	Aural	Condition
EMER LIGHTS	Advisory	UN-ARMED		The emergency lights switch is not in the Armed position.

Emergency Locator Transmitter (ELT)

N422LA through N526LA

Message	Level	Aural	Condition
ELT ON	Advisory		An ELT has been activated.

Introduction

Volume 2 of this Flight Crew Operations Manual describes the aircraft systems for aircraft N316LA. Sections 60 through 75 of this chapter cover the systems differences for aircraft registration number CC-CZZ. The sections in this chapter are set up to correspond to the applicable system chapter in volume 2 of the Flight Crew Operations Manual. The list below details this relationship:

Aircraft System	FCOM Volume. 2 Chapter	CC-CZZ Differences Section in this Chapter
Airplane General	1	61
Automatic Flight	4	64
Communications	5	65
Engines, APU	7	67
Flight Instruments, Displays	10	70
Flight Management, Navigation	11	71
Fuel	12	72
Warnings	15	75

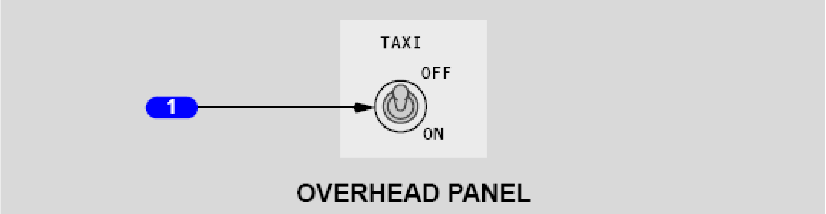
All FWIA crewmembers must be familiar with the information contained in this section prior to operation of aircraft registration number CC-CZZ.

Intentionally
Blank

Runway Turnoff Light Switches

1 - RUNWAY TURNOFF Light Switches
ON – the runway turnoff light illuminates.
OFF – the runway turnoff light extinguishes.

Taxi Light Switch



1 - TAXI Light Switch
ON – the taxi light illuminates.
OFF – the taxi light extinguishes.
Note: The taxi light does not illuminate when the nose landing gear is not down and locked.

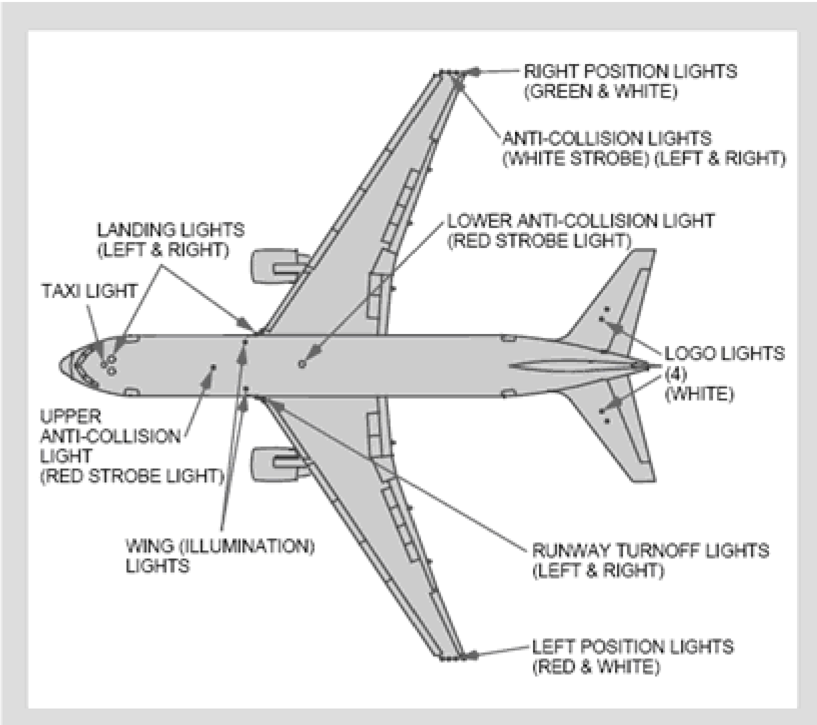
Exterior Lighting

Exterior lighting consists of these lights:
- landing
- runway turnoff
- anti-collision
- navigation (position)
- wing leading edge illumination
- taxi
- logo

Taxi Light

The taxi light is installed on the steerable portion of the nose landing gear. The light is inoperative when the nose landing gear is not down and locked.

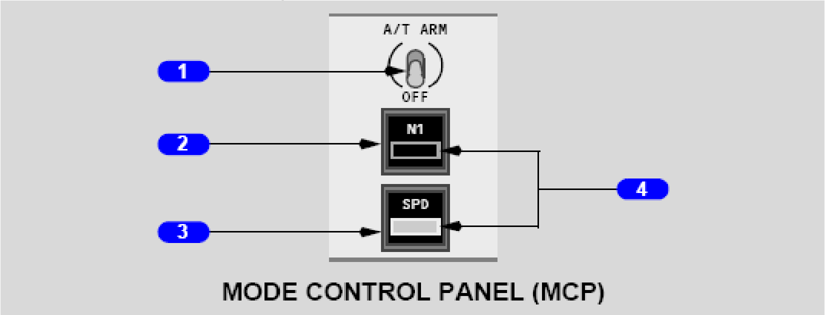
Exterior Lighting Locations



Flight Deck Seats

Electrical controls provide forward, aft, and vertical adjustment.

Autothrottle (A/T) System Controls

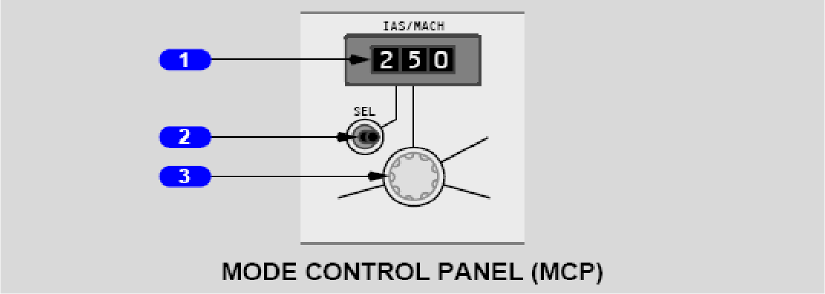


2 - N1 Switch

Push –

- selects autothrottle N1 mode
- N1 annunciates on each FMA
- autothrottle holds reference thrust value displayed on EICAS subject to maximum speed limits

Autopilot Flight Director IAS/MACH Controls



3 - IAS/MACH Selector

Push – when VNAV mode is engaged, alternately changes IAS/MACH window between current IAS or MACH and a blank display.

- VNAV active, window opens and speed control transfers from FMC target speed to IAS/MACH selector

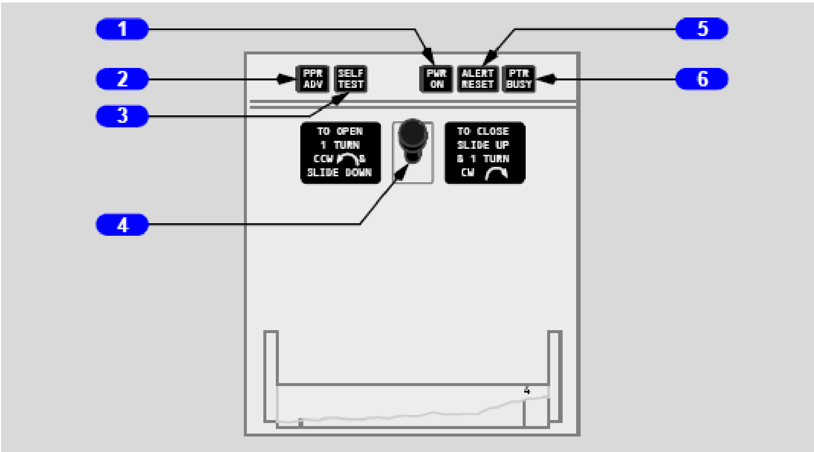
Intentionally
Blank

VHF Communication Panel

5 - COMM TEST Switch

Push – removes automatic squelch and permits reception of background noise to verify VHF receiver operation.

Printer



1 - POWER ON Light
Illuminated – power is applied to the printer.

2 - Advance (PPR ADV) Switch
Push – advances printer paper as long as switch is pushed.

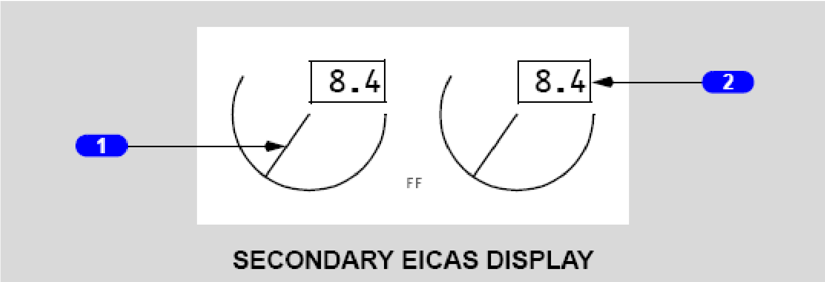
3 - SELF TEST Switch
Push – produces test pattern as long as switch is pushed.

4 - Paper Access Knob
Opens access door for paper replacement.

5 - ALERT RESET Switch
Push – resets aural/visual printer alert functions.

6 - Printer (PTR) BUSY Light
Illuminated – printer is processing message text.

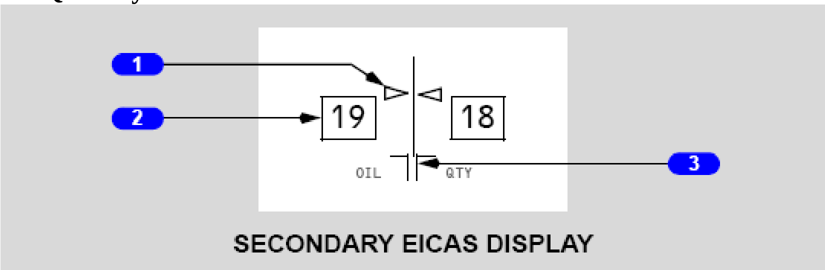
Fuel Flow Indications



2 - Fuel Flow (FF)

Displayed (white) – fuel flow to the engine (pounds per hour x 1000)

Oil Quantity Indications



2 - Oil Quantity

Usable oil quantity (quarts), displayed:

- (white) – normal quantity

Thrust Management Computer (TMC)

The CON switch is used to select maximum continuous thrust inflight. The CRZ switch is used to select cruise thrust inflight. The assumed temperature selector is used to set assumed temperatures when reduced takeoff thrust is desired.

Assumed Temperature Takeoff

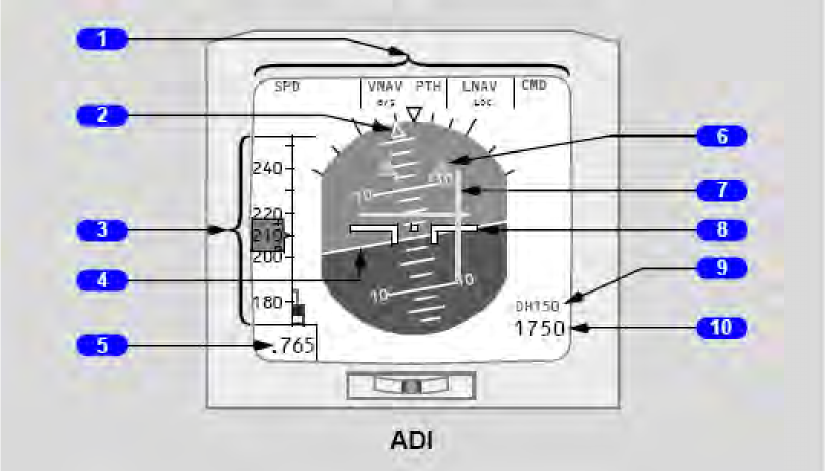
The thrust management computer calculates the reference N1 for assumed temperature reduced thrust takeoff. The assumed temperature can be selected using the assumed temperature selector on the TMSP. The assumed temperature is displayed above the thrust reference mode.

When the assumed temperature selector on the TMSP is initially rotated clockwise, a reference temperature is displayed on EICAS. This temperature also appears on the CDU TAKEOFF REF page as TEMP SEL.

Assumed temperature takeoff thrust is limited to a 25% reduction of takeoff thrust or selected climb thrust, whichever is the greater thrust value. When the limit is reached, further clockwise rotation of the selector does not change the displayed assumed temperature or reference thrust value.

Attitude Director Indicator (ADI) Display

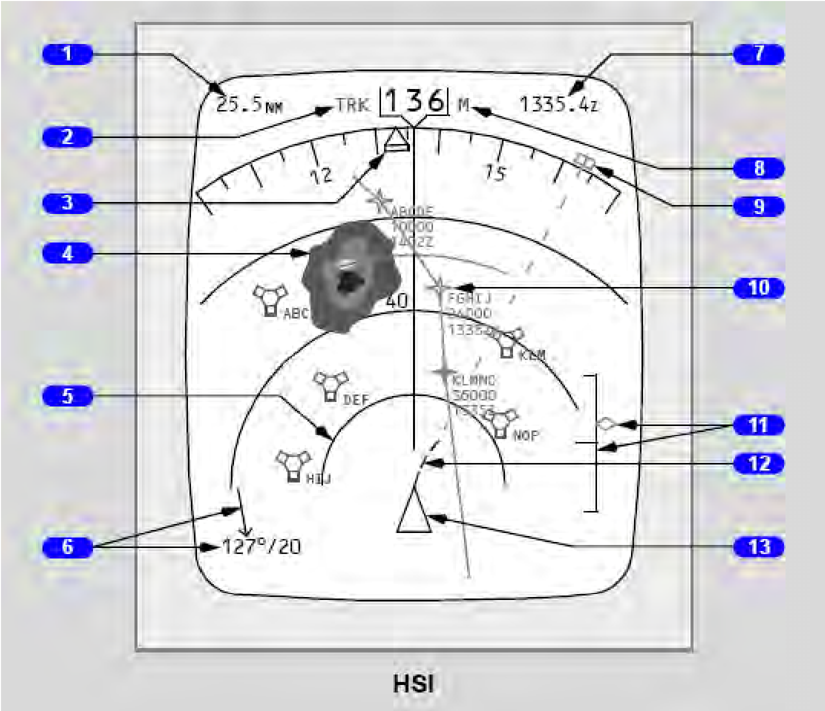
ADIs with Flight Mode Annunciations (FMA) on Top



6 - Pitch Limit Indicator
Indicates pitch limit (stick shaker activation point for the existing flight conditions).
- displays when flaps are extended

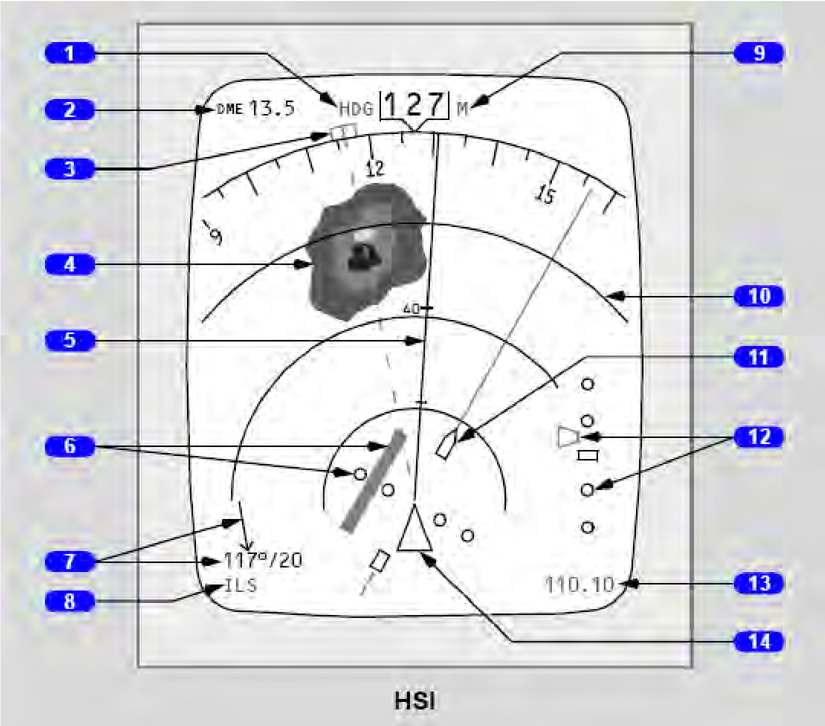
Horizontal Situation Indicator (HSI) Display Modes

MAP Mode



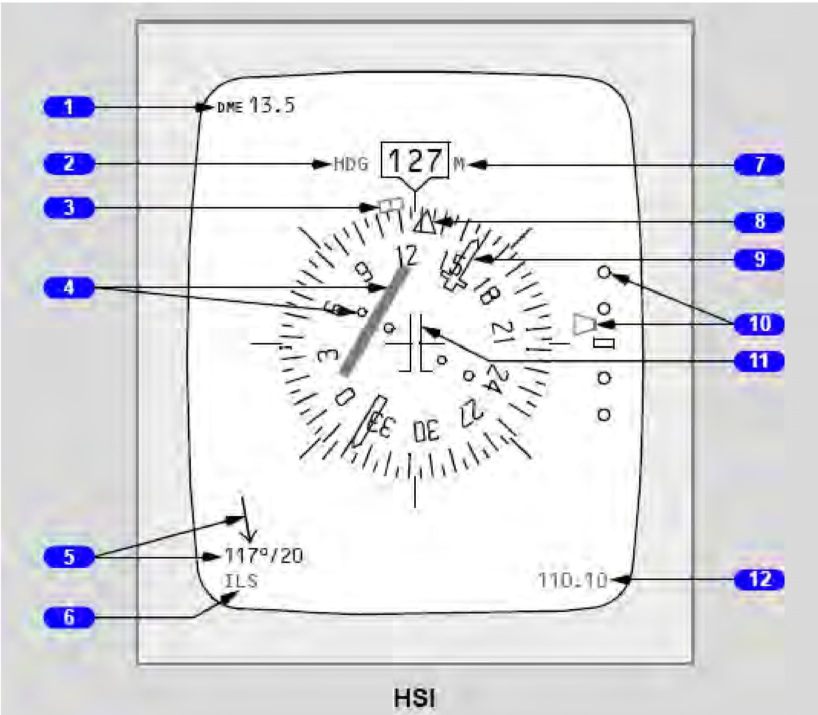
1 - Distance to the Active Waypoint
2 - Current Track
3 - Heading Pointer
4 - Weather Radar Returns
5 - Range Arcs
6 - Wind Direction and Speed
7 - Estimated Time of Arrival at the Active Waypoint
8 - Magnetic/True Reference
9 - Selected Heading Bug
10 - Active LNAV Route
11 - Vertical Pointer and Deviation Scale
12 - Position Trend Vector
13 - Airplane Symbol

EXP ILS Mode



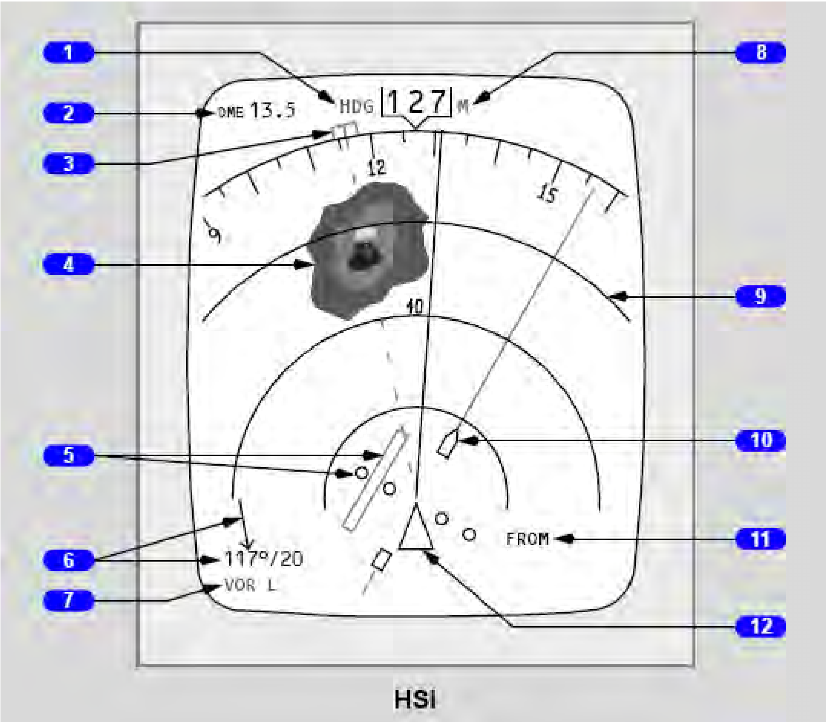
1 - Current Heading
2 - Reference ILS DME
3 - Selected Heading Bug
4 - Weather Radar Returns
5 - Track Line
6 - Course Deviation Indicator and Deviation Scale
7 - Wind Direction and Speed
8 - Reference ILS Receiver
9 - Magnetic/True Reference
10 - Range Arcs
11 - Selected Course Pointer
12 - Glideslope Pointer and Deviation Scale
13 - Reference ILS Frequency
14 - Airplane Symbol

FULL ILS Mode



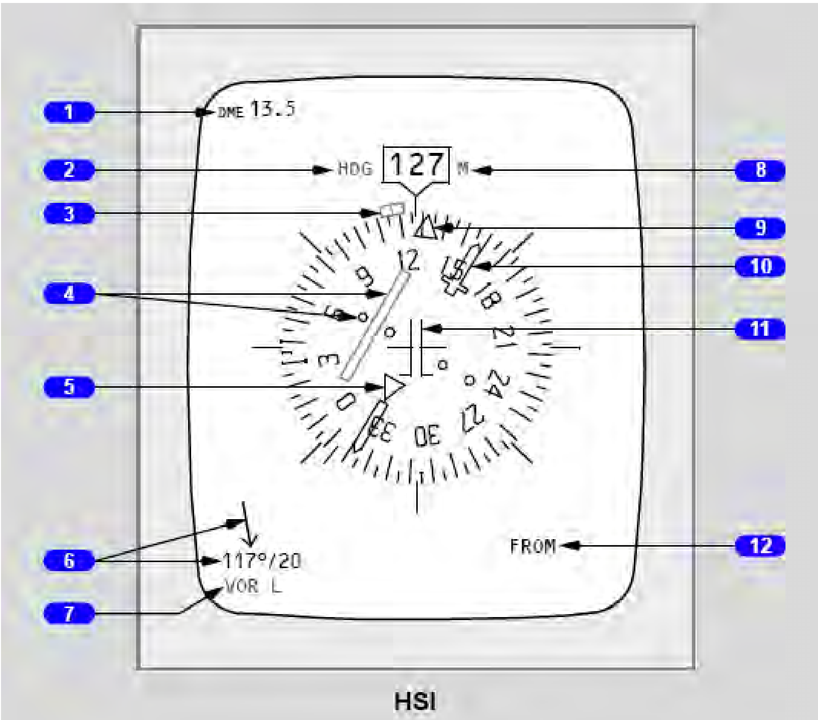
1 - Reference ILS DME
2 - Current Heading
3 - Selected Heading Bug
4 - Course Deviation Indicator and Deviation Scale
5 - Wind Direction and Speed
6 - Reference ILS Receiver
7 - Magnetic/True Reference
8 - Drift Angle Pointer
9 - Selected Course Pointer
10 - Glideslope Pointer and Deviation Scale
11 - Airplane Symbol
12 - Reference ILS Frequency

EXP VOR Mode



1 - Current Heading
2 - Reference VOR DME
3 - Selected Heading Bug
4 - Weather Radar Returns
5 - Course Deviation Indicator and Deviation Scale
6 - Wind Direction and Speed
7 - Reference VOR Receiver
8 - Magnetic/True Reference
9 - Range Arcs
10 - Selected Course Pointer
11 - TO/FROM Indication
12 - Airplane Symbol

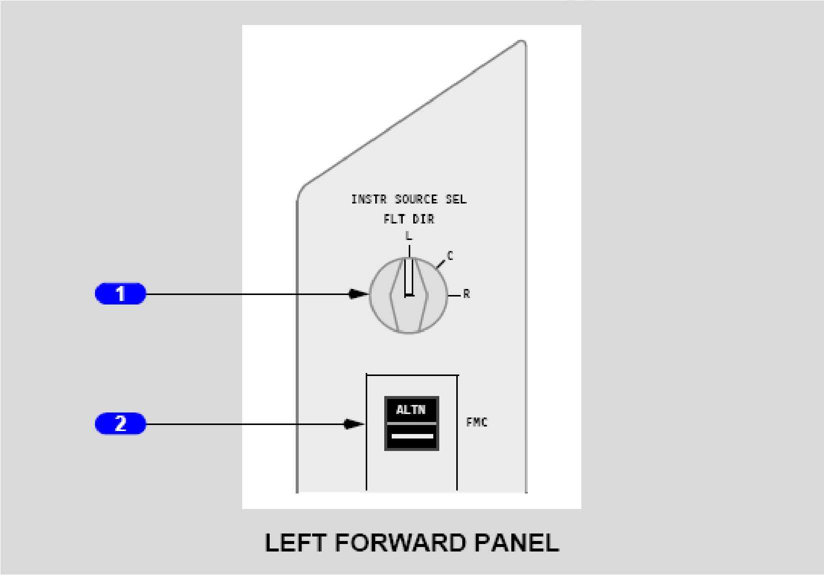
FULL VOR Mode



1 - Reference VOR DME
2 - Current Heading
3 - Selected Heading Bug
4 - Course Deviation Indicator and Deviation Scale
5 - To/From Pointer
6 - Wind Direction and Speed
7 - Reference VOR Receiver
8 - Magnetic/True Reference
9 - Drift Angle Pointer
10 - Selected Course Pointer
11 - Airplane Symbol
12 - TO/FROM Indication

Instrument Switching

Left Instrument Source Selector Panel (Upper)

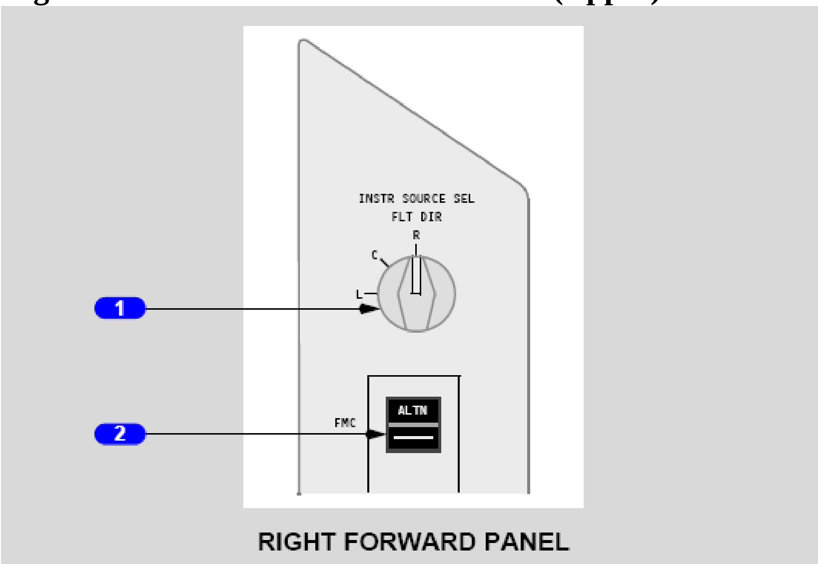


2 - FMC Switch

Selects the source of FMC information used by the left and center EFIS symbol generators and the left and center flight control computers (FCCs).

- Blank – normal position. The left FMC provides information to the left and center symbol generators, and to the left and center FCCs
- ALTN– alternate position. The right FMC provides information to the left and center symbol generators

Right Instrument Source Selector Panel (Upper)

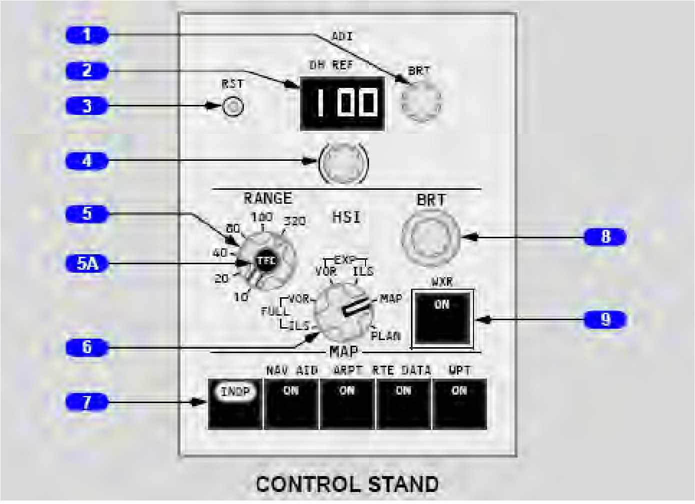


2 - FMC Switch

Selects the source of FMC information used by the right EFIS symbol generator and the right flight control computer (FCC).

- Blank – normal position. The right FMC provides information to the right symbol generator, and to the right FCC
- ALTN – alternate position. The left FMC provides information to the right symbol generator

EFIS Control Panel



6 - HSI Mode Selector

EXP/FULL VOR –

- displays VOR navigation information
- selects manual VOR and DME tuning on the VOR/DME panel (automatic tuning inhibited)

EXP/FULL ILS –

- displays ILS navigation information
- selects manual VOR and DME tuning on the VOR/DME panel (automatic tuning inhibited)

MAP –

- displays a dynamic map
- allows selection of manual or automatic VOR and DME tuning on the VOR/DME panel
- allows remote manual VOR and DME tuning on the PROGRESS page

PLAN –

- displays static FMC map in true–north–up orientation
- displays heading information in heading–up form
- allows selection of manual or automatic VOR and DME tuning on the VOR/DME panel
- allows remote manual VOR and DME tuning on the PROGRESS page
- activates the MAP CTR STEP prompt on the LEGS page for stepping through the displayed route

Horizontal Situation Indicator (HSI)

Track

Airplane track data is supplied by the FMC during normal operation.

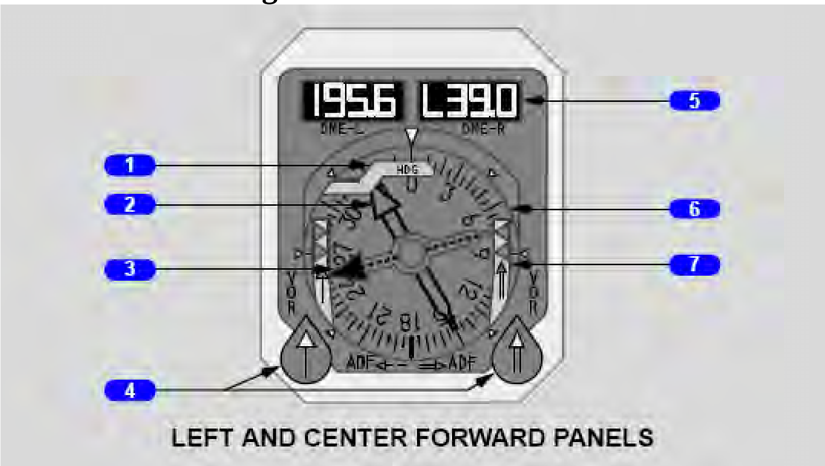
ILS Mode

The ILS mode is presented heading up. The ILS mode displays track, heading, and wind speed and direction with ILS approach information.

EFIS Failure Flags and Annunciations

If an FMC FAIL message is observed on a CDU, a MAP flag will appear on the associated HSI when viewing the MAP mode. Selecting ALTN with the FMC switch will restore the map display. However, the range selector for the opposite side pilot now controls the displayed range for both HSIs. If the failed side pilot selects a range that is not the same as the opposite side pilot, map information will again be lost and a MAP RANGE DISAGREE message will be displayed.

Radio Distance Magnetic Indicator



5 - Left/Right DME (DME –L/R) Indicators

Displays distance to the VOR–tuned station (VORTAC or VOR/DME) in nautical miles, except when ILS is selected on the associated (L or R) EFIS control panel.

- displays distance to the ILS–tuned station when ILS is selected on the associated (L or R) EFIS control panel (L is displayed when valid ILS/DME is available)
- displays dashes when no computed data is available
- displays blank when DME distance is unreliable

Intentionally
Blank

LINE SELECT KEY
(momentary action)

PUSH- selects or enters data on adjacent line
- selects page, procedure, data or function identified on adjacent line
- if scratch pad blank, copies adjacent data in scratch pad
- if scratch pad contains data, transfers scratch pad data to adjacent line, replacing previous data on selected line. This is normal method for entering data
- scratch pad data cannot be moved to blank line
- some data cannot be moved or changed
- scratch pad displays message if inappropriate line selection made

CDU DISPLAY
- displays pages of data as selected with Function and Mode Keys or Line Select Keys

PAGE TITLE
- indicates type of data displayed
- ACT or MOD may be displayed to indicate whether page is active or modified data

PAGE NUMBERS
- first digit indicates page number
- second digit indicates total number of related pages

BOXES
- indicates data entry required for full LNAV and VNAV capability
- data entered by transfering data from scratch pad using Line Select Key

DASHES
- indicates data entry is requested by system and should be made, if data known
- data entered by transfering data from scratch pad using Line Select Key

LINE TITLE
- identifies type of data on line below
- data line blanks when data unknown to FMC

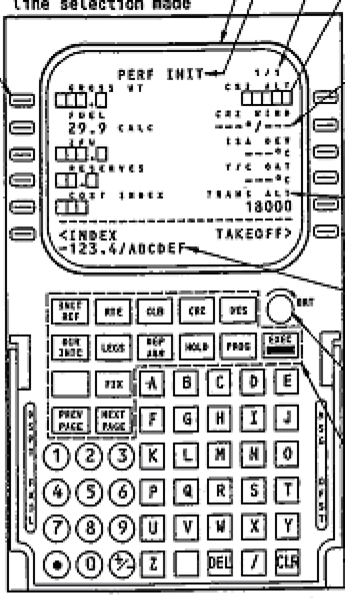
SCRATCH PAD LINE
- bottom line of display
- displays system generated messages for crew, keyboard entries and data being moved from one line to another
- may be blanked by pushing CLR Key

BRIGHTNESS CONTROL

ROTATE - controls intensity of display

FUNCTION AND MODE KEYS
(Momentary action)

PUSH - selects data for display or executes changes
- provides rapid access to data most often used



FORWARD ELECTRONIC PANEL (2)

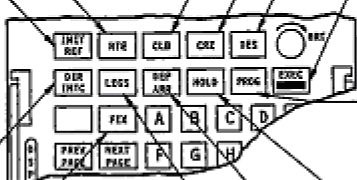
CONTROL DISPLAY UNIT (CDU)

INITIALIZATION/REFERENCE KEY

PUSH – selects page for initializing the navigation systems or various categories of reference data

ROUTE KEY

PUSH – selects page for entering or changing origin, destination or route



FIX KEY

PUSH – selects page for creation of intersections using bearing from an offroute waypoint (Fix) stored in data base

DIRECT/INTERCEPT KEY

PUSH – selects page with box prompts required for entering route from present position direct to waypoint, or to intercept designated course to waypoint

CLIMB KEY

PUSH – selects page for evaluating and changing climb schedule

CRUISE KEY

PUSH – selects page for evaluating and changing cruise schedule

DESCENT KEY

PUSH – selects page for evaluating and changing descent schedule

EXECUTE KEY

ILLUMINATED – (white) indicates modification to active route or vertical profile armed

PUSH – activates the modification and extinguishes the light in key

PROGRESS KEY

PUSH – selects current dynamic flight and navigation data, including ETAs for next two waypoints and destination

HOLD KEY

PUSH – selects page for entering or exiting holding pattern

DEPARTURE/ARRIVAL KEY

PUSH – selects page for entering or changing departure and arrival procedures for route one or route two

LEGS KEY

PUSH – selects page showing lateral and vertical details of each leg of route
- selects page for modifying lateral or vertical waypoints
- selects page for controling HSI PLAN mode map

CDU FUNCTION AND MODE KEYS

001

FMC FAIL LIGHT (amber)

ILLUMINATED – fault detected in related CDU or FMC

DISPLAY LIGHT (white)

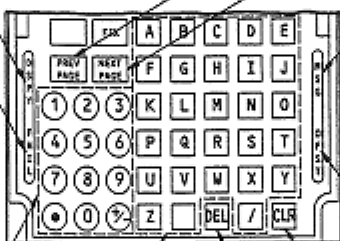
ILLUMINATED – displayed data is not related to active route leg or climb/cruise/descent schedule

PREVIOUS PAGE KEY

PUSH (momentary) – selects next lower page number in multiple page displays

NEXT PAGE KEY

PUSH (momentary) – selects next higher page number in multiple page displays



MESSAGE LIGHT (white)

ILLUMINATED – indicates system contains message for pilot
- if non-message data is displayed on scratch pad pushing CLR key displays message
- pushing CLR Key again extinguishes light and clears message

OFFSET LIGHT (white)

ILLUMINATED – LNAV based on lateral offset course

ALPHA KEYS
(momentary action)

PUSH – enters alpha characters on scratch pad.
/ key used to separate speed/altitude, wind direction/speed, bearing/distance and similar type entries

CLEAR KEY
(momentary action)

PUSH – clears scratch pad line
- momentary push clears last character of data
- holding down clears all data
- with message displayed on scratch pad, momentary push clears message, extinguishes MSG light and FMC light

NUMERIC KEYS
(momentary action)

PUSH – enters numeric characters on scratch pad. First push of +/- key enters - sign. Subsequent push changes sign to +

DELETE KEY
(momentary action)

PUSH – enters DELETE in scratch pad when scratch pad is blank. Subsequent line selection deletes data on adjacent line if the data is deleteable.

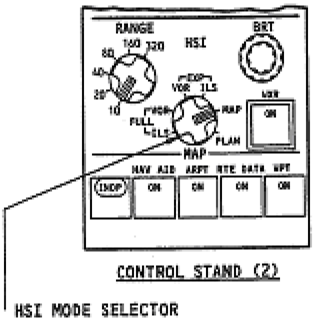
CENTER PANEL

FMC LIGHT (amber)

ILLUMINATED – CDU is displaying an operationally significant message on scratch pad
- pushing CLR Key extinguishes light and clears message

001

CDU/FMC LIGHTS



CONTROL STAND (2)

HSI MODE SELECTOR

FULL ILS - displays heading up, full, conventional, compass rose, and ILS navigation information
- displays ILS in lower left corner and and frequency in the lower right corner of the HSI
- require manual ILS/DME frequency tuning
- WXR displays inhibited

FULL VOR - displays heading up, full, conventional, compass rose and VOR navigation information
- displays VOR (L or R) in the lower left corner of the HSI
- require manual VOR/DME frequency tuning
- WXR displays inhibited

EXP VOR - displays heading up, expanded compase rose, and VOR navigation information
- displays VOR (L or R) in the lower left corner of the HSI
- requires manual VOR/DME frequency tuning
- displays WXR returns when weather radar is on

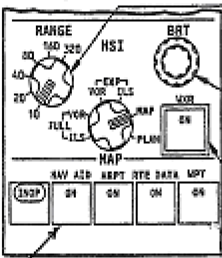
EXP ILS - displays heading up, expanded compass rose, and ILS navigation information
- displays ILS in the lower left corner and the frequency in the lower right corner of the HSI
- requires manual ILS/DME frequency tuning
- displays WXR returns when weather radar is on

MAP - displays track up, expanded compass rose, and dynamic FMC generated map information including aeronautical chart information, flight route information, airplane position and heading
- provides automatic tuning of VOR and DME from the FMC
- remote VOR/DME tuning is available via the CDU
- displays WXR returns when weather radar is on

PLAN - displays a static, true north up map in the lower portion of HSI, top portion remains the same as in the MAP mode
- provides automatic tuning of VOR and DME from the FMC
- remote VOR/DME tuning is available via the CDU
- permits pilot action via the CDU LEGS Page to step through a selected route
- WXR displays inhibited

HSI CONTROL PANEL

002



CONTROL STAND (2)

HSI RANGE SELECTOR

- selects desired nautical miles range for HSI MAP, PLAN and weather radar displays

HSI BRIGHTNESS CONTROLS (2)

OUTER CONTROL – adjusts brightness for HSI display

INNER CONTROL – adjusts brightness for weather radar display.

WEATHER RADAR SWITCH (alternate action)

ON – (ON illuminated white)
- displays radar data on related HSI

OFF – (blank) removes radar data from related HSI

MAP SWITCHES (alternate action)

- adds information to HSI display when selected
- multiple switches can be selected simultaneously
- illuminated ON (white) when selected

NAVAID – adds information to HSI Map mode
- displays high altitude navigation aids if on high map scales (80, 160, 320)
- displays all navigation aids if on low map scales (10, 20, 40)

AIRPORT – adds information to HSI Map mode
- displays all data base airports within the map area of the HSI

ROUTE DATA – adds information to HSI Map and Plan modes
- displays altitude and estimated time of arrival at each waypoint on the displayed route of flight

WAYPOINT – adds information to the HSI Map mode
- displays waypoints in data base not on the displayed route of flight if 40nm or less is selected for HSI range
- waypoints not displayed above 40nm selected HSI range

BLANK – spare

CDU AND FMC OVERVIEW

Refer to the next page for a diagram showing an overview of the system.

Entries made from either CDU are sent to both computers. Because of this interconnection, to prevent confusion it is recommended that only one CDU at a time be used for entering information. The second CDU is best used as a monitor to check information being entered on the other CDU.

The supporting systems supplying inputs to the FMC include the IRS, DME, VOR, ILS, clocks, air data computers, fuel quantity and fuel flow systems. Normally, each CDU and HSI map displays data from the related computer. Positioning a FMC switch to the ALTN position connects the related HSI and CDU displays to the other sides computer. This level of interconnection makes all flight management functions available as long as either CDU and either FMC is operating.

When a FMC switch is in the ALTN position the related HSI control panel must be set to the same map mode (MAP or PLAN) and range as the panel sending signals into the FMC being used. This is required to display a map on both sides of the cockpit because a FMC can only generate one map. However, the same FMC generated map can be displayed on both HSI.

If both FMCs are operating, they operate independently but occasionally compare data. If the comparison fails to meet established tolerances, or an FMC detects a potential fault, a resynchronization is initiated. (Actual faults may result in multiple resynchronizations followed by one FMC shutting down.)

One FMC is designated the master and the other is the slave. The left FMC is the master except when one of the following two conditions exist:

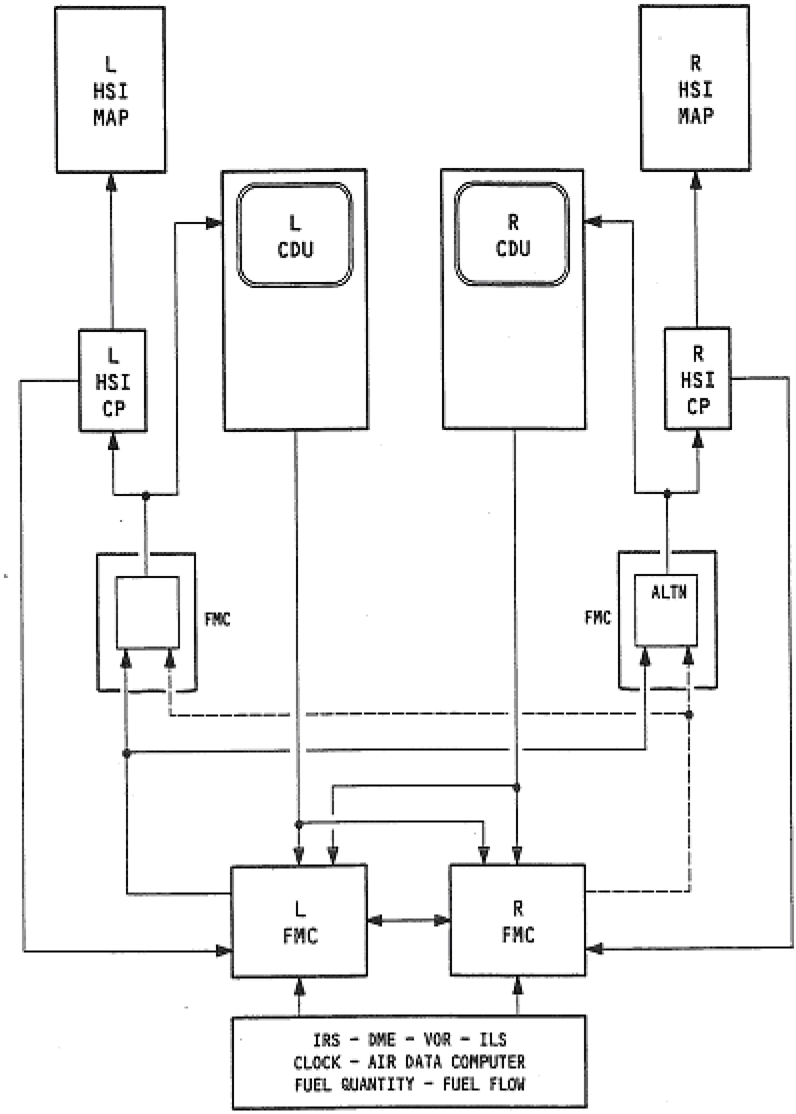
- the right autopilot is in command;
- all autopilots are disengaged, the left flight director is OFF and the right flight director is ON. (When operating in LNAV and/or VNAV mode the master FMC provides commands to the AFDS and autothrottle.)

In most cases the master FMC resynchronizes the slave FMC. However, if the master detects a potential fault the slave resynchronizes the master. During a resynchronization one FMC stops supplying data while the other FMC loads it with new data. Resynchronizations normally take about 15 seconds, but can take longer if a CDU key is pressed.

Any of the following flight deck indications may appear during a resynchronization: The FMC light illuminates and EICAS displays FMC MESSAGE and perhaps FMC FAIL. One CDU displays the RESYNCING OTHER FMC message while the other CDU display is frozen, or displays the FMC FAIL indications. The SINGLE FMC OPERATION message may appear. The HSI on the side being resynchronized displays the VTK flag. If the slave resynchronizes the master while in LNAV and VNAV mode, the autothrottle disengages and the AFDS indicates a mode failure (amber line through mode annunciation, F/D bar removed and an autopilot caution).

The FMC with CDU meets regulatory requirements for an Area Navigation System when used with radio updating. In this configuration, and in conjunction with the map display of the HSI, the FMC and CDU may be used for enroute and terminal area navigation and RNAV approaches and as a supplement to primary navigation means when conducting other types of non-precision approaches. In a dual FMC, dual CDU configuration and in conjunction with two or three IRS, the systems are approved for use as sole means of navigation in areas without radio coverage.

001



CONDITION: F/O USING ALTERNATE (LEFT) FMC FOR CDU AND HSI DISPLAYS

CDU OPERATION

General Rules

To avoid errors, work in a slow deliberate manner while operating the CDU. Avoid pushing more than one key at a time. Avoid entering data in both CDUs at the same time. Do not push CDU keys when the system is going through a resynchronization. Resynchronizations take about 15 seconds to complete. During this time one map and CDU shows a failed condition while the other CDU displays the RESYNCING OTHER FMC message.

When selecting a CDU page read the page title to ensure the correct page appears.

Check that the scratch pad line is blank before trying to enter data on the line. Use the CLR key as required to blank the scratch pad.

When entering data on the scratch pad line ensure that it is correct before continuing with the procedure.

Use care when pushing line select keys to ensure the correct key is being pushed.

Confirm that data displayed on the CDU is correct before pushing the EXEC key. If an error has been made, correct the erroneous data or push the ERASE line select key and then restart the procedure. Data cannot be entered on a blank line.

Messages that commonly indicate an error has been made are NOT IN DATA BASE, INVALID ENTRY and INVALID DELETE.

Preflight

During preflight, information from the flight plan and load sheet are entered into the CDU. This information defines the starting point of the flight for initialization of the inertial reference systems, the desired route to the destination to initialize LNAV, and performance information to initialize VNAV. If necessary, the CDU may be used to modify the flight plan while enroute.

Although the CDU may display many pages of information, proper page selection is not difficult. Automatic display of some pages as well as visual prompts on the CDU provide assistance in selecting the appropriate page for most tasks. For example, the diagram on the next page illustrates how at initial electrical power application the CDU displays the appropriate page for starting the preflight.

After checking and entering the necessary data on each preflight page, the lower right line select key is pushed to select the next page. When ACTIVATE is selected on the route page the EXEC key illuminates. The EXEC key should then be pushed to complete the task of making the route active before continuing the sequence.

If a Standard Instrument Departure (SID) must be entered into the route the DEP/ARR key is pushed. After selecting the desired SID the lower right line select key is again used to proceed with the preflight sequence.

When the TAKEOFF REF page is reached it confirms that all required preflight entries have been made by displaying PRE-FLT COMPLETE.

If the IDENT page is not displayed at the beginning of the preflight, such as during a through flight, the lower part of the diagram shows how the IDENT page can be selected by starting with the INIT REF (initialization) key.

001

Inflight

Inflight the CDU is used to modify the flight plan and display navigation and performance information.

The first step is to select the appropriate page of data by pushing the key that says what you want to do. For example, DIR = go direct; CLB = change climb conditions; HOLD = enter or exit holding pattern, etc. Then, if required, enter the desired modification.

For example, to fly from present position direct to a waypoint, push the DIR/INTC key and enter the waypoint in the box prompts that appear. Or to answer a "what if" type question, select the page that displays the desired information and enter the modified conditions. The CDU then displays predictions of what will happen if the modification is executed. The pilot then has the option of erasing or executing the modification.

LATERAL NAVIGATION

Position Determination

The FMC determines present position by using inputs from the IRS, DME, VOR and localizer receivers. The FMC uses its calculated present position to generate lateral steering commands along the active leg to the active waypoint.

While the airplane is on the ground the FMC calculates present position based only on data received from the IRS. To function the FMC requires a present position input from at least one IRS. Since inertial systems accumulate position errors as a function of time, the position information being used by the FMC is slowly accumulating errors. These position errors can be detected by observing the position of the airplane on the HSI map. If an extended ground delay occurs and a significant map error is noticed the IRS should be realigned and present position re-entered.

While the airplane is inflight the FMC refines its position calculations based on inputs from the three IRSs, DME, VOR, and ILS. The refinement of position calculations are made by use of two DME stations, if available, or one VOR and one colocated DME. During an ILS approach the position can also be refined by use of localizer signals.

Normally the FMC automatically tunes the VOR and DME to provide the best available signals for updating the FMC calculated present position. However, the pilot can select frequencies manually and if the FMC can continue to use the signals for position updating it will do so.

001

LNAV Guidance

General

LNAV guidance outputs from the FMC are normally great circle courses between the waypoints making up the active route. If the active route contains a holding pattern, guidance is provided to enter and remain in the holding pattern. When a procedure stored in the FMC data base is entered into the active route, the FMC may supply commands to fly procedure turns, constant headings or tracks, or follow a DME arc, as required to comply with the procedure.

Holding Patterns

The FMC computes holding patterns with constant radius turns based on the current wind and the FMC command speed (displayed on the command airspeed bug in VNAV mode). The computed pattern displayed on the HSI map is limited so as not to exceed the size of the FAA or ICAO protected airspace. In LNAV mode, the AFDS tracks the displayed holding pattern using up to a 30° bank angle. However, if airspeed or wind speed is in excess of the FAA and ICAO assumed speeds, the airplane may leave the protected airspace. This can be seen on the map by observing the airplane symbol or trend vector outside the magenta holding pattern.

The holding pattern entry method is not displayed on the HSI map. If LNAV mode is engaged before passing the holding fix, standard holding pattern entry methods (parallel, teardrop or direct entry) are used with the following differences:

1. The entry method used (parallel, teardrop or direct entry) is a function of actual airplane track as the holding fix is crossed, not a function of airplane heading or the direction from which the active route approaches the holding pattern.

2. The initial outbound leg is maintained until a distance from the fix is reached, rather than maintained for a specific time. This distance is a function of the command airspeed and wind speed as the holding pattern becomes active.

3. Teardrop entries use a 40° angle.

4. Parallel and teardrop entries may take the airplane slightly beyond the outside end of the pattern shown on the map. However, the airplane will remain in protected airspace if the airspeed is within FAA or ICAO limits.

If LNAV mode is not engaged until after passing the holding fix, standard holding pattern entries are not used. Rather, the initial turn is in the shortest direction toward a track equivalent to the holding pattern inbound course. If this is in other than the desired direction, Heading Select mode should be used to complete the desired entry procedure.

Heading Hold Submode

A submode of LNAV exists which is designed to maintain the airplane on current heading during the following conditions:

1. When flying into a route discontinuity.

   - The CDU message DISCONTINUITY is displayed.

2. When flying past the end of a lateral offset.

   - Approaching the end of an offset, the CDU message END OF OFFSET is displayed.

3. When flying past the last route waypoint.

   - The CDU message END OF ROUTE is displayed.

4. When executing an INTERCEPT LEG/COURSE TO procedure while the airplane is outside the LNAV capture band of the active leg.

   - If current airplane heading intercepts the active leg, LNAV maintains heading pending leg capture.

   - If current airplane heading does not intercept the active leg, LNAV maintains heading and the CDU message NOT ON INTERCEPT HEADING is displayed.

5. When the AFDS approach or localizer mode is armed and sequencing occurs to a leg aligned with the runway centerline, if at a waypoint that is between the runway and the end of the extended runway centerline on the HSI map.

   - Airplane maintains current heading until localizer capture rather than following the magenta line.

VERTICAL NAVIGATION

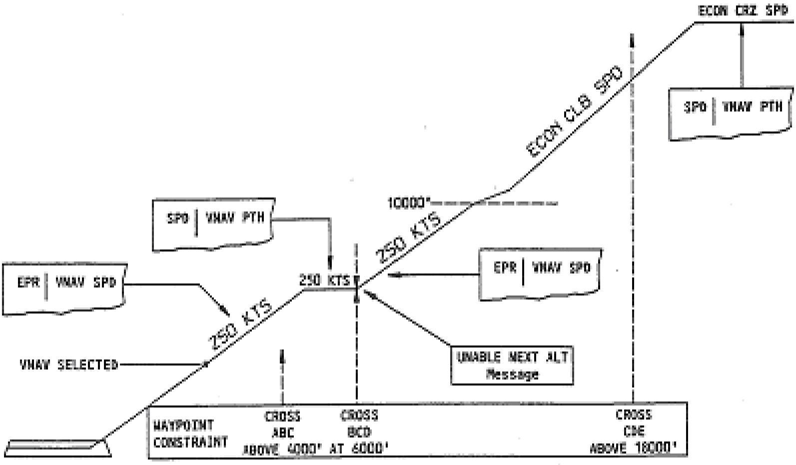
Climb and Cruise

Above 400 feet RA, VNAV mode can be engaged if the MCP Altitude Window is set to an altitude above the airplane. VNAV mode disengages if the MCP altitude is intercepted before reaching the FMC cruise altitude. After VNAV engagement, the MCP may be reset to an altitude below the airplane without causing a VNAV disengagement or climb interruption.

The VNAV profile that the FMC commands if not modified by the pilot is a climb with climb thrust at the airspeed limit associated with the origin airport until above the limit altitude, then climb at economy speed to the entered cruise altitude. During climb, remain within all altitude constraints that are part of a SID entered into the active route. Cruise at economy speed until reaching the top of descent point. Thrust is limited to maximum cruise thrust.

If flying the climb speed profile would cause a violation of an altitude constraint the UNABLE NEXT ALT message appears. The pilot must manually select a different speed on the MCP that provides a steeper climb angle.

The following diagram shows a climb profile containing waypoint altitude constraints and a speed transition with a limit of 250 kts below 10000 feet. The diagram also shows normal mode annunciations that appear on the ADI.



Descent

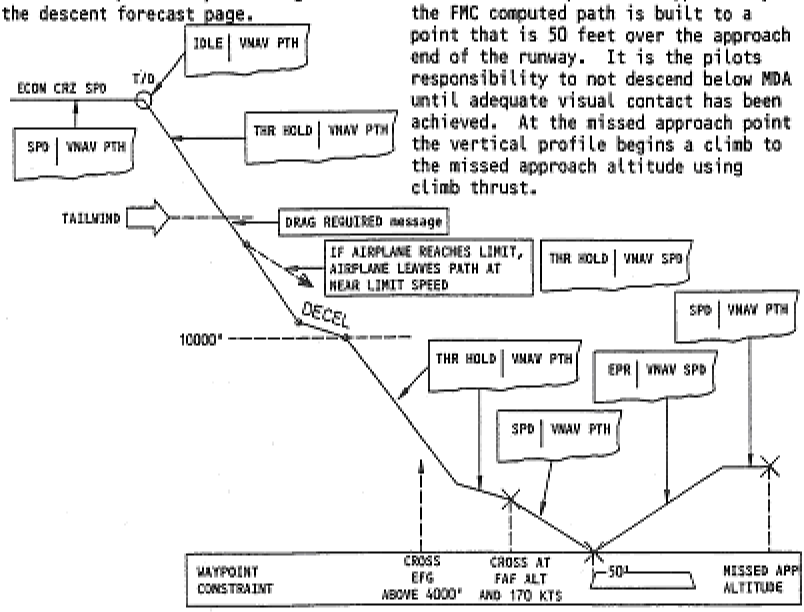
When an (E/D) point is entered the FMC calculates a descent path. (An E/D is a waypoint altitude constraint that requires a descent from cruise altitude. The E/D normally is entered on the legs page as a result of selecting a STAR or APPROACH.)

The descent path begins at the calculated T/D and passes over waypoints so as to comply with altitude constraints. The path to the first constraint assumes the use of idle thrust, speed brakes retracted, a wind speed that decreases with altitude and the appropriate target speed. Normally, the target speed is economy above 10,000 feet and 240 kts below 10,000 feet until necessary to begin a deceleration to reach the final approach fix (FAF) inbound at 170 kts. Target speeds may be changed by entries on the legs or descent page. Wind and thrust assumptions may be changed on the descent forecast page.

If the MCP is set to an altitude below the airplane, when the T/D point is reached the FMC commands idle thrust and pitch to track the descent path. VNAV disengages if MCP altitude is reached before the lowest altitude constraint. During descent the MCP may be set to an altitude above the airplane without VNAV disengaging or stopping the descent.

If an unexpected (not entered on descent forecast page) headwind is encountered, that causes a significant decrease in airspeed, thrust increases to regain the target speed. If the autothrottle is not engaged, a THRUST REQUIRED message is displayed. If an unexpected tailwind is encountered, that causes a significant increase in airspeed, the DRAG REQUIRED message is displayed. If airspeed reaches a limit the airplane flies the limit speed even if it must leave the path.

For VFR and non-precision approaches, the FMC computed path is built to a point that is 50 feet over the approach end of the runway. It is the pilots responsibility to not descend below MDA until adequate visual contact has been achieved. At the missed approach point the vertical profile begins a climb to the missed approach altitude using climb thrust.



OPERATIONAL NOTES

1. When operating in LNAV and VNAV modes monitor system operation for undesired pitch, roll or thrust commands. If undesired operation is noticed switch over to the heading select and flight level change modes.

2. The system should be carefully monitored for errors following activation of a new data base, resynchronization, power interruption or IRS failure.

3. During two IRS operation each FMC uses a different IRS for position calculations. The IRS positions are not averaged as during normal operation. This can result in a difference between the two HSI maps and descent paths when radio updating is not available.

4. When operating significantly off the active route, the active waypoint may not change as it is passed. When the LNAV mode is armed it can only capture the active leg. It will not capture an inactive leg in the active route. The DIRECT TO or INTERCEPT LEG/COURSE TO procedures may be used to make the desired leg active.

5. When the same waypoint is used more than once in the route, certain route modifications (such as DIRECT TO and HOLD) use the first waypoint.

6. Some standard instrument departures and arrivals contain a heading vector leg. These show on the CDU LEGS page as a VECTORS waypoint and on the map as a magenta line leading away from a waypoint or the airplane. When VECTORS becomes the active waypoint, sequencing of waypoints stops. Sequencing restarts when LNAV mode is disengaged, or a DIRECT/INTERCEPT is accomplished.

7. When entering airways into a route page the beginning and ending waypoints must be in the data base. Otherwise the route segment must be entered as a DIRECT leg.

8. Occasionally a procedure in the data base contains a hidden discontinuity that appears on the LEGS page as --- for the inbound course.

9. If an ILS procedure is entered into the active route, and it contains a leg to intercept the inbound course, LNAV mode will maintain intercept heading until LOC mode engages.

10. If engines are not shut down on landing, a cruise altitude entry must be made prior to the next flight to ensure that the vertical profile is rebuilt.

    If in descent and a diversion to another airport is entered, a cruise altitude entry must be made to rebuild the vertical profile

11. When operating outside the FMC navigation data base area the following operating characteristics will be noticed:

    A. The actual origin, destination and runways can not be entered into the route. However, any origin that is in the data base may be entered. An origin entry is required for VNAV operation.
    B. All waypoints must be entered as latitudes and longitudes.
    C. The FMC will not use radio signals to update its calculated position and will not tune the VOR or DME.
    D. The HSI map can not display airports navaids or waypoints that are not in route.

FUEL MONITORING

The FMC receives fuel data from the fuel quantity system and EICAS.

The fuel quantity system provides a totalizer value that is displayed on Progress Page 2. When this value is displayed on the Performance Initialization Page it is labeled SENSED.

The FMC also calculates a fuel quantity. Prior to engine start the calculated value is set to agree and track the totalizer value unless the pilot makes a manual fuel quantity entry. When the FMC receives a positive fuel flow signal (engine start) the calculated value is disconnected from the fuel quantity system until the engines are shutdown after the next flight. After start the calculated value decreases at the rate the fuel flow signals indicate. The calculated value is displayed on Progress Page 2. The calculated value is also displayed on the Performance Initialization page where it is labeled CALC unless a manual entry of fuel quantity is made. In that case it's labeled MANUAL.

If fuel is loaded after the FMC receives a positive fuel flow signal the calculated value will not include the new fuel loaded. This could occur if the engines are shutdown at one location, then restarted to taxi to the fueling location. Normal operation can be restored by making a manual fuel quantity entry on the Performance Initialization Page followed by deletion of the manual entry.

The fuel flow signals are also used for calculating the fuel used by the engines. FUEL USED is displayed on Progress Page 2 and is reset to zero following a flight and then shutdown of both engines.

Beginning with engine start, the FMC monitors the fuel load on board as detected by the fuel quantity system totalizer and as calculated by the FMC using fuel flow inputs. If the FMC determines a significant difference between the totalizer and calculated values the FUEL DISAGREE - PROG 2/2 or FUEL QTY ERROR-PROG 2/2 message is displayed on the CDU scratch pad. The pilot may then select which value the FMC should use for fuel calculations for the remainder of the flight.

The FMC also continually estimates the amount of fuel that will remain when the destination airport is reached if the active route is flown. If the estimate is less than the fuel reserve value entered on the Performance Initialization Page the INSUFFICIENT FUEL message is displayed.

CDU MESSAGES

Messages are generated by the FMC when a condition exists which degrades the operation of the system. Certain messages have a higher priority than others. Higher priority messages appear in the scratchpad regardless of the prior contents on the line. As messages are activated, they are displayed in the scratch pad if no high priority message is displayed; otherwise they are inserted below the stack of higher priority messages. As the CLR key is pushed, the stack is displayed sequentially from the top to the bottom. Only higher priority messages cause the EICAS to display FMC MESSAGE. All messages illuminate the CDU Message (MSG) annunciator light. Clearing the message or correcting the condition cancels the message.

The following list contains messages which cause FMC MESSAGE to appear on EICAS and illuminates the FMC and MSG lights.

MESSAGE	CAUSE
CHECK ALT TGT	VNAV is engaged when the airplane is between the MCP and FMC target altitudes. VNAV holds level flight.
CYCLE IRS OFF - NAV	IRS requires a shutdown and realignment prior to entering nav mode.
DESCENT PATH DELETED	VNAV engaged and all waypoint altitude constraint defining descent path are deleted.
DISCONTINUITY	LNAV engaged and airplane entered route discontinuity.
DRAG REQUIRED	VNAV engaged and additional drag or less thrust required to track descent path and maintain command speed.
END OF OFFSET	LNAV engaged and approaching end of route offset.
END OF ROUTE	LNAV engaged and end of active route overflown.
ENTER IRS POSITION	IRS requires a position entry prior to entering nav mode.

CDU MESSAGES (CONT)

MESSAGE	CAUSE
FUEL DISAGREE - PROG 2/2	Fuel totalizer and calculated values disagree by 3,000 lbs (1,360 Kg).
FUEL QTY ERROR - PROG 2/2	Fuel totalizer and calculated values disagree by 3,000 lbs (1,360 Kg).
INSUFFICIENT FUEL	Estimated fuel at destination is less than entered RESERVES value.
IRS MOTION	IRS sensed excessive airplane motion.
IRS NAV ONLY	FMC is navigating without radio updating. (Not acceptable for instrument approaches)
LIMIT ALT FLNNN	VNAV engaged and cruise altitude greater than VNAV limit altitude.
NAV INVALID - TUNE AAA (AAA = Required navaid)	Signals not being received from navaid required for approach procedure.
NO ACTIVE ROUTE	LNAV selected, but no route is activated.
PERF/VNAV UNAVAILABLE	VNAV selected without origin, gross weight, cost index and cruise altitude entry.
RESET MCP ALT	Approaching T/D point with MCP not set to altitude below cruise altitude.
RESYNC FAIL - SINGLE FMC	Resynchronization was unsuccessful and one FMC shutdown.
RESYNCING OTHER FMC	FMC synchronization in progress.
SINGLE FMC OPERATION	One FMC is inoperative.
THRUST REQUIRED	VNAV engaged, A/T disengaged and additional thrust required to track descent path and maintain speed.
UNABLE NEXT ALT	VNAV engaged and climb gradient not great enough to comply with waypoint altitude constraint.
VERIFY POSITION	Computed radio, mixed IRS or FMC positions differ.

CDU MESSAGES (CONT)

The following list contains messages which illuminate the MSG light, but does not illuminate the FMC light or display an EICAS message.

MESSAGE	CAUSE
ARR N/A FOR RUNWAY	Selected arrival and runway not compatible.
CRS REVERSAL AT FA FIX	Entered route contains a course reversal at final approach fix.
DELETE	DEL key pushed.
INVALID DELETE	Delete function attempted where not allowed.
INVALID ENTRY	The entry has an incorrect format and/or range.
INVALID TUNE REQUEST	Remote tune attempted to override a procedure specified navaid on Progress Page 1.
MANUALLY TUNED	Remote tuning attempted while manual tuning selected.
MAX ALT FLNNN	Entered cruise altitude greater than performance maximum altitude.
NNNNN (Altitude set in MCP)	VNAV engaged, climb or cruise page displayed, and new cruise altitude set in MCP.
NO ACTIVE ROUTE	DIR/INTC key pushed without active route.
NOT IN DATA BASE	Data not in system.
NOT ON INTERCEPT HEADING	LNAV selected and airplane outside active leg capture criteria and current heading will not intercept leg.
RE-ENTER IRS POSITION	Disagreement between SET IRS POS and IRS feedback position.

CDU MESSAGES (CONT)

MESSAGE	CAUSE
ROUTE FULL	Total number of waypoints in Route 1 plus Route 2 has filled FMC to its waypoint capacity. Last selection not entered in route.
RUNWAY N/A FOR SID	Runway not compatible with SID.
RW/ILS FREQ ERROR	Selected ILS frequency does not match frequency for runway in active route.
STANDBY ONE	The FMC requires more than 6 seconds to display data.
UNABLE CRZ ALT	Entered cruise altitude results in a zero cruise time prediction.
VOR AAA INVALID (where AAA is the VOR ident)	Inflight and remote CDU tuned VOR signal input is lost.

Intentionally
Blank

Fuel Tank Capacities

Tank	Liters	Kilograms *
Left main	22,751	18,267
Right main	22,751	18,267
Center	45,045	36,167
Total	90,547	72,700
* Usable fuel at level attitude, fuel density = 0.8029 kilograms per liter		

Fuel System FMS CDU Messages

The CDU can display the following message.

FUEL DISAGREE–PROG 2/2 – The fuel totalizer and calculated fuel quantity disagree

Intentionally
Blank

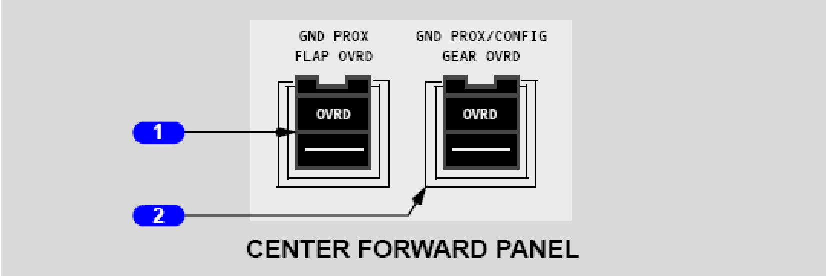
Master Warning/Caution Reset Switches and Lights

Pushing either Master WARNING/CAUTION reset switch also silences the warning siren and fire bell except for the following warnings:

- landing configuration (for example, when the flaps are in a landing position and landing gear are not down)
- autopilot disconnect
- takeoff configuration
- overspeed warning

Ground Proximity Warning System (GPWS)

GPWS Controls



1-Ground Proximity Flap Override (GND PROX FLAP OVRD) Switch

Push (OVRD visible) –

- inhibits the ground proximity TOO LOW FLAPS caution
- inhibits the ground proximity TOO LOW TERRAIN caution

2-Ground Proximity Configuration Gear Override (GND PROX/CONFIG GEAR OVRD) Switch

Push (OVRD visible) –

- inhibits the ground proximity TOO LOW GEAR caution
- inhibits the ground proximity TOO LOW TERRAIN caution
- inhibits the landing configuration warning siren

Ground Proximity Warning System (GPWS)

Introduction

The ground proximity warning system (GPWS) provides time-critical alerts for potentially hazardous flight conditions involving imminent impact with the ground. GPWS is enabled whenever power is applied to the airplane. Override or inhibit switches allow the flight crew to inhibit certain GPWS alerts.

GPWS (Enhanced)

In addition to standard alerts, enhanced GPWS provides look-ahead terrain awareness, including alerting and display functions. These functions compare the airplane's geographic position and altitude against an internal terrain database to predict and display potential conflicts between the airplane flight path and terrain.

GPWS Look–Ahead Alerts and Display

When the terrain control panel (TERR) display select switch is pushed on, the TERR annunciation is displayed on the HSI and terrain contours may be displayed.

GPWS look-ahead data and weather radar returns cannot be displayed simultaneously on an HSI. If either pilot selects terrain while the other selects weather radar, each display updates on alternating sweeps. All other navigation displays can be simultaneously displayed with terrain data.

Traffic Alert and Collision Avoidance System (TCAS)

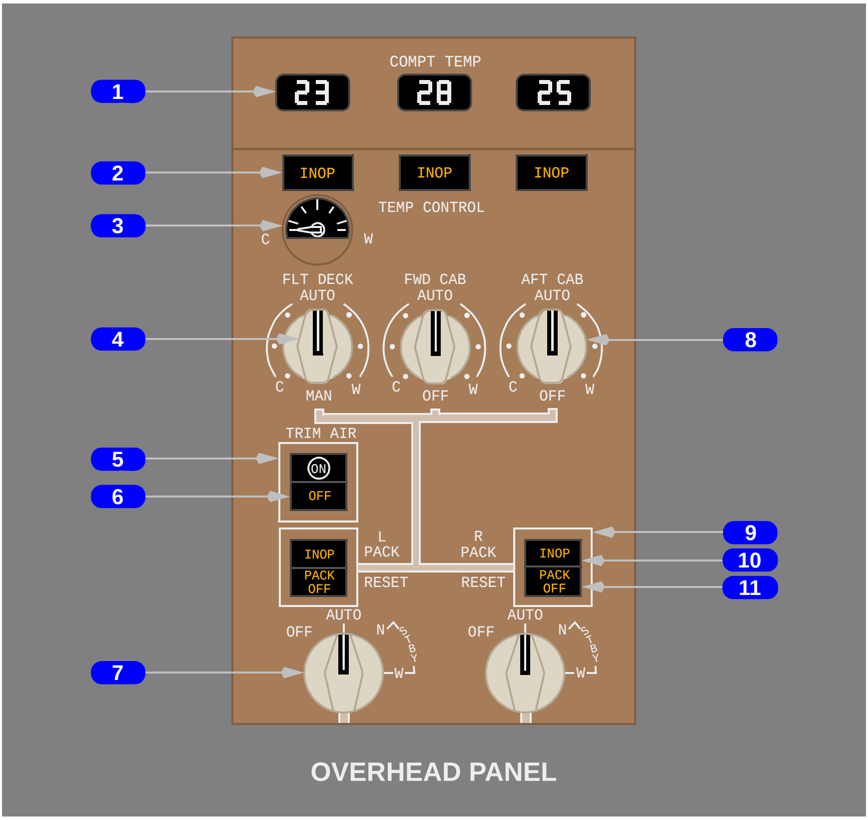
Automatic TA and RA Display

TCAS automatically displays RA and TA symbols on the HSI when:

- a RA or TA occurs, and
- neither pilot has pushed the EFIS Traffic (TFC) Switch, and
- the HSI Mode Selector is in the EXP VOR, EXP ILS, or MAP mode, and
- the TCAS Mode Selector is in TA ONLY or TA/RA

Intentionally
Blank

Air Conditioning System
Air Conditioning Control Panel



1 Compartment Temperature (COMPT TEMP) Indicators

Displays actual temperature sensed in the compartment.

2 Compartment Temperature Inoperative (INOP) Lights

Illuminated (amber) –

- fault in the zone temperature controller
- the Compartment Temperature Control is OFF (FWD and AFT CAB only)
- the trim air switch is OFF.

3 Flight Deck Trim Air Valve Position Indicator

C (cool) – valve closed

W (warm) – valve open

4 Flight Deck Compartment Temperature Control

AUTO

- provides automatic flight deck temperature control
- rotating the control toward C (cool) or W (warm) sets the desired temperature between 18 degrees C and 30 degrees C.

MAN

- provides manual control of compartment trim air valve
- spring loaded to the 6 o'clock position in this sector.

5 TRIM AIR Switch

ON – the trim air valve is commanded open.

OFF – the trim air valve is commanded closed.

6 Trim Air OFF Light

Illuminated (amber) – the TRIM AIR switch is off.

7 PACK Control Selectors

OFF – closes the pack valve.

AUTO – the pack is automatically controlled.

STBY

- N (normal) – regulates the pack outlet temperature to a constant, moderate temperature.
- W (warm) – sets the pack to full warm operation.

8 Compartment Temperature (COMPT TEMP) Controls

AUTO –

- provides automatic compartment temperature control
- rotating the control toward C (cool) or W (warm) sets the desired temperature between 18 degrees C and 30 degrees C.

OFF –

- closes the compartment trim air valve
- the compartment temperature INOP light illuminates.

9 PACK RESET Switches

Push –resets an overheated pack if the pack has cooled to a temperature below the overheat level.

10 Pack Inoperative (INOP) Light

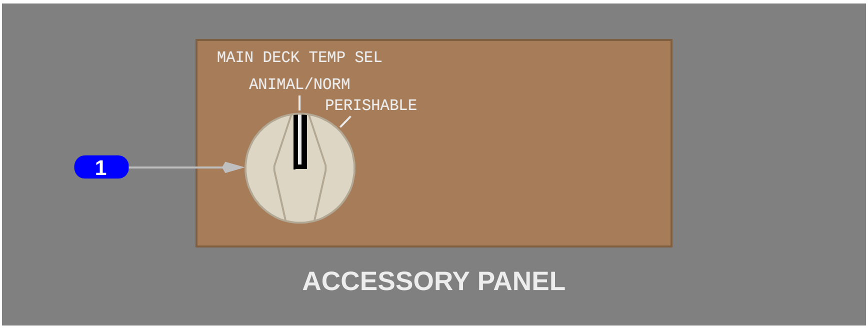
Illuminated (amber) –

- the pack is overheated
- fault in the automatic control system.

11 PACK OFF Lights

Illuminated (amber) – pack valve is closed.

Main Deck Temperature Selector

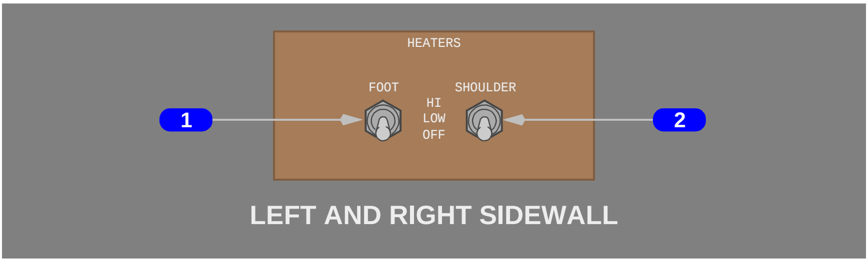


1 Main Deck Temperature Selector

Animal/Norm – allows the temperature for the FWD CAB and AFT CAB to be controlled between 18°C (65°F) and 30°C (85°F)

Perishable – allows the temperature for the FWD CAB and AFT CAB to be controlled between 2°C (35°F) and 22°C (71°F)

Shoulder and Foot Heaters



1 FOOT HEATERS Switch

HIGH – the electric heater adds heat at high setting to the conditioned air flowing to the rudder pedal area in flight only.

LOW – the electric heater adds heat at low setting to the conditioned air flowing to the rudder pedal area in flight only.

OFF – the electric heater is not operating (no heat added to the conditioned air flowing to the rudder pedal area).

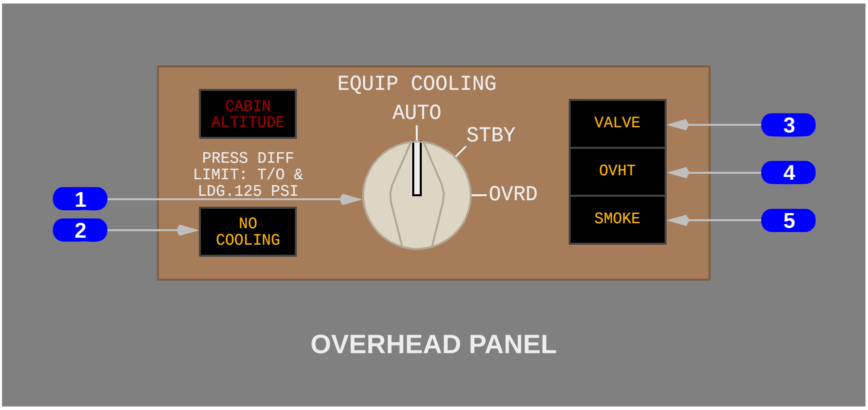
2 SHOULDER HEATERS Switch

HIGH – the electric heater adds heat at high setting to the conditioned air flowing to the side window area in flight only.

LOW – the electric heater adds heat at low setting to the conditioned air flowing to the side window area in flight only.

OFF – the electric heater is not operating (no heat added to the conditioned air flowing to the side window area).

Equipment Cooling Panel



1 Equipment (EQUIP) COOLING Selector

AUTO – automatically controls equipment cooling system.

STBY – positions equipment cooling system for inboard air flow.

OVRD – positions equipment cooling system for reverse air flow.

2 NO COOLING Light

Illuminated (amber) –

- active in OVRD only
- no reverse air flow through the E/E compartment avionics.

3 **VALVE Light**

Illuminated (amber) – equipment cooling valves are not in their commanded position.

4 **Overheat (OVHT) light**

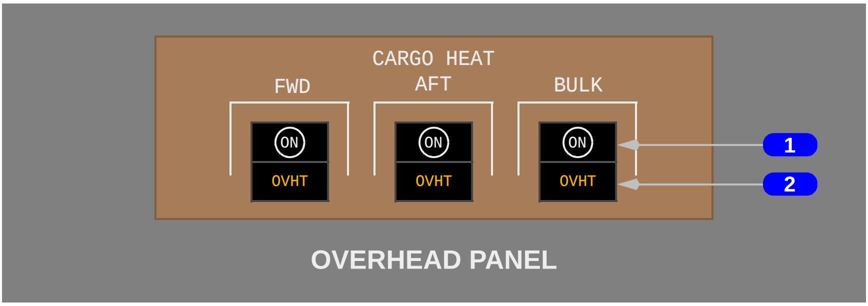
Illuminated (amber) – high temperature or low airflow in the equipment cooling system.

5 **SMOKE Light**

Illuminated (amber) – smoke in the equipment cooling system.

Cargo Heating

Cargo Heat Panel



1 **CARGO HEAT Switches**

ON – provides power for heat valves to cycle open and closed for automatic temperature control

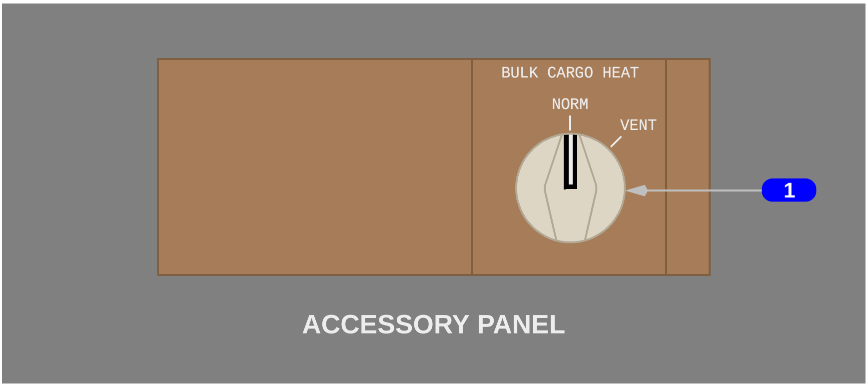
Off (ON not visible)– the heat valves are commanded closed

2 **Cargo Heat Overheat (OVHT) Lights**

Illuminated (amber) –

- cargo compartment temperature above standard control range
- shutoff valve signaled closed

Bulk Cargo Heat Panel



1 BULK CARGO HEAT Selector

Bulk cargo heat switch must be on

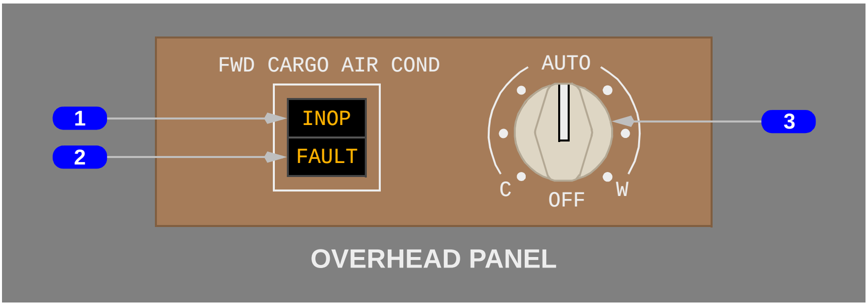
NORM – standard cargo heating range

VENT –

- requests higher temperature control range than NORM
- turns on ventilating fan for bulk cargo compartment

Cargo Air Conditioning

Forward Cargo Air Conditioning Panel



1 Forward Cargo Air Conditioning Inoperative (INOP) Light

Illuminated (amber) – system has failed.

2 Forward Cargo Air Conditioning FAULT Light

Illuminated (amber) –

- fault in forward cargo compartment temperature control system
- system is operating in backup

3 Forward Cargo Air Conditioning Temperature Control

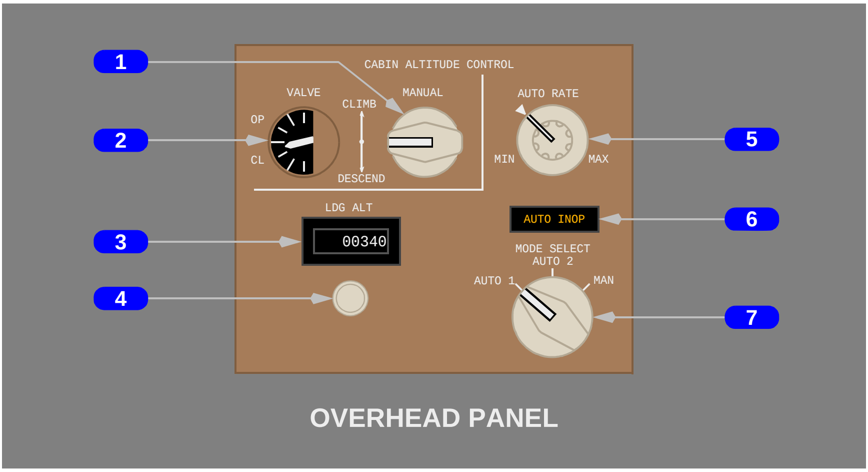
AUTO –

- provides automatic temperature control for forward cargo compartment
- changes desired temperature output by rotating the control towards C (cool) or W (warm)

OFF –

- air conditioning to forward cargo area turned off
- forward cargo exhaust/overboard valve remains open
- inhibits INOP light

Pressurization System
Cabin Altitude Controls



1 Cabin Altitude MANUAL Control

Spring – loaded to center.

Controls cabin outflow valve position with the Cabin Altitude Mode Selector in manual (MAN) mode.

CLIMB – moves outflow valve toward open.

DESCEND – moves outflow valve toward closed.

2 Outflow VALVE Position Indicator

OP – Open.

CL – Closed

3 Landing Altitude (LDG ALT) Indicator

Feet.

Displays selected landing altitude.

4 Landing Altitude (LDG ALT) Selector

Rotate – sets landing altitude indicator.

5 Cabin Altitude AUTO RATE Control

Rotate –

- sets limit for cabin altitude rate of climb or descent during auto control
- index mark establishes approximately 500 fpm climb and 300 fpm descent.

6 AUTO Inoperative (INOP) Light

Illuminated (amber) –

- AUTO 1 and AUTO 2 cabin altitude control functions are inoperative
- MAN mode is selected.

7 Cabin Altitude MODE SELECTOR

AUTO 1 –

- activates Auto 1 cabin altitude control for automatic operation
- outflow valve positioned automatically.

AUTO 2 –

- activates Auto 2 cabin altitude control for automatic operation
- outflow valve positioned automatically.

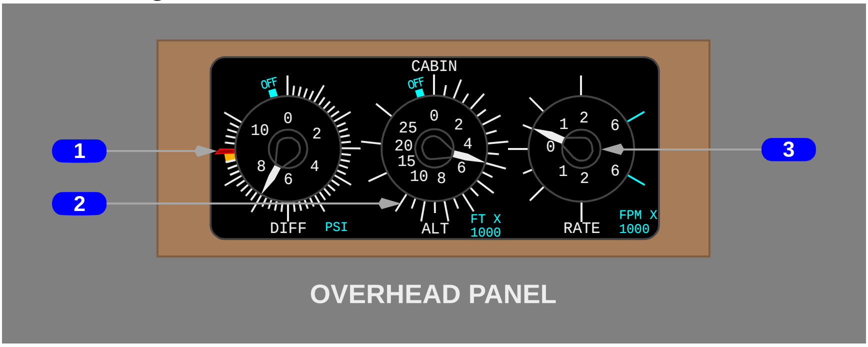
MAN (Manual) –

- outflow valve position is controlled by the cabin altitude MANUAL control
- AUTO INOP light illuminates.

Cabin Altitude Indicators

N316LA

N422LA through N526LA



1 Cabin Differential Pressure Indicator

Pounds per square inch (psi).

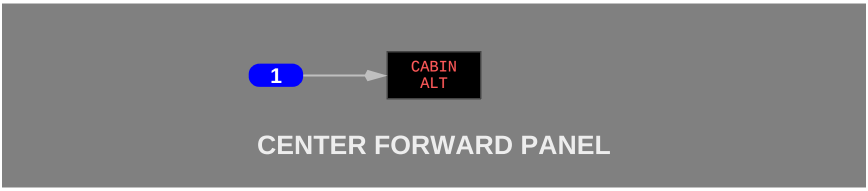
2 Cabin Altitude

Feet x 1,000.

3 Cabin Altitude Rate

Feet per minute (fpm x 1,000).

Cabin Altitude (CABIN ALT) Light

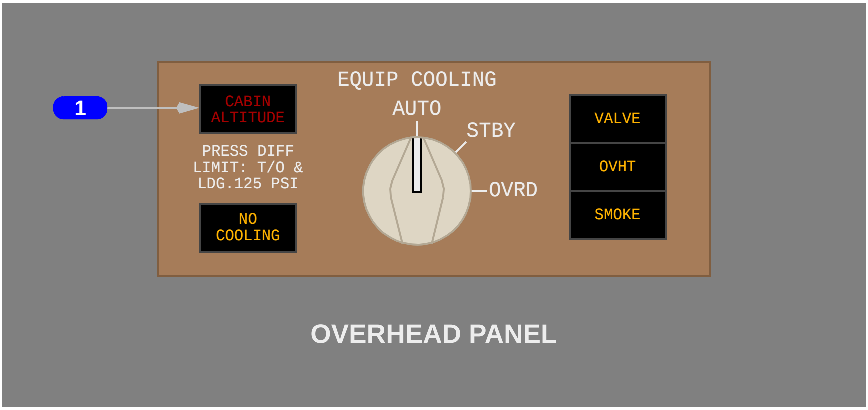


1 Cabin Altitude Light

Illuminated (red) –

- cabin altitude exceeds 10,000 feet
- extinguishes when cabin altitude descends below 8,500 feet.
- illuminates the crew lavatory Cabin Depressurization Warning Light.

Cabin Altitude Light



1 Cabin Altitude Light

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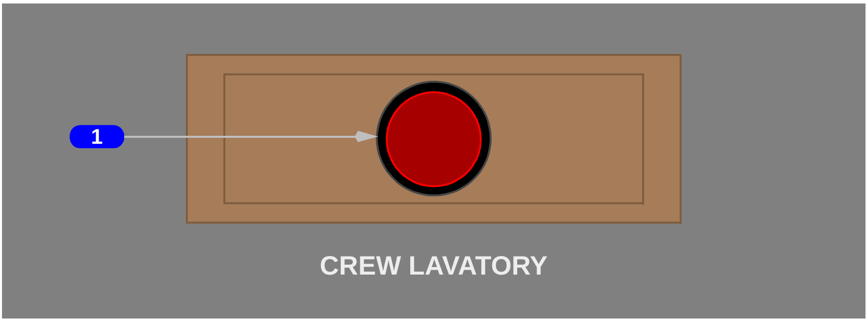
Cabin Depressurization Warning Light



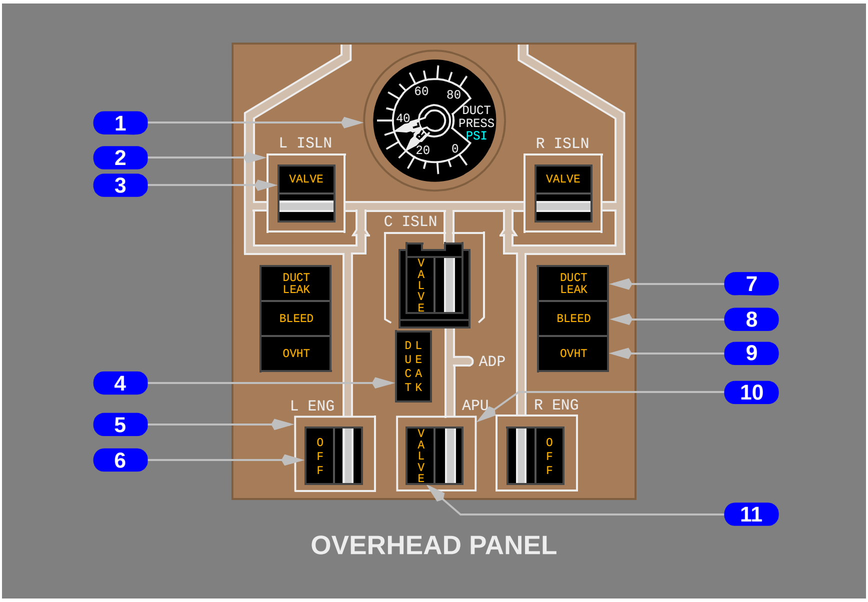
1 Cabin Depressurization Warning Light

Illuminates (red) -when cabin depressurization occurs or when the MAIN Cargo Compartment ARMED Switch/Light located on the CARGO FIRE panel is pushed. Upon illumination.

- Don portable Oxygen mask
- Return to work station

Bleed Air System

Bleed Air Control Panel



1 Duct Pressure (DUCT PRESS) Indicators

Pounds per square inch (PSI).

2 Isolation (ISLN) Switches

On (bar in view) – commands isolation valves to open.

Off (bar not in view) – commands isolation valves to close.

3 Isolation VALVE Lights

Illuminated (amber) – isolation valve position disagrees with commanded position.

4 DUCT LEAK Light

Illuminated (amber) – a high temperature bleed air leak is detected in the center pneumatic duct.

5 Engine (ENG) Bleed Air Switches

On (bar in view) – the engine bleed air valve opens when engine bleed air is available.

Off (bar not in view) – valve is manually commanded closed.

6 Engine Bleed Air OFF Lights

Illuminated (amber) – engine bleed air valve is closed:

- automatically due to a system fault
- the switch is OFF
- the engine is not running.

7 DUCT LEAK Lights

Illuminated (amber) – a high temperature bleed air leak is detected in the left, right, or engine strut pneumatic duct.

8 Engine BLEED Lights

Illuminated (amber) – the engine high pressure bleed air valve and/or pressure regulating valves are open when they should be closed.

9 Engine Bleed Air Overheat (OVHT) Lights

Illuminated (amber) –

- engine bleed air overtemp
- engine bleed valves automatically closed.

10 APU Bleed Air Switch

On (bar in view) – the APU bleed air valve is automatically controlled

Off (bar not in view) – commands APU bleed air valve to close.

11 APU Bleed Air VALVE Light

Illuminated (amber) – APU bleed air valve position disagrees with commanded position.

Introduction

The air conditioning system supplies conditioned bleed air at a controlled temperature throughout the airplane.

The system supplies conditioned air to the flight deck shoulder heaters.

Pack control, zone temperature control, fault detection, and overheat protection are all automatic.

The airplane is divided into three temperature zones: the flight deck and two cabin zones.

Air Conditioning Packs

Two identical air conditioning packs cool bleed air from the engines, APU, or high pressure air from a ground source. Bleed air is precooled before entering the pack. The packs are controlled by two identical pack controllers. Pack output is limited during high bleed air demand periods (such as during takeoff/landing or with an engine inoperative). Pack output is further reduced when the main cargo fire suppression system is activated.

Air Conditioning Automatic Mode

With the pack selector in the AUTO position, pack output temperature is determined by the left and right cabin temperature controllers:

Air Conditioning Standby Mode

With the pack selector in the standby mode, pack output temperature is determined by the position of the pack selector:

- N (normal) - constant, moderate temperature
- W (warm) - full warm.

Ground Conditioned Air Operation

When a ground source of conditioned air is available, it may be used to supply conditioned air directly to the cabin distribution system, eliminating the need for pack operation.

Pack Non-Normal Operation

Pack control, fault detection, and overheat protection are all automatic.

The pack INOP light illuminates and the EICAS advisory message L or R PACK TEMP displays for all pack control system faults and overheats.

When an automatic control system fault or a pack outlet overheat is detected, the pack continues to operate in an uncontrolled, degraded condition, requiring crew interaction.

The pack valve closes and the pack is shut down automatically when an internal pack overheat is detected. The PACK OFF light illuminates and the EICAS advisory message L or R PACK OFF displays in addition to the PACK TEMP indications.

If the INOP light remains illuminated after selecting STBY, the fault is a pack overheat. After the pack has cooled, an attempt to restore pack operation may be made by pushing the PACK RESET switch.

Temperature Control

The airplane is divided into three temperature control zones:

- flight deck
- forward cabin
- aft cabin.

The pack controllers regulate the pack output air temperature to satisfy the temperature requirement of the compartment requiring the coolest air. Hot trim air from the bleed air system is added through trim air valves to control the temperature in each of the other compartments. Each temperature control compartment has an associated temperature control.

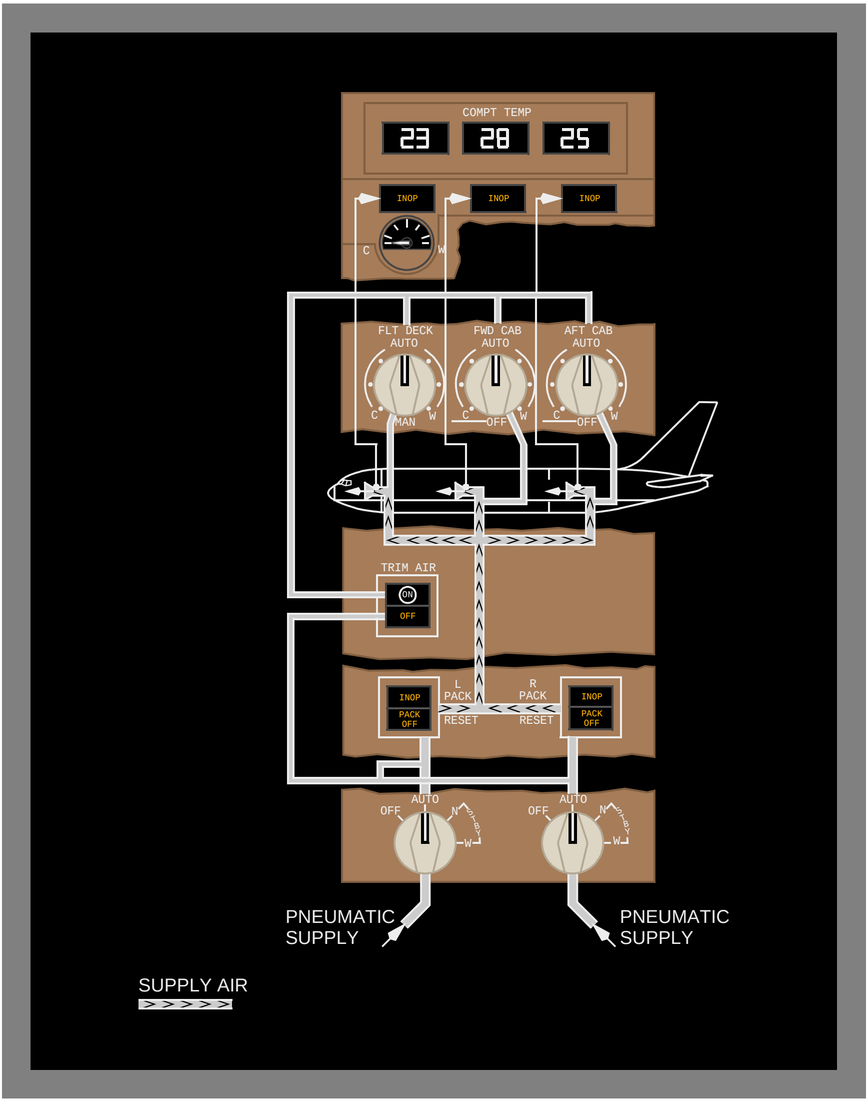
A compartment INOP light illuminates, and the EICAS advisory message FLT DECK TEMP, FWD CABIN TEMP, or AFT CABIN TEMP displays to indicate:

- zone temperature controller failure
- compartment temperature control is in the OFF position (FWD and AFT CAB only)
- trim air switch is OFF

Temperature Control With Loss of Trim Air System

During operation with the trim air system off, the packs attempt to maintain all compartments at an average temperature. The trim air OFF light illuminates and the EICAS advisory message TRIM AIR displays when a TRIM AIR switch is off.

Air Conditioning System Schematic



Shoulder and Foot Heaters

Flight crew shoulder and foot heat is provided by electric heaters in the ducts that supply conditioned air to the side windows and rudder pedal areas respectively. The heaters operate in flight only.

Equipment Cooling System
Forward Equipment Cooling

The forward equipment cooling system supplies cooling air to equipment in the forward electronic equipment racks and the flight deck avionics.

System operation is automatic with the EQUIP COOLING selector in AUTO.

On the ground, engine operation, pack operation, air/ground logic, airplane skin temperature and ambient temperature are all factors that determine system configuration. A supply fan and an exhaust fan either recirculate the cooling air back through the system, or port it overboard.

In flight, only the exhaust fan operates, and the air is recirculated through the system.

Non-Normal Operation

The VALVE light illuminates and the EICAS advisory message FWD EQPT VAL displays if the system valves fail to reconfigure during automatic operation. Placing the EQUIP COOLING selector in STBY provides an alternate command to reconfigure the system for recirculating the cooling air back through the system,.

The OVHT light illuminates and the EICAS advisory message FWD EQPT OVHT displays if low airflow or high temperature is sensed. Placing the EQUIP COOLING selector in STBY may correct the condition by reconfiguring the system.

The SMOKE light illuminates and the EICAS advisory message FWD EQPT SMOKE displays if smoke is sensed in the forward equipment cooling ducts. Placing the EQUIP COOLING selector in OVRD allows conditioned air to be drawn in reverse through the system by differential pressure and exhausted overboard.

The NO COOLING light illuminates and the EICAS caution message FWD EQPT COOLING displays if no cooling airflow is sensed after selecting OVRD.

Cargo Heat System

The forward, aft, and bulk cargo compartments are provided heat from the bleed air system.

Normal Operation

Separate switches control a shutoff valve and a heat control valve in each compartment. The system automatically maintains compartment temperature above approximately 45°F (7°C).

Bulk Cargo Heat Selector

A BULK CARGO HEAT selector allows a higher temperature to be selected for the bulk compartment. With the selector in the NORM position, the bulk compartment operates the same as the forward and aft compartments. With the selector in the VENT position, the bulk compartment is maintained above approximately 65°F (18°C), and a vent fan draws cabin discharge air into the compartment.

Non-Normal Operation

The forward cargo heat switch OVHT light illuminates and the EICAS advisory message CGO FLOOR OVHT displays, or the aft or bulk cargo heat switch OVHT lights illuminate and the EICAS advisory messages AFT or BULK CARGO OVHT display when the cargo compartment temperature is above the standard control range. The compartment shutoff valve closes automatically if a compartment temperature exceeds approximately 90°F (32°C). When the compartment temperature decreases below the overheat temperature setting, the OVHT light extinguishes, the EICAS message is removed, and the compartment shutoff valve re-opens.

Main Deck Cargo Air Conditioning

The Main Deck Temperature Selector determines which of two separate temperature control ranges will apply to the main deck temperature zones.

With the Main Deck Temperature Selector in the ANIMAL/NORM position, the FWD CAB and AFT CAB Compartment Temperature Selectors can adjust compartment temperatures within a range suitable for cargo such as live animals that require moderate temperatures. With the Main Deck Temperature Selector in the PERISHABLE position, the temperature range is suitable for carrying cargo requiring cooler than moderate temperatures.

Forward Cargo Air Conditioning and Ventilation System

The Forward Cargo Air Conditioning and Ventilation System supplies conditioned air and ventilation to the forward cargo compartment. The Forward Cargo Air Conditioning Temperature Control on the overhead panel enables and disables the air conditioning system.

Compartment temperature is displayed on the EICAS Status page.

Forward Cargo Air Conditioning

Compartment temperature is selected with the Forward Cargo Air Conditioning Temperature Control in the AUTO range. A temperature below 45°F (7°C) requires selecting the Forward Cargo Heat Switch OFF.

Conditioned air is supplied from the left air conditioning pack, and bleed air provides temperature control.

Forward Cargo Ventilation

Ventilation system operation is independent of the Forward Cargo Air Conditioning Temperature Control. Ventilation is provided by an exhaust/overboard valve when two packs are operating and the airplane is in flight. The exhaust/overboard valve is closed when one or both packs are not operating, the equipment cooling selector is in OVERRIDE, or when the airplane is on the ground.

Non-Normal Operation

The FAULT light illuminates, and the EICAS advisory message FWD CGO BACKUP displays when the forward cargo air conditioning system fails to the backup mode. The backup mode helps to keep the compartment temperature as close to the selected temperature as possible. Manual adjustment of the Forward Cargo Air Conditioning Temperature Control may be necessary to maintain the appropriate compartment temperature.

The INOP light illuminates and the EICAS advisory message FWD CARGO A/C displays if the forward cargo air conditioning fails, or for one of the following:

- either pack valve closed
- either engine bleed valve closed
- forward cargo conditioning shutoff valve failed closed
- auxiliary zone controller failure
- forward cargo temperature selector failure
- arming either cargo fire switch

The INOP light illuminates and the EICAS advisory message CARGO AC CONT displays if the forward cargo air conditioning controller fails.

The FAULT light illuminates and the EICAS advisory message CGO GND EX VALS displays if Ground Exhaust Valves fail in the open position.

Introduction

Cabin pressurization is controlled by adjusting the discharge of conditioned cabin air through the outflow valve.

Positive pressure relief valves and negative pressure relief doors protect the fuselage against excessive pressure differential.

The pressurization system has automatic and manual operating modes.

Pressurization System Automatic Operation

The pressurization system is in the automatic mode when the cabin altitude mode selector is set to AUTO 1 or AUTO 2. If the selected auto mode fails, control is automatically switched to the other auto mode.

In the automatic mode, the pressurization system uses ambient pressure data from the air data system in conjunction with the selected cabin auto rate, the takeoff altitude and the indicated landing altitude to calculate the cabin pressurization schedule.

Takeoff

For takeoff, the system supplies a small positive pressurization to cause a smooth cabin altitude transition.

Climb

During climb, cabin altitude increases on a schedule related to the takeoff field elevation, airplane altitude, and the selected auto climb rate limit.

If the maximum cabin pressure differential is reached, cabin climb rate becomes a function of airplane climb rate, while maintaining the maximum differential pressure.

Cruise

Shortly after the airplane levels off, the system enters the cruise mode. The landing altitude and the scheduled cabin altitude are compared and the higher of these two is selected for the cruise cabin altitude. If necessary, the cabin climbs to the cruise cabin altitude at one-half the auto rate or descends to the cruise cabin altitude at the auto rate.

The cruise cabin altitude does not change for minor altitude variations. A significant altitude change causes the system to re-enter the climb mode or to enter the descent mode.

Descent and Landing

During descent, cabin altitude decreases to slightly below the selected landing altitude. This ensures that the airplane lands pressurized. Landing altitude barometric pressure correction comes from the captain's altimeter.

At touchdown, the outflow valve opens to depressurize the airplane.

Non-Normal Indications

If the cabin altitude climbs above 10,000 feet, the CABIN ALT and CABIN ALTITUDE lights illuminate and the EICAS warning message CABIN ALTITUDE displays. The lights extinguish and the EICAS message blanks when the cabin altitude descends below 8,500 feet.

The AUTO INOP light illuminates and the EICAS caution message CABIN AUTO INOP displays when automatic pressurization control fails or when cabin altitude MODE SELECT is MAN. Manual operation is needed if the AUTO INOP light illuminates and the EICAS caution message CABIN AUTO INOP displays. Positive pressure relief valves and negative pressure relief doors operate independently from the pressurization control system to protect the fuselage against excessive pressure differential.

Only the automatic mode is equipped with an aneroid switch that automatically closes the outflow valve when the cabin exceeds 11,000 feet. The manual mode has no auto closure feature.

To operate the pressurization system manually:

- set the cabin altitude MODE SELECT to MAN
- hold the cabin altitude MANUAL control to CLIMB to move the outflow valve toward open and cause the cabin altitude to climb
- hold the cabin altitude MANUAL control to DESCEND to move the outflow valve toward closed and cause the cabin altitude to descend.

Cabin Depressurization Warning Light (located in crew lavatory)

The crew lavatory has a red depressurization warning light installed which activates in conjunction with the red CABIN ALT light, the red CABIN ALTITUDE overhead panel annunciators and the CABIN ALT EICAS message. The warning light is also illuminated when the MAIN Cargo Compartment ARMED Switch/Light located on the CARGO FIRE panel, is pushed.

Introduction

Bleed air can be supplied by the engines, APU, or a ground air source.

Bleed air is used for:

- air conditioning
- pressurization
- engine start
- wing and engine anti-ice
- center hydraulic system air driven pump (ADP)
- hydraulic reservoir pressurization
- thrust reversers

Engine Bleed Air Supply

Engine bleed air comes from either the high pressure (HP) or the low pressure (LP) engine compressor sections. LP air is used during high power setting operations. HP air is used during descent and other low power setting operations.

The engine bleed air valves are armed when the engine bleed switches are selected ON. The valves are pressure actuated and remain closed until engine bleed air pressure is sufficient to cause forward flow. The valves may close when the APU is starting either engine. The valves may close when ground pneumatic air is connected or during periods of low engine bleed air demand, such as when the air conditioning packs are off.

The engine bleed air OFF light illuminates and the EICAS advisory message L or R ENG BLEED OFF displays when the engine bleed air valve is closed for a system fault.

The OVHT light illuminates and the EICAS advisory message L or R ENG BLD OVHT displays when the engine bleed air temperature is excessive.

(SB Deletes N316LA when equipped with EICAS software version six or newer.)
The BLEED light illuminates and the EICAS caution message L or R ENG HPSOV displays when the engine high pressure bleed air valve is open when commanded closed.

N422LA through N526LA
(SB Adds N316LA when equipped with EICAS software version six or newer.)
The BLEED light illuminates and the EICAS advisory message L or R ENG HPSOV displays when the engine high pressure bleed air valve is open when commanded closed.

(SB Deletes N316LA when EICAS software version six or later is installed.)
The BLEED light illuminates and the EICAS caution message L or R ENG PRV displays when the pressure regulating valve is open when commanded closed.

N422LA through N526LA
(SB Adds N316LA when EICAS software version six ,seven or eight is installed.)
The BLEED light illuminates and the EICAS advisory message L or R ENG PRV displays when the pressure regulating valve is open when commanded closed.

APU Bleed Air Supply

APU bleed air is used primarily during ground operations for air conditioning pack operation and engine starting. In flight, APU bleed air is available up to approximately 17,000 feet.

The check valve in the APU supply line prevents reverse flow of bleed air from the duct into the APU.

The VALVE light illuminates and the EICAS advisory message APU BLEED VAL displays when the APU bleed valve position disagrees with the commanded position.

Ground Pneumatic Air Supply

External connectors are provided to connect a ground source of high pressure air directly to the bleed air duct.

Check valves prevent reverse flow of bleed air from the bleed air duct to the connectors.

Bleed Air Duct System

The duct pressure indicator displays the pressure in the left and right bleed air ducts.

Isolation valves separate the bleed air ducts into isolated segments. The left and right isolation valves are normally closed except for engine start or single bleed source operation. The center isolation valve normally remains open.

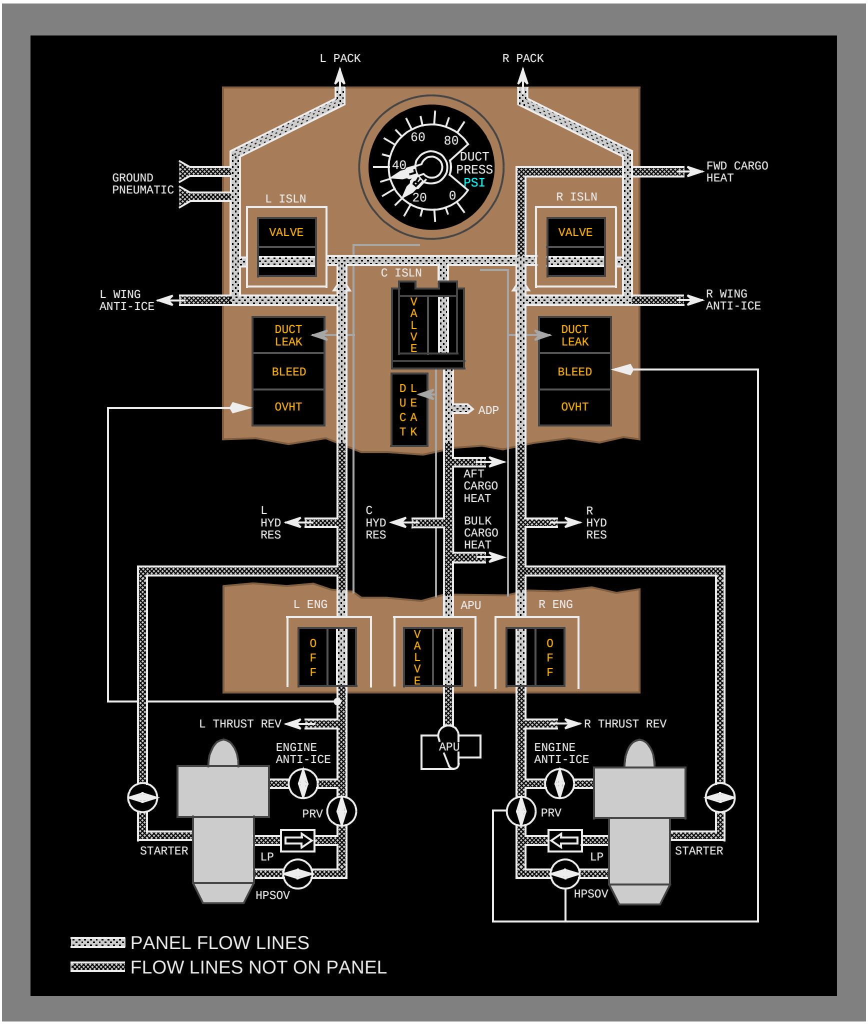
The isolation VALVE lights illuminate and the EICAS advisory message C, L or R BLD ISLN VAL displays when the bleed isolation valve position disagrees with the commanded position.

The DUCT LEAK light illuminates and the EICAS caution message L or R BLD DUCT LEAK, BODY DUCT LEAK or STRUT DCT LEAK displays when a high temperature bleed air leak is detected.

Bleed Air System Non-normal Operations

Bleed air overheat protection is provided by a bleed air temperature sensor. A higher than normal temperature causes a L or R ENG BLD OVHT advisory message to appear and the engine bleed air OVHT light to illuminate. If a bleed overheat occurs, the engine bleed air valve is automatically closed. With the engine bleed air valve closed, the HPSOV and PRV are closed. Activation of engine anti-ice will cause the PRV to open to provide cowl anti-ice unless a strut duct leak exists.

Bleed Air System Schematic



Air Systems EICAS Messages

The following EICAS messages can be displayed.

Message	Level	Light	Aural	Condition
APU BLEED VAL	Advisory	VALVE		APU bleed valve position disagrees with the commanded position.
L BLD DUCT LEAK R BLD DUCT LEAK BODY DUCT LEAK	Caution	DUCT LEAK	Beeper	A high temperature bleed air leak is detected.
C BLD ISLN VAL L BLD ISLN VAL R BLD ISLN VAL	Advisory	VALVE		Bleed isolation valve position disagrees with the commanded position.
CABIN ALTITUDE	Warning	CABIN ALTITUDE CABIN ALT	Siren	Cabin altitude excessive.
CABIN AUTO INOP	Caution	AUTO INOP	Beeper	Automatic pressurization control has failed or the cabin altitude mode selector is in manual.
AFT CABIN TEMP FWD CABIN TEMP	Advisory	INOP		A fault in the zone temperature controller, compartment temperature control is in the OFF position, or trim air switch OFF.

Message	Level	Light	Aural	Condition
FWD CARGO A/C	Advisory	INOP		Forward cargo air conditioning has failed.
CARGO A/C CONT	Advisory	INOP		A fault in the forward cargo air conditioning controller.
FWD CGO BACKUP	Advisory	FAULT		The forward cargo air conditioning system has failed to the backup mode of operation.
CGO FLOOR OVHT	Advisory	OVHT		The forward cargo compartment floor temperature has exceeded limit.
AFT CARGO OVHT BULK CARGO OVHT	Advisory	OVHT		Cargo compartment temperature above standard control range.
L ENG BLEED OFF R ENG BLEED OFF	Advisory	OFF		Engine bleed air valve is closed for a system fault.
L ENG BLD OVHT R ENG BLD OVHT	Advisory	OVHT		Engine bleed air temperature is excessive.

(SB Deletes N316LA when EICAS software version six or newer is installed.)

L ENG HPSOV R ENG HPSOV	Caution	BLEED	Beeper	High pressure bleed air valve is open when commanded closed.

N422LA through N526LA
(SB Adds N316LA when EICAS software version six or newer is installed.)

L ENG HPSOV R ENG HPSOV	Advisory	BLEED		High pressure bleed air valve is open when commanded closed.

Message	Level	Light	Aural	Condition

(SB Deletes N316LA when EICAS software version six or newer is installed.)

L ENG PRV R ENG PRV	Caution	BLEED	Beeper	Pressure regulating valve is open when commanded closed.

N422LA through N526LA
(SB Adds N316LA when EICAS software version six or newer is installed.)

L ENG PRV R ENG PRV	Advisory	BLEED		Pressure regulating valve is open when commanded closed.

FWD EQPT COOLING	Caution	NO COOLING	Beeper	OVRD selected and no reverse airflow detected through the E/E compartment avionics.
FWD EQPT OVHT	Advisory	OVHT	Ground crew call horn on ground	High temperature or low airflow in equipment cooling system.
FWD EQPT SMOKE	Advisory	SMOKE		Smoke detected in the forward equipment cooling ducts.
FWD EQPT VAL	Advisory	VALVE		An equipment cooling valve not in commanded position.
FLT DECK TEMP	Advisory	INOP		A fault in the zone temperature controller or trim air switch OFF.
L PACK OFF R PACK OFF	Advisory	PACK OFF		Pack valve is closed.
L PACK TEMP R PACK TEMP	Advisory	INOP		Automatic control system fault or overheat.

Message	Level	Light	Aural	Condition
L STRUT DCT LEAK R STRUT DCT LEAK	Caution	DUCT LEAK	Beeper	A high temperature bleed air leak is detected.
TRIM AIR	Advisory	OFF		Trim air switch OFF.

Anti-Ice, Rain — Chapter 3

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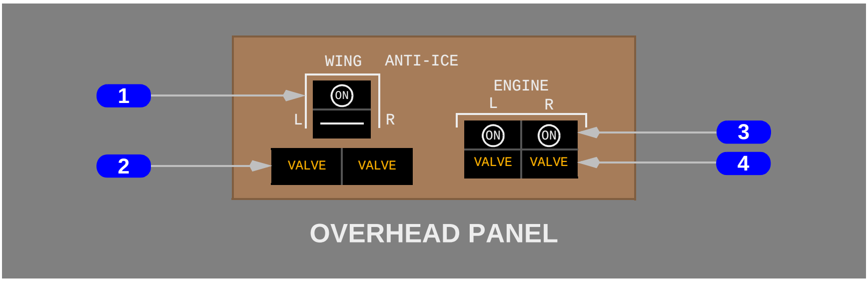
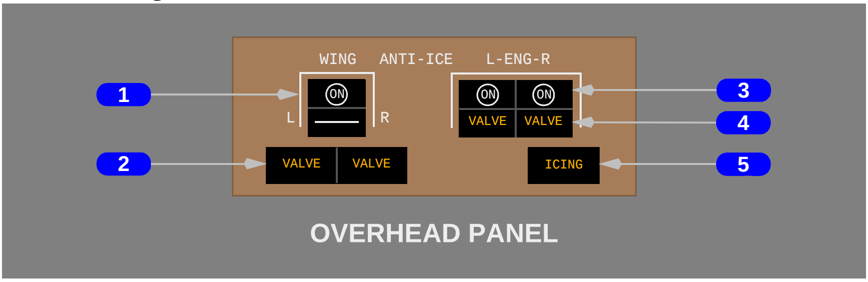
Manual Anti-Ice Panel

N316LA



N422LA through N526LA



1 WING ANTI-ICE Switch

ON – in flight, both wing anti-ice valves are commanded open.

Off (ON not visible) – both wing anti-ce valves are commanded closed.

2 Wing Anti-Ice VALVE Lights

Illuminated (amber) – wing anti-ice valve position disagrees with the switch position.

3 ENGINE ANTI-ICE Switches

ON – the engine anti-ice valve is commanded open.

Off (ON not visible) – the engine anti-ice valve is commanded closed.

4 Engine Anti-Ice VALVE Lights

Illuminated (amber) – engine anti-ice valve position disagrees with the switch position.

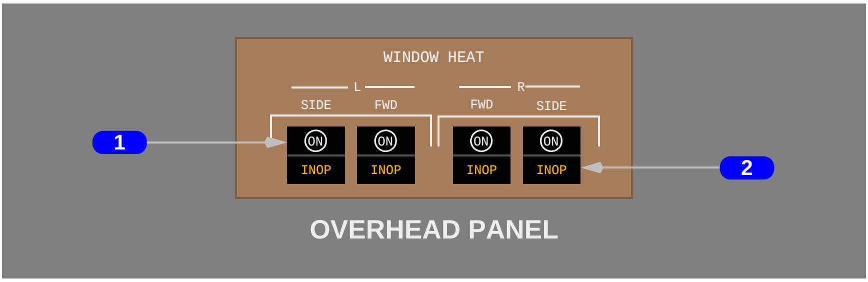
N422LA through N526LA

5 ICING Light

Illuminated (amber) – ice detection system indicates ice buildup on the airplane.

Window Heat and Wiper Panels

Window Heat Panel



1 WINDOW HEAT Switches

ON – window heat is applied to the selected windows.

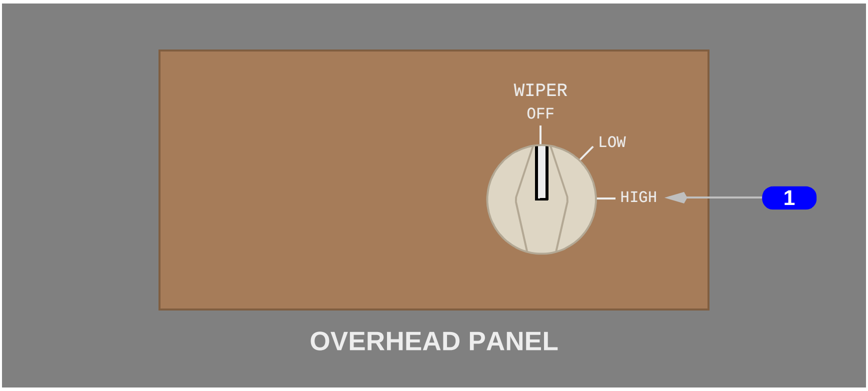
Off (ON not visible) – window heat is removed from the selected windows

2 Window Heat Inoperative (INOP) Lights

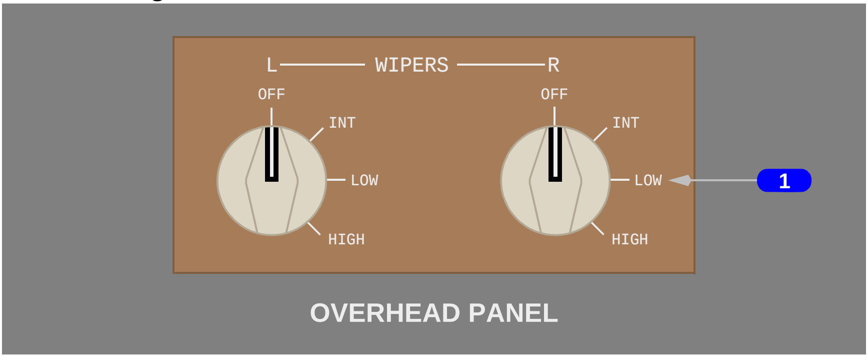
Illuminated (amber) – the window is not being heated.

Wiper Panel

N316LA



N422LA through N526LA



1 WIPER Selector

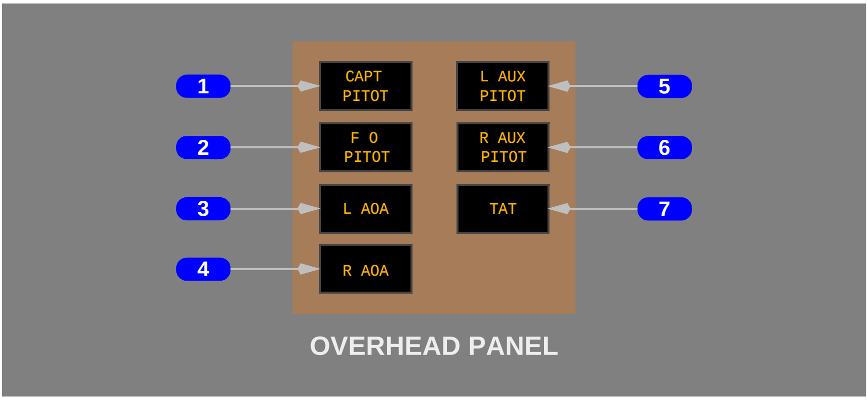
OFF – the wipers are stowed at the base of the windows.

N422LA through N526LA
INT – the wipers operate intermittently, cycle approximately seven seconds.

LOW – the wipers operate at low speed.

HIGH – the wipers operate at high speed.

Probe Heat Lights



1 Captain Pitot (CAPT PITOT) Light

Illuminated (amber) – probe is not being heated in flight or neither engine is running on the ground.

2 First Officer Pitot (F O PITOT) Light

Illuminated (amber) – probe is not being heated in flight or neither engine is running on the ground.

3 Left Angle of Attack (L AOA) Probe Light

Illuminated (amber) – probe is not being heated in flight or neither engine is running on the ground.

4 Right Angle of Attack (R AOA) Probe Light

Illuminated (amber) – probe is not being heated in flight or neither engine is running on the ground.

5 Left Auxiliary Pitot (L AUX PITOT) Light

Illuminated (amber) – probe is not being heated in flight or neither engine is running on the ground.

6 Right Auxiliary Pitot (R AUX PITOT) Light

Illuminated (amber) – probe is not being heated in flight or neither engine is running on the ground.

7 Total Air Temperature (TAT) Probe Light

Illuminated (amber) – probe is not being heated in flight.

Introduction

The anti-ice and rain systems include:

- engine anti-ice
- wing anti-ice
- flight deck window heat
- windshield wipers
- probe heat

Engine Anti-Ice System

The engine anti-ice system uses engine bleed air to provide engine cowl inlet ice protection. Engine anti-ice can be operated in flight or on the ground. The left and right engines have identical, independent anti-ice systems. This allows the remaining system to operate if one engine fails.

The engine thermal anti-ice (TAI) annunciation appears below the EICAS N1 indication when an engine anti-ice switch is on.

The VALVE light illuminates and the EICAS advisory message L or R ENG ANTI-ICE displays when the engine anti-ice valve disagrees with the switch position.

Wing Anti-Ice System

The wing anti-ice system provides bleed air to the three outboard leading edge slats on each wing. Wing anti-ice can be operated in flight only. It is inhibited on the ground.

The VALVE light illuminates and the EICAS advisory message L or R WING ANTI-ICE displays if the wing anti-ice valve disagrees with the switch position.

Manual Anti-Ice System Operation

Engine Anti-Ice Operation

On the ground or in flight, pushing the ENGINE ANTI-ICE switches ON commands the engine anti-ice valves to open, and allows engine bleed air to anti-ice the engine cowl inlets. Pushing the ENGINE ANTI-ICE switches again commands the engine anti-ice valves to close, and stops engine bleed air from anti-icing the engine cowl inlets.

Wing Anti-Ice Operation

In flight, pushing the WING ANTI-ICE switch ON commands the wing anti-ice valve in each wing to open, allowing bleed air to flow from the bleed air manifold to the affected slats. Pushing the WING ANTI-ICE switch again commands the wing anti-ice valve in each wing to close, stopping bleed air from flowing from the bleed air manifold to the affected slats.

Advisory Ice Detection System

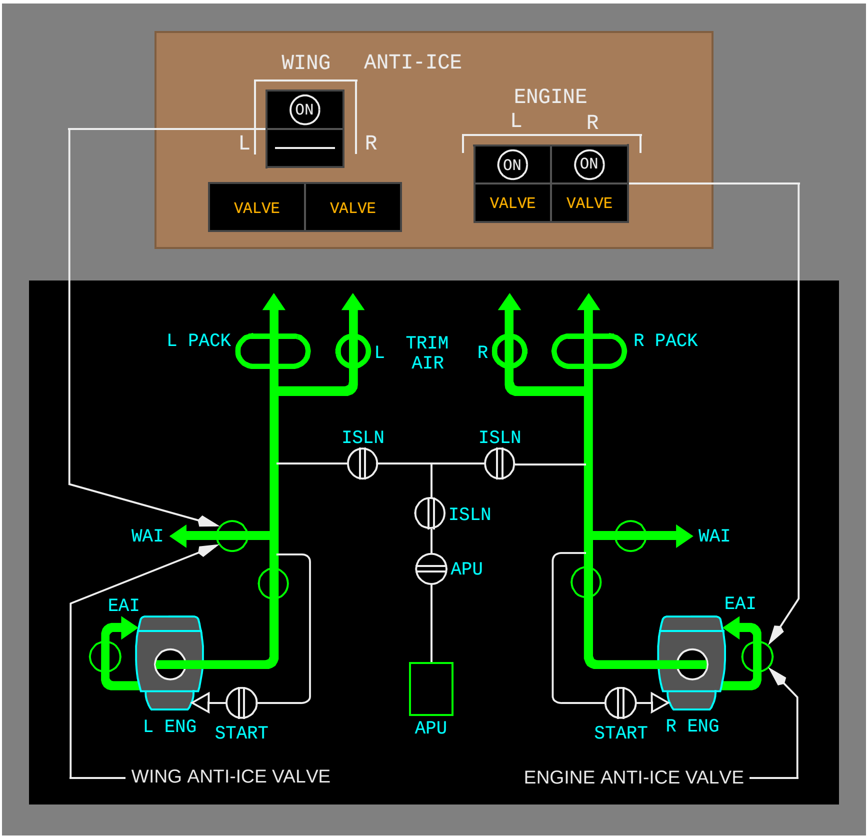
N422LA through N526LA

An ice detecting sensor is installed on the nose of the airplane. When the sensor detects ice, the amber ICING light illuminates and the EICAS advisory message, ICE DET ON displays. When the sensor no longer detects ice, the ICING light extinguishes and the EICAS message ICE DET OFF displays.

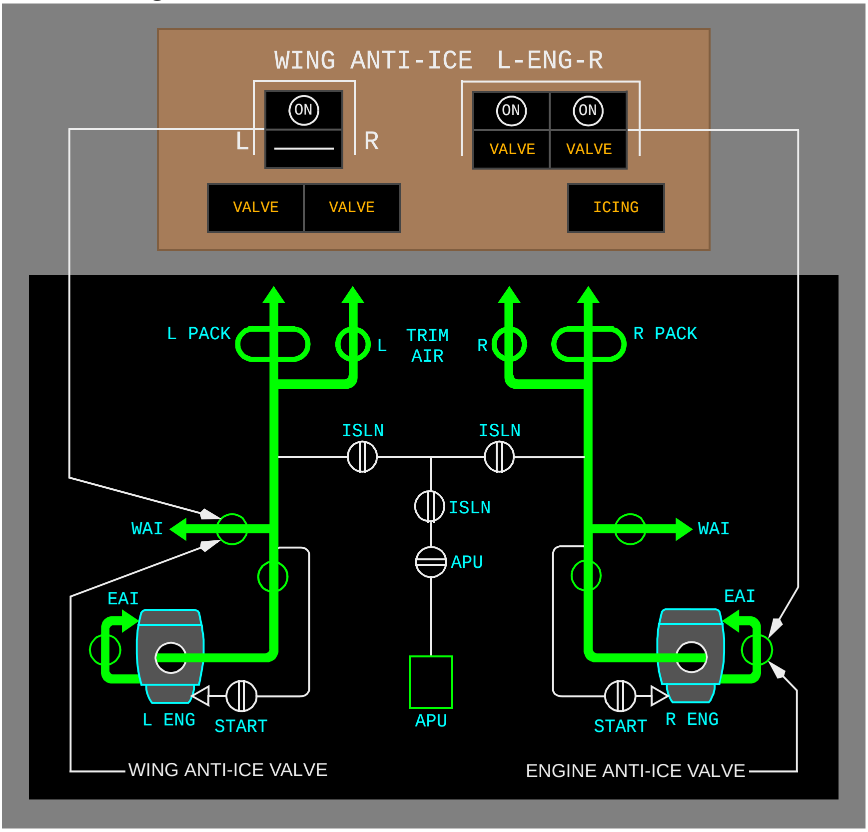
The system operates in an advisory capacity only. Flight crew action is required to activate and deactivate the engine and wing anti-ice systems.

Anti-Ice System Schematic

N316LA



N422LA through N526LA



Flight Deck Window Heat

All flight deck windows are electrically heated. The forward windows have anti-icing protection and anti-fogging. The side windows have anti-fogging protection only.

The WINDOW HEAT switches control heating for all flight deck windows. With the switches ON, window heat operates as soon as electrical power is established. The windows are protected from thermal shock when the switches are initially placed ON.

In addition to the electric heating, conditioned air is ducted to the top of the forward windows and then flows along the inside surface to provide supplemental anti-fogging. The anti-fogging airflow is continuous and is independent of electric window heat.

One INOP light illuminates and the EICAS advisory message L or R FWD WINDOW or L or R SIDE WINDOW displays to indicate a window is not being heated. If two or more INOP lights illuminate, the EICAS advisory message WINDOW HEAT displays.

The WINDOW HEAT EICAS message displays, and electrical power for the aft-most cockpit window heat is load shed when the Fuel Jettison Switch is selected ON. Electrical power is reset, and the WINDOW HEAT EICAS message no longer displays when the Fuel Jettison Switch is selected OFF.

Windshield Wipers

N316LA
The forward windows are equipped with two-speed wipers. One selector controls both wipers. With the WIPER selector in the OFF position, the wipers are off and stowed.

N422LA through N526LA
The forward windows are equipped with three-speed wipers. Each wiper is equipped with its own selector. With a WIPER selector in the OFF position, the associated wiper is off and stowed.

Probe Heat

Operation of the probe heat system is fully automatic. Power to the electrically heated pitot and angle of attack probes is applied any time an engine is running. The total air temperature (TAT) probes are heated when airborne.

An individual probe heat light illuminates and the associated EICAS advisory message displays when a probe is not being heated. If two or more probe lights illuminate, the EICAS advisory message PROBE HEAT displays.

Intentionally
Blank

Anti-Ice EICAS Messages

The following EICAS messages can be displayed.

Message	Level	Light	Aural	Condition
L AOA PROBE R AOA PROBE	Advisory	L AOA R AOA		AOA probe heat is inoperative.
L AUX PITOT R AUX PITOT	Advisory	L AUX PITOT R AUX PITOT		Left aux or right aux pitot heat is inoperative.
CAPT PITOT	Advisory	CAPT PITOT		Captain's pitot probe heat is inoperative.
L ENG ANTI-ICE R ENG ANTI-ICE	Advisory	VALVE		Engine anti-ice valve disagrees with switch position.
F/O PITOT	Advisory	F O PITOT		First officer's pitot probe heat is inoperative.

N422LA through N526LA

ICE DET OFF	Advisory			Icing is no longer detected.
ICE DET ON	Advisory	ICING		Icing is detected.

PROBE HEAT	Advisory	Two or more PITOT, AOA or TAT		Two or more probe heats are inoperative.
TAT PROBE	Advisory	TAT		TAT probe heat is inoperative.
L FWD WINDOW R FWD WINDOW	Advisory	INOP		Window is not being heated.

Message	Level	Light	Aural	Condition
L SIDE WINDOW R SIDE WINDOW	Advisory	INOP		Window is not being heated.
WINDOW HEAT	Advisory	Two or more INOP		Two or more windows are not being heated.
L WING ANTI-ICE R WING ANTI-ICE	Advisory	VALVE		Wing anti-ice valve disagrees with switch position.

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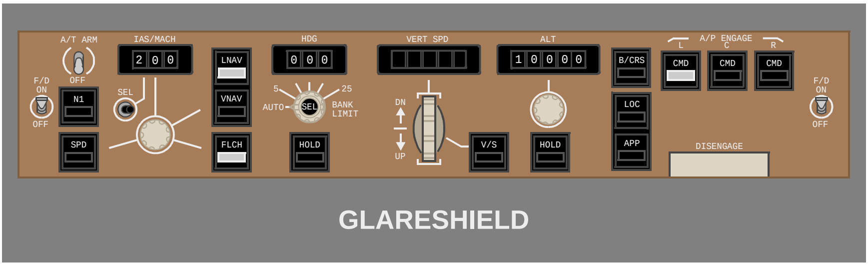
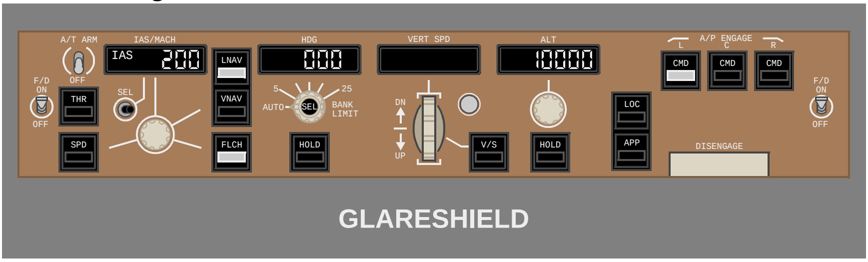
Mode Control Panel (MCP)

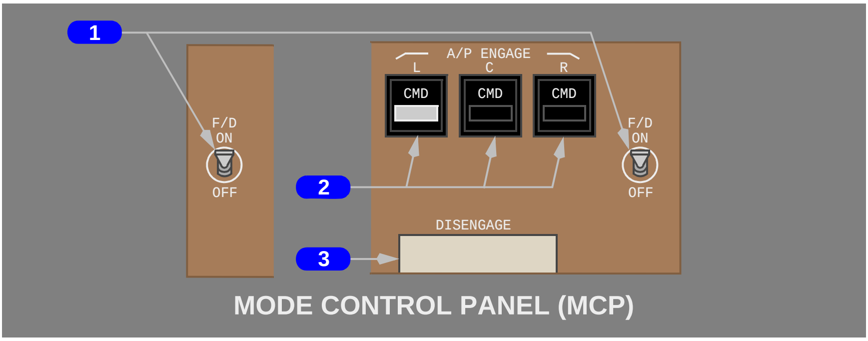
N316LA



N422LA through N526LA



Autopilot Flight Director System (AFDS) Controls



1 Flight Director (F/D) Switches

The left and right flight director switches activate flight director steering indications on their respective flight mode annunciator (FMA).

ON – respective pilots command bars operate in current AFDS mode.

- On the ground with no autopilot engaged and both F/D switches OFF, the first F/D switch positioned to ON arms the flight director in the takeoff (TO) roll and pitch modes. Positioning the second F/D switch to ON displays the flight director steering indications on the second FMA
- In flight, with the autopilot engaged and both F/D switches OFF, the first F/D switch positioned to ON activates the flight director in the selected autopilot mode(s)
- In flight with the autopilot disengaged and both F/D switches OFF, the first F/Ds switch positioned to ON engages the flight director in:
  - V/S as the pitch mode and HDG HOLD as the roll mode

  N316LA
  - or V/S and attitude (ATT) mode if bank angle is greater than five degrees

OFF –

- flight director steering indications do not display unless:
  - the go–around switch is pushed when airspeed is greater than 80 knots
  - and the flaps are not retracted.

2 Autopilot (A/P) ENGAGE Switches

Push (any switch can engage the autopilot) –

- CMD displays on each FMA
- if either F/D switch is ON, the autopilot engages in the selected flight director mode(s) except TO and GA
- if both F/D switches are OFF, the autopilot engages in:
  - V/S as the pitch mode and HDG HOLD as the roll mode

  N316LA
  - or V/S and attitude (ATT) mode if bank angle is greater than five degrees

3 Autopilot DISENGAGE Bar

Push down –

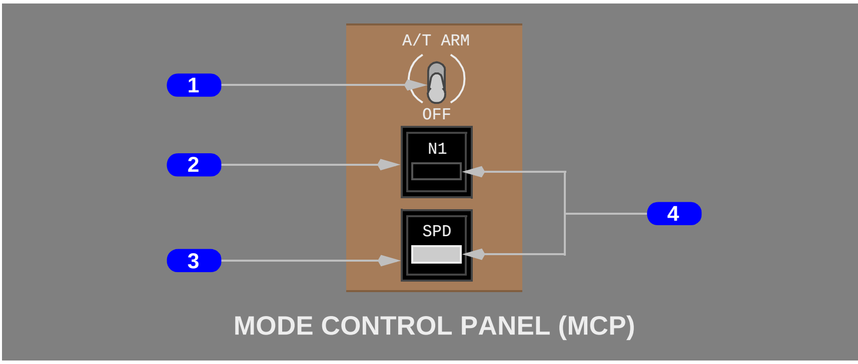
- disengages all three autopilots
- prevents autopilot engagement
- exposes amber stripe.

Lift up –

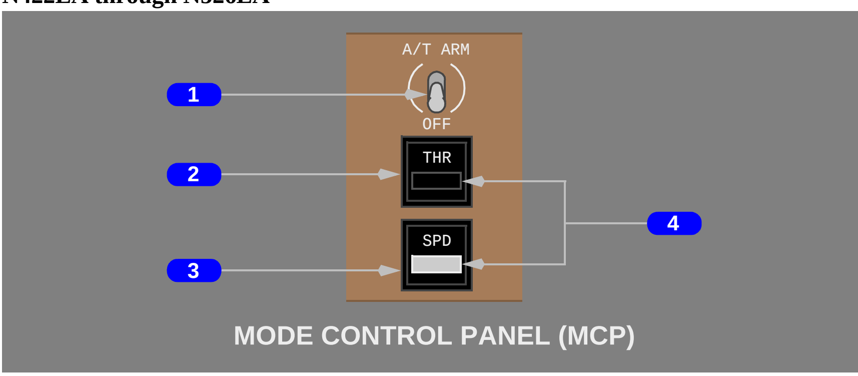
- enables autopilot engagement
- conceals amber stripe.

Autothrottle (A/T) System Controls

N316LA



N422LA through N526LA



1 Autothrottle (A/T) ARM Switch

ARM –

- arms autothrottle system for mode selection

  N422LA through N526LA
- autothrottle operates when THR, SPD, V NAV, FL CH, or GA switch pushed

  N316LA
- autothrottle operates when N1, SPD, V NAV, FL CH, or GA switch pushed
- autothrottle operates when SPD switch pushed and pitch mode is ALT HOLD, V/S or G/S.

OFF – disconnects autothrottle and prevents autothrottle engagement.

N422LA through N526LA

2 Thrust (THR) Switch

Push –

- selects autothrottle N1 mode
- N1 annunciates on each FMA
- autothrottle holds reference thrust value displayed on EICAS subject to maximum speed limits
- changes thrust reference from TO to CLB if above 400 feet radio altitude
- updates FMC position to takeoff runway threshold position when selected for takeoff only if GPS NAV is OFF (i.e. GPS NAV data not available to the FMC).

N316LA

2 N1 Switch

Push –

- selects autothrottle N1 mode
- N1 annunciates on each FMA
- autothrottle holds reference thrust value displayed on EICAS subject to maximum speed limits
- changes thrust reference from TO to CLB if above 400 feet radio altitude
- updates FMC position to takeoff runway threshold position when selected for takeoff only if GPS NAV is OFF (i.e. GPS NAV data not available to the FMC).

3 Speed (SPD) Switch

Push –

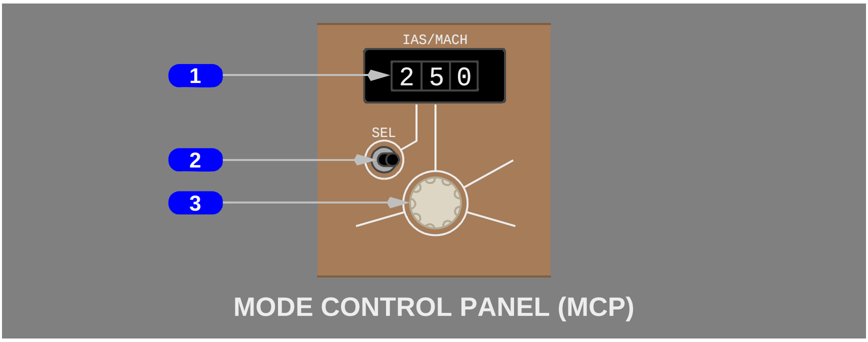
- selects autothrottle SPD mode
- SPD appears on each FMA
- autothrottle controls thrust to maintain IAS or MACH displayed in the speed window subject to minimum and maximum speed limits
- changes thrust reference from TO to CLB if above 400 feet radio altitude

4 MCP Mode Switch Lights

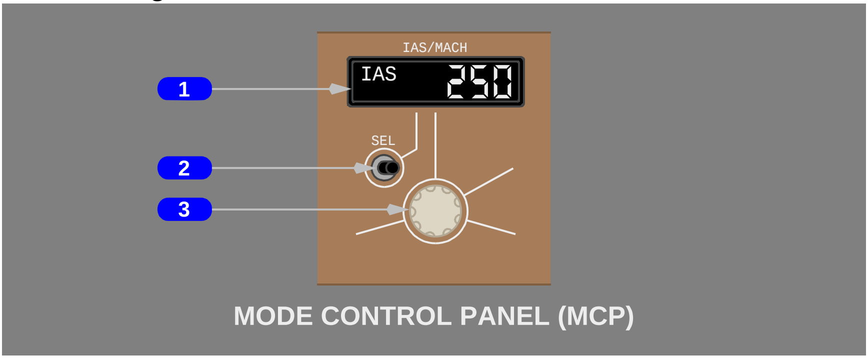
All MCP mode switches contain an annunciator light that illuminates when the mode switch is selected to indicate the mode is either engaged or armed.

Autopilot Flight Director IAS/MACH Controls

N316LA



N422LA through N526LA



1 IAS/MACH Window

Displays selected speed when IAS/MACH selector controls command speed.

Displays 200 knots when power first applied.

Blank when FMC is controlling command airspeed bugs.

Display range:

- 0.40 – 0.95 MACH
- 100 – 399 KIAS

In climb, changes from IAS to MACH at approximately .80 MACH.

In descent, changes from MACH to IAS at approximately 300 KIAS.

2 Select (SEL) Switch

Push – alternately changes the IAS/MACH window between IAS and MACH.

3 IAS/MACH Selector

Rotate –

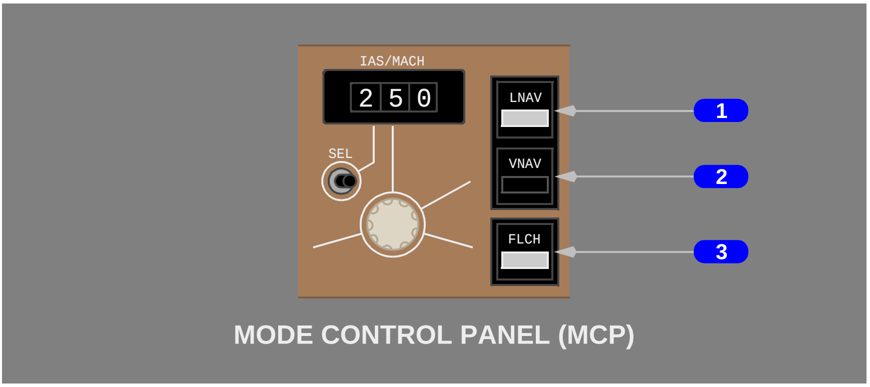
- sets speed in IAS/MACH window and positions command airspeed bugs
- inoperative when IAS/MACH window blank.

Push – when VNAV mode is engaged, alternately changes IAS/MACH window between current IAS or MACH and a blank display.

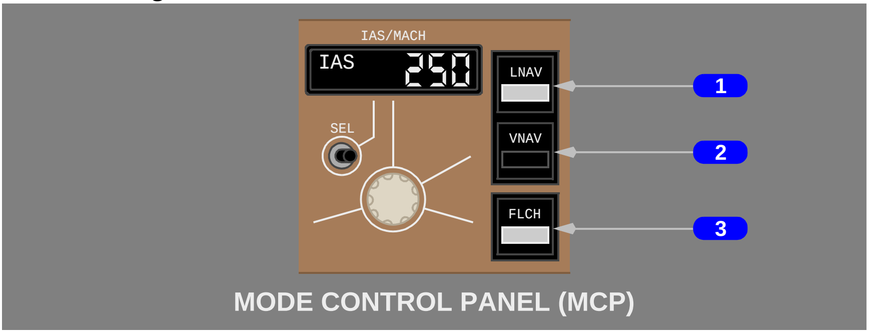
- VNAV active, window opens and speed control transfers from FMC target speed to IAS/MACH selector
- descending in VNAV PTH, pitch mode changes to VNAV SPD. Selected speed maintained by pitch until airplane intercepts an altitude constraint and VNAV PTH reengages. Although, if on approach, pitch mode remains in VNAV PTH and autothrottle controls speed.

Autopilot Flight Director Roll and Pitch Controls

N316LA



N422LA through N526LA



1 Lateral Navigation (L NAV) Switch

Push –

- Arms, engages or disarms LNAV as the roll mode
- Displays LNAV in white (armed) on the roll flight mode annunciator when armed; the previous roll mode remains active.
- LNAV engages if the airplane is above 50 feet radio altitude and:
  - within 2.5 NM of the active leg
  - if not within 2.5 NM of the active leg and on an intercept heading to the active leg, remains armed then engages when approaching the active leg
  - when engaged, displays LNAV in green on roll flight mode annunciator.
- selection of LNAV with the airplane not on a heading which intercepts the active leg, displays NOT ON INTERCEPT HEADING in the CDU scratch pads
- Selection of LNAV when an active FMC route is not available displays NO ACTIVE ROUTE in the CDU scratchpad.

LNAV maintains current heading when:

- passing the last active route waypoint
- passing the last waypoint prior to a route discontinuity
- passing the last route offset waypoint
- activating the inactive route or activating an airway intercept and not within LNAV engagement criteria.

LNAV deactivates:

- by selecting heading hold (HDG HOLD) or heading select (HDG SEL)
- when localizer is captured
- if there is a dual FMC failure
- by pushing LNAV switch a second time when LNAV is armed.

2 Vertical Navigation (V NAV) Switch

Push –

- engages AFDS and A/T in VNAV mode
- VNAV PTH or VNAV SPD displays on each FMA
- AFDS and autothrottle follow vertical path and thrust guidance from FMCS
- changes thrust reference from TO to CLB if above 400 feet radio altitude.

During climbs or descents, AFDS captures and holds altitude displayed in altitude window or FMC target altitude, whichever is reached first.

N422LA through N526LA
When reaching a point on the VNAV profile to begin a climb or descent, with the MCP altitude window set at the current altitude, or reaching the altitude in the MCP altitude window before the FMC target altitude, VNAV ALT will be displayed on the FMA.

With VNAV engaged, pushing IAS/MACH selector permits manual speed selection. FMCs then use manually selected speeds for speed control.

VNAV deactivates:

N422LA through N526LA
- by selecting GA, FL CH, SPD or THR, V/S or ALT HOLD

N316LA
- by selecting GA, FL CH, SPD or N1, V/S or ALT HOLD
- by pushing VNAV switch a second time when VNAV is armed
- when glideslope is captured

N316LA
- in climb or descent, reaching altitude displayed in altitude window prior to reaching FMCs target altitude

N316LA
- passing top of descent point if the MCP is not set to an altitude below cruise altitude.

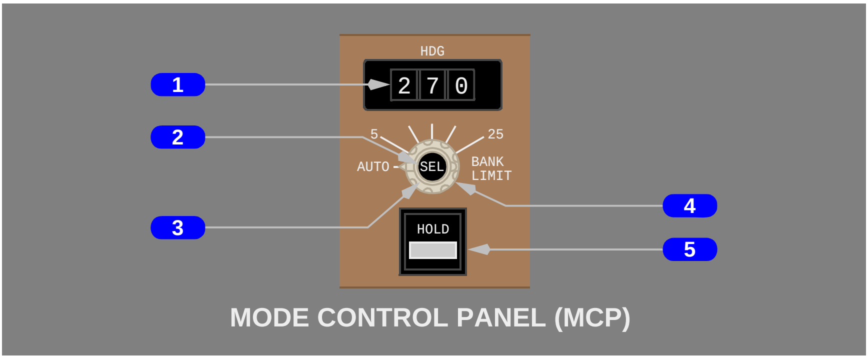
3 Flight Level Change (FL CH) Switch

Push –

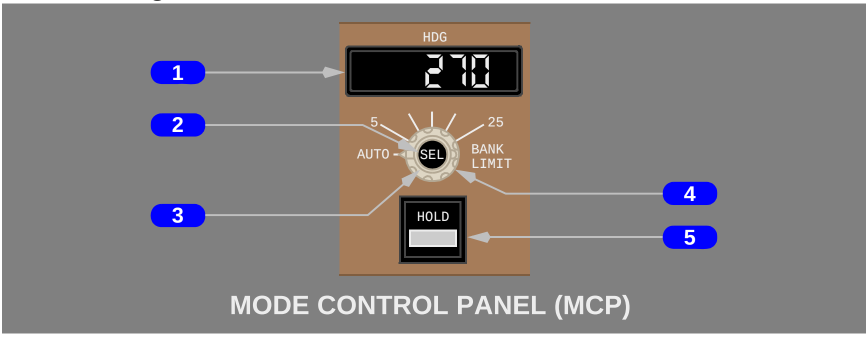
- selects FLCH mode and sets IAS/MACH window and command airspeed bugs to current airspeed
- FLCH displays on each FMA
- AFDS pitch holds existing airspeed and A/T sets required thrust, limited by the thrust limit for climb and idle for descent. When selected altitude is reached, pitch mode changes to ALT HOLD and A/T changes to SPD mode
- with FLCH mode displayed, pushing switch resets IAS/MACH window and commands airspeed bugs to current airspeed
- changes thrust reference from TO to CLB if above 400 feet radio altitude.

Autopilot Flight Director Heading and Bank Angle Controls

N316LA



N422LA through N526LA



1 Heading (HDG) Window

Displays selected heading and positions map display selected heading markers.

HDG window and map display headings set to 000 when power first applied.

Automatically changes to ILS front course heading at LOC capture.

2 Heading Select (SEL) Switch

Push –

- engages HDG SEL roll mode
- HDG SEL roll mode displays on each FMA
- AFDS controls roll to acquire and hold heading shown in heading window and on map display heading markers
- bank is limited by bank limit selector.

3 Heading Selector (inner)

Rotate – sets heading in HDG window and positions selected heading marker on both map displays.

4 BANK LIMIT Selector (outer)

Rotate – sets AFDS commanded bank limit when in HDG SEL roll mode as follows:

AUTO – bank angle varies between 15 – 25 degrees, depending on true airspeed.

- at slower true airspeeds the bank angle limit is 25 degrees
- as true airspeed increases, the bank angle limit decreases.

Manually selected – 5, 10, 15, 20, or 25 selected value is maximum regardless of airspeed.

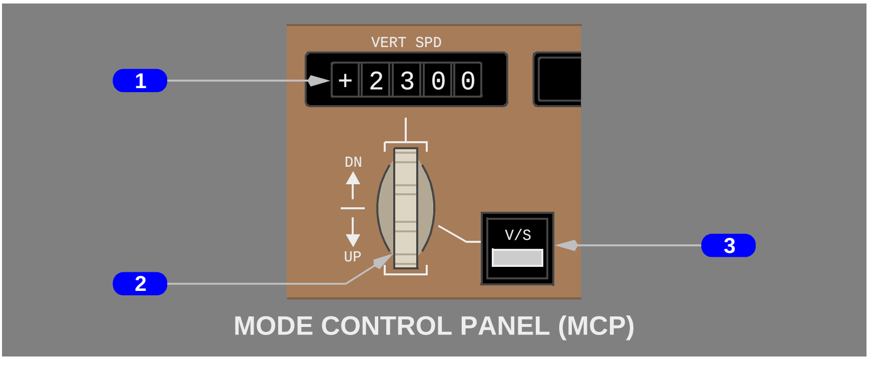
5 Heading HOLD Switch

Push –

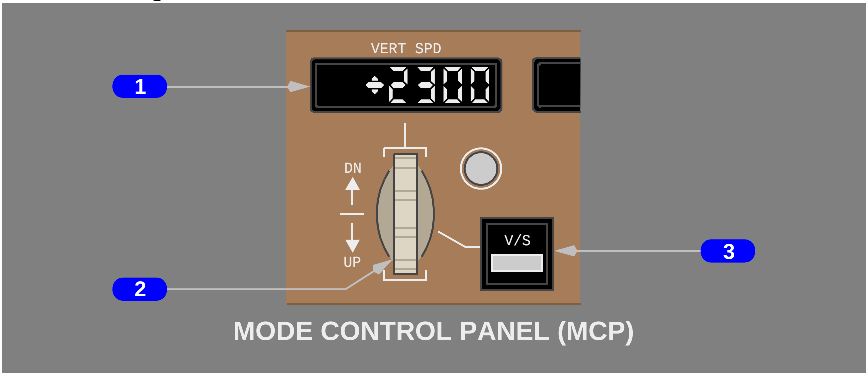
- selects HDG HOLD roll mode and displays on each FMA
- AFDS rolls wings level, then holds present heading.

Autopilot Flight Director Vertical Speed (V/S) Controls

N316LA



N422LA through N526LA



1 Vertical Speed (VERT SPD) Window

Displays selected vertical speed.

Blank when V/S pitch mode not selected.

Display range is from (–8000 to +6000 fpm) in 100 fpm increments.

2 Vertical Speed Selector (DN/UP)

UP or Down (DN) – sets vertical speed in VERT SPD window.

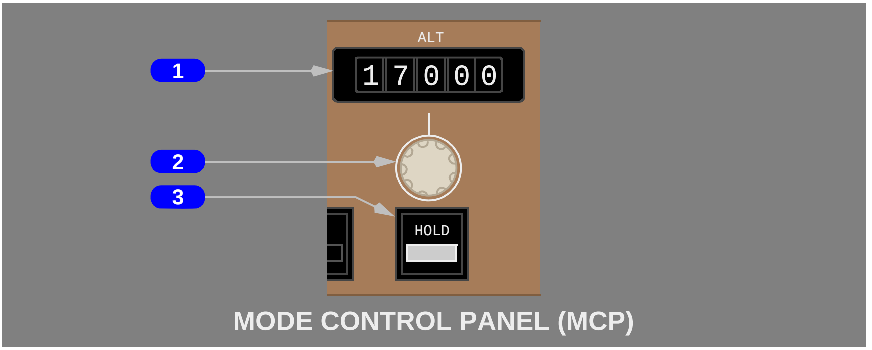
3 Vertical Speed (V/S) Switch

Push –

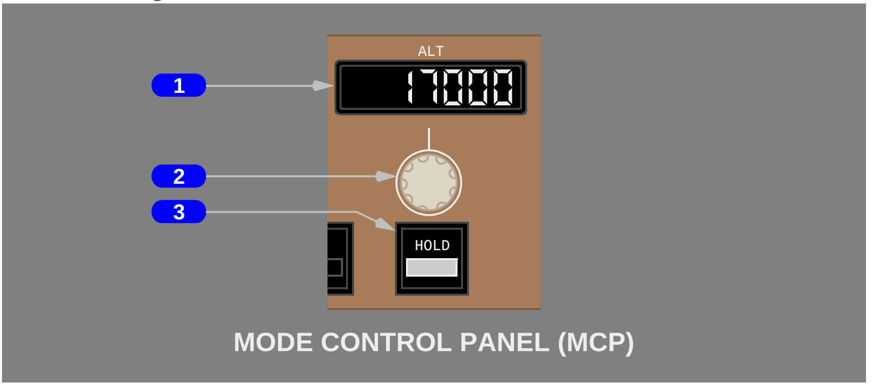
- selects V/S pitch mode and displays on each FMA
- displays current vertical speed in VERT SPD window
- when selected altitude reached, pitch flight mode annunciation changes to ALT HOLD
- AFDS pitch maintains vertical speed displayed in the VERT SPD window
- if AFDS is engaged in V/S from FLCH or from VNAV, A/T automatically engages in SPD mode if armed.

Autopilot Flight Director Altitude Controls

N316LA



N422LA through N526LA



1 Altitude (ALT) Window

Displays selected altitude in 100 feet increments. Range: 0 to 50,000 feet.

Displayed altitude is reference altitude, for altitude alerting and level off.

ALT window set to 10,000 feet when power is first applied.

N316LA

2 Altitude Selector

Rotate – sets altitude in ALT window.

N422LA through N526LA

2 Altitude Selector

Rotate – sets altitude in ALT window.

Push – climb or descent:

- during climb or descent with altitude constraints, each push deletes the next waypoint constraint between the airplane altitude and the MCP altitude window setting
- during climb with no altitude constraints, and the MCP altitude window is set above the FMC cruise altitude, changes cruise altitude to the MCP altitude window value.

During cruise:

- with the altitude window set above or below FMC cruise altitude, resets the FMC cruise altitude to the altitude window altitude
- when in VNAV PTH or VNAV ALT pitch mode, initiates a climb or descent toward the altitude window altitude
- within 50 NM of the top–of–descent (T/D) point, with the altitude window set below cruise altitude, initiates the DES NOW feature.

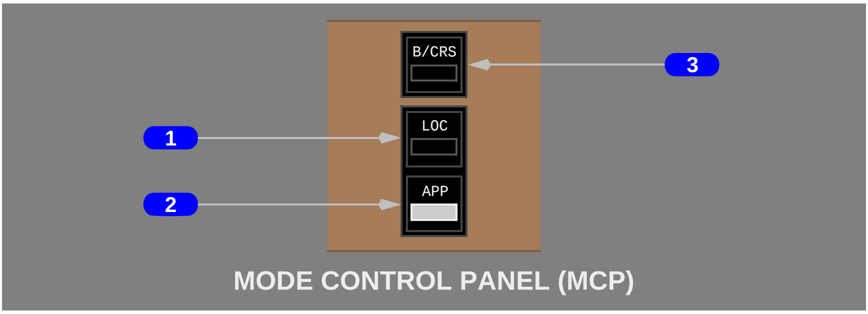
3 Altitude HOLD Switch

Push –

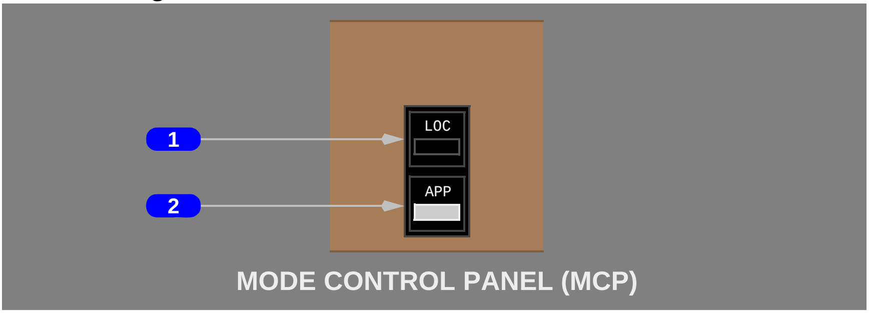
- selects altitude ALT HOLD pitch mode
- ALT HOLD pitch mode displays on FMA pitch mode annunciation
- AFDS commands pitch to maintain the altitude when the switch was pushed.

Autopilot Flight Director Approach Mode Controls

N316LA



N422LA through N526LA



1 Localizer (LOC) Switch

Push –

- arms, disarms, captures LOC as roll mode
- displays LOC on both FMA roll flight mode annunciations before localizer capture; current roll mode LNAV, HDG SEL or HDG HOLD remains active until LOC capture
- displays LOC on FMA roll flight mode annunciations after localizer capture
- arms AFDS to capture and track inbound on front course, capture point varies based on range and intercept angle
- localizer capture can occur when intercept track angle is within 120 degrees of the localizer course.

  Note: After localizer capture, flight director roll commands may appear inconsistent with A/P roll maneuvers for one to two minutes.

Localizer mode can be disarmed before localizer capture by:

- pushing localizer switch a second time
- arming LNAV.

Localizer mode can be deactivated after localizer capture by:

- pushing a GA switch
- selecting a roll mode other than LNAV
- disengaging the autopilot and turning both F/D switches off.

Note: The LOC mode is a single autopilot function only. Multiple autopilots cannot be engaged with this mode.

2 Approach (APP) Switch

Push –

- autopilot systems powered by separate sources with three autopilots engaged
- arms, disarms, or captures LOC as roll mode and glideslope (G/S) as pitch mode
- displays LOC and G/S on FMA roll and pitch flight mode annunciations prior to localizer and glideslope capture
- displays LOC and G/S on both FMA roll and pitch flight mode annunciations after each is captured
- localizer captures when intercept track angle is within 120 degrees of localizer course

Note: After localizer capture, flight director roll commands may appear inconsistent with A/P roll maneuvers for one to two minutes.

- glideslope captures when intercept track angle to the localizer is within 80 degrees of localizer course
- either localizer or glideslope can be captured first
- AFDS captures and tracks localizer and glideslope upon intercepting the respective localizer and glideslope radio signals
- arms the other autopilot systems (CMD switch bars in view) for subsequent automatic engagement which occurs when localizer and glideslope are captured, and radio altitude is below 1500 feet.

Approach mode can be disarmed before localizer or glideslope capture by:

- pushing approach switch a second time
- pushing LOC switch (G/S disarms, LOC remains armed)
- pushing LNAV switch and LNAV arms (does not immediately engage)
- pushing VNAV switch and VNAV arms (does not immediately engage).

Approach mode deselects:

- with LOC captured and G/S armed, by selecting another roll mode other than LNAV; selecting LOC mode initiates a localizer approach
- with G/S captured and LOC armed, by selecting another pitch mode other than VNAV
- after LOC and/or G/S are captured, by selecting GA mode or disengaging the autopilot and turning both F/D switches off.

N316LA

3 Backcourse (B/CRS) Switch

Push – (Must be used concurrently with LOC switch), arms or engages AFDS in B/CRS mode as follows:

B/CRS appears on each FMA prior to localizer capture.

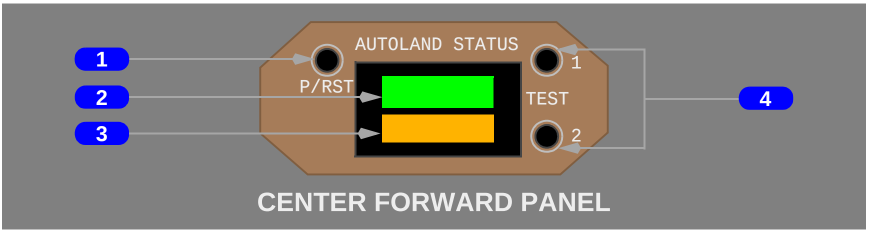
- AFDS is armed to capture and track inbound on backcourse of localizer
- capture point varies based on range and intercept angle
- initial roll modes; LNAV, HDG SEL or HDG HOLD remain engaged until B/CRS capture
- before localizer capture, pushing the LOC switch a second time disarms both the LOC and B/CRS modes. Pushing only the B/CRS switch a second time, disarms the B/CRS mode but the LOC mode remains armed.

B/CRS appears on each FMA after localizer capture.

- AFDS tracks inbound on backcourse
- if the LOC switch is selected and localizer is captured before B/CRS switch is pushed, AFDS will track the localizer front course (outbound) and B/CRS cannot be selected
- G/S, FLARE and ROLLOUT functions are not available.

Note: The B/CRS mode is a single autopilot function only. Multiple autopilots cannot be engaged with this mode.

Autoland Status



1 Push/Reset (P/RST) Switch

Push – resets both pilots annunciators as follows:

Before APP mode selected:

- changes NO AUTOLND or NO LAND 3 to blank,
- if condition is still present when switch release, annunciation returns.

After APP mode selected:

- if NO LAND 3 displayed, becomes blank and remains blank until after landing and autopilots disengaged
- if NO AUTOLND displayed, remains displayed until autopilots are disengaged.

2 AUTOLAND STATUS Annunciator (Upper)

Normal (blank) –

LAND 3 – (green)

- indicates all three autopilot systems and their associated supporting airplane system inputs are operating normally
- appears below 1500 feet radio altitude with LOC and G/S captured.

LAND 2 – (green)

- indicates a minimum of two autopilot systems and their associated supporting airplane system inputs are operating normally
- appears below 1500 feet radio altitude with LOC and G/S captured.

3 AUTOLAND STATUS Annunciator (Lower)

Normal (blank) –

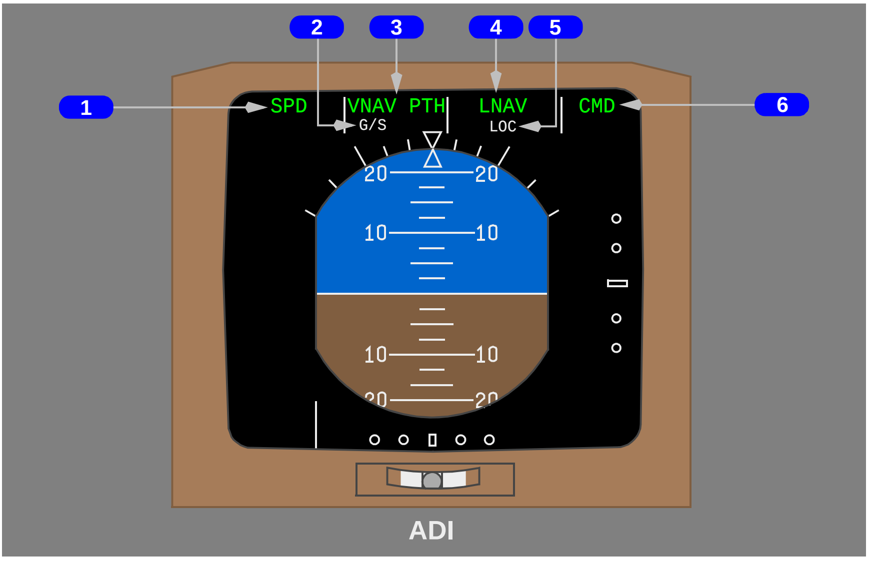
NO AUTOLND (amber) – indicates fault conditions exist which preclude the use of the autopilots for an automatic landing.

NO LAND 3 (amber) – indicates a fault condition exists which results in a LAND 2 condition

4 TEST Switches

Push – activates autoland status annunciator tests.

ADI Flight Mode Annunciations (FMAs)



1 Autothrottle Modes (Active)

Displayed (green) – ***

- N1
- SPD
- FLCH
- GA
- IDLE
- THR HLD

Autothrottle Limits: displayed (green) – */***

- FLAP LIM
- ALPHA
- SPD LIM

2 AFDS Pitch Modes (Armed)

Displayed (white) –

- G/S
- FLARE
- VNAV

3 AFDS Pitch Modes (Active)

Displayed (green) – **/ ***

- TO
- ALT HOLD
- V/S
- VNAV PTH
- VNAV SPD
- SPD
- G/S
- FLARE
- ALT CAP
- GA

N422LA through N526LA
- VNAV ALT

AFDS Pitch Limits: displayed (green) – */***

- FLAP LIM
- SPD LIM

4 AFDS Roll Modes (Active)

Displayed (green) – **/ ***

- HDG HOLD
- HDG SEL
- LNAV
- LOC
- ROLLOUT
- TO
- GA

N316LA
- ATT

N316LA
- B/CRS

5 AFDS Roll Modes (Armed)

Displayed (white) –

- LOC
- ROLLOUT
- LNAV

N316LA
- B/CRS

6 AFDS (Active)

Displayed (green) –

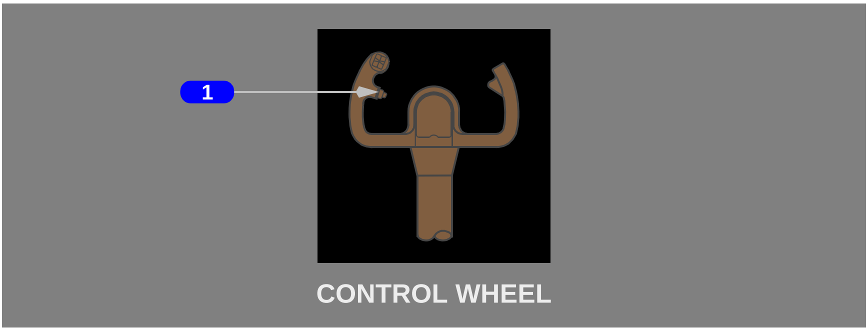
- CMD
- FD

* Mode is operating with angle of attack (alpha) or airspeed limit. Limit mode annunciation replaces engaged mode annunciation.

** An amber horizontal line is drawn through the appropriate autopilot pitch or roll mode annunciation when a flight mode fault is detected.

*** AFDS/Autothrottle mode changes are emphasized for 10 seconds by a box (green) drawn around the annunciated mode.

Autopilot Disengage Switch



1 Autopilot Disengage Switches

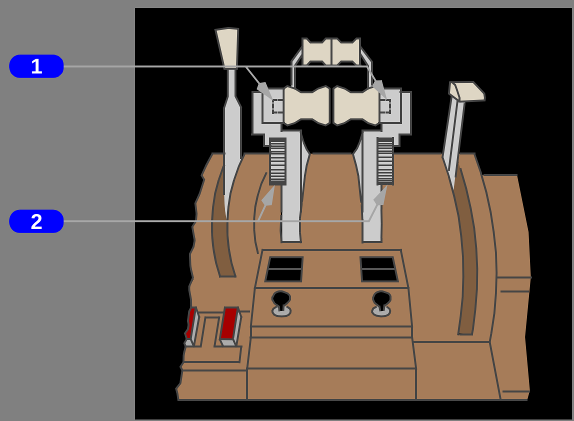
Push (either switch) –

- disconnects the autopilot
- A/P DISC and master warning lights illuminate
- displays the EICAS warning message AUTOPILOT DISC
- sounds an aural warning
- if the autopilot automatically disengages, resets the master warning lights, EICAS warning message, and the aural warning.

Second push – resets

- the master warning light
- EICAS warning message
- the aural warning.

Autothrottle Disconnect and Go–Around Switches



CONTROL STAND

1 Autothrottle Disconnect Switches

Push (either switch) –

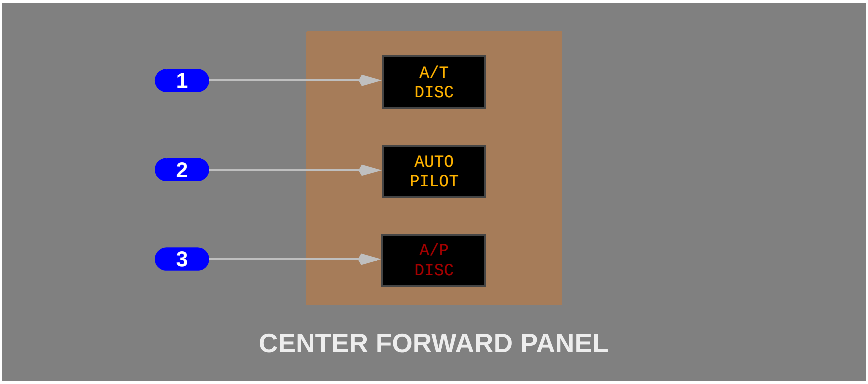
- disconnects autothrottle and A/T DISC light illuminates
- autothrottle remains armed
- subsequent push extinguishes A/T DISC light.

2 Go–Around Switches

Push (either switch) –

- automatic arming occurs at glide slope capture or with extension of wing flaps
- engages AFDS and autothrottle in GA mode if previously armed
- provides windshear guidance during GA if windshear detected
- if flight director off, activates flight director in GA mode
- cancels all thrust derates if selected after takeoff.

Autoflight Lights



1 Autothrottle Disconnect (A/T DISC) Light

Illuminated (amber) –

- autothrottle has disconnected
- extinguished by pushing either autothrottle disconnect switch.

2 Autopilot (AUTO PILOT) Light

Illuminated (amber) –

- a degraded operating condition exists in engaged autopilot
- extinguished when condition is corrected or an alternate autopilot is selected, provided fault is not common to alternate autopilot.

3 Autopilot Disconnect (A/P DISC) Light

Illuminated (red) –

- an autopilot has been automatically or manually disconnected
- extinguished by pushing either autopilot disengage switch.

Introduction

The automatic flight control system consists of the autopilot flight director system (AFDS) and the autothrottle system (A/T). The mode control panel (MCP) and flight management computer (FMC) control the AFDS and the autothrottle system to perform climb, cruise, descent and approach.

Autopilot Flight Director System

The AFDS consists of three flight control computers (FCCs) and the MCP.

The MCP provides control of the autopilot, flight director, altitude alert, and autothrottle systems. The MCP selects and activates AFDS modes, and establishes altitudes, speeds, and climb/descent profiles.

The three FCCs, left, center, and right, control separate hydraulically powered autopilot control servos to operate flight controls. The autopilot controls ailerons and elevators. Rudder commands are added only during a multiple autopilot approach. Nose wheel steering is also added during rollout from an automatic landing. During an ILS approach with all three autopilots engaged, separate electrical sources power the three FCCs.

The FCCs also provide inputs for AFDS operating mode displays and flight director commands on the FMA.

MCP Switches

MCP switches select automatic flight control and flight director modes. A light in the lower half of the switch illuminates to indicate the mode is armed or active. Respective roll and pitch flight mode annunciations on the FMA will also display. Autothrottle modes are discussed later in this section.

The following modes activate with a single push. These modes include:

- flight level change (FLCH)
- heading hold (HDG HOLD)
- heading select (HDG SEL)
- vertical speed (V/S)
- altitude hold (ALT HLD)

Other modes arm or activate with a single push. These modes are:

- lateral navigation (LNAV)
- vertical navigation (VNAV)
- localizer (LOC)
- approach (APP)

N316LA
- back course localizer (B/CRS)

All modes deactivate by disengaging the autopilot and turning both flight directors off. After localizer and glideslope capture, the localizer and glideslope modes can only be deactivated by disengaging the autopilot and turning both flight directors off or by selecting GA mode.

Desired target values can be selected on the MCP for:

- airspeed
- mach
- heading
- vertical speed
- altitude

All parameters except vertical speed can be preselected before autopilot and/or flight director engagement.

Autopilot Engagement

N316LA
Autopilot engagement requires at least one FCC and pushing one of the MCP autopilot engage switches.

N422LA through N526LA
Autopilot engagement requires at least two FCCs and pushing one of the MCP autopilot engage switches.

Autopilot Disengagement

Normal autopilot disengagement is through either control wheel autopilot disengage switch.

The autopilots can also be disengaged by the MCP autopilot disengage bar.

The A/P DISC light illuminates and the EICAS warning message AUTOPILOT DISC displays when the autopilot has been manually or automatically disconnected.

AFDS Failures

During autopilot operation, failures affecting the active mode annunciate on the FMA. If the failure affects only the active mode:

- the autopilot remains engaged in an attitude stabilizing mode
- an amber line is drawn through the mode annunciation
- the AUTO PILOT light illuminates
- the EICAS caution message AUTOPILOT displays.

If unwanted operation is noticed or when an autopilot failure is annunciated, the autopilot should be disconnected and the airplane flown manually.

Failures affecting all autopilot modes result in an autopilot disengagement accompanied by an aural warning. Depending on the system failure, it may be possible to reengage an autopilot by pushing the autopilot engage switch.

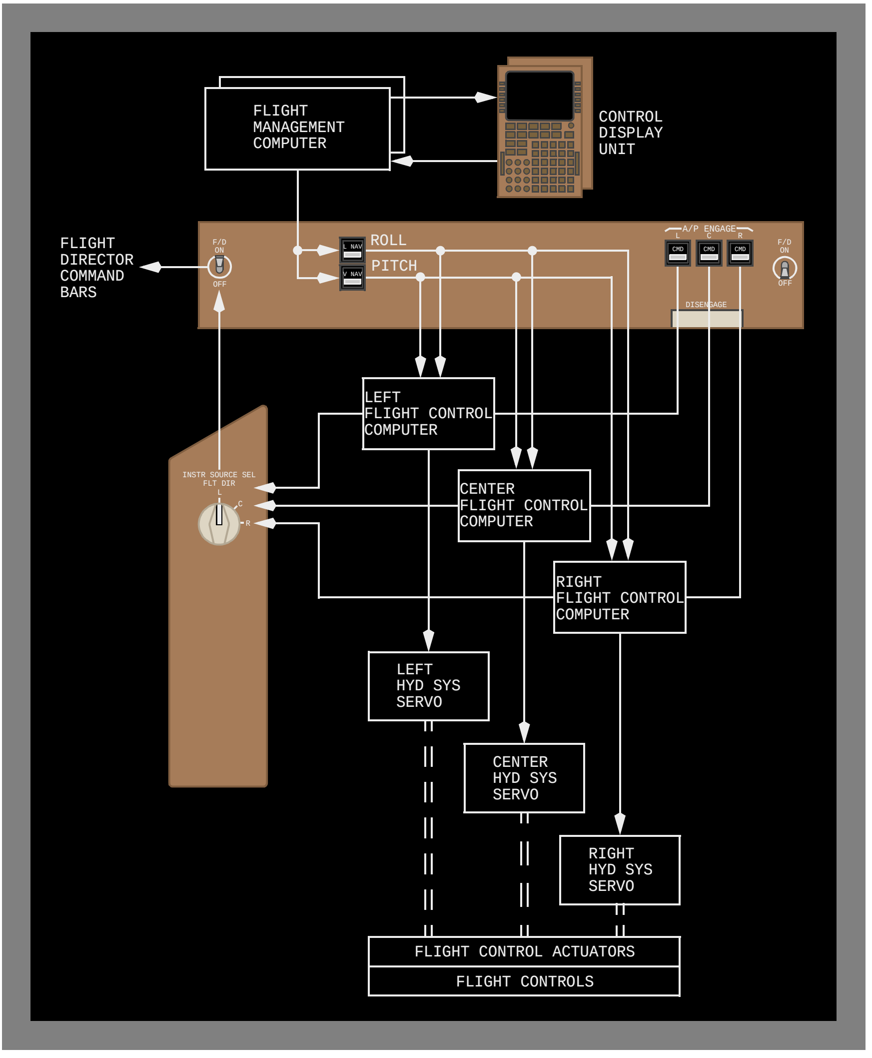
Flight Director Display

Flight director steering indications normally display any time the related F/D switch is ON.

The steering indications are also displayed when the related flight director switch is OFF and a go–around switch is pushed, if airspeed is greater than 80 knots and the flaps are not retracted. In this case, the flight director display can be removed by cycling the respective flight director switch on and then off.

A flight director failure in either pitch or roll, causes the respective steering bars to disappear.

Autopilot Flight Director System Schematic



Autoland Status Annunciators (ASA)

The following AFDS status annunciations can be displayed:

- LAND 3 – three autopilots engaged and operating normally for an automatic landing
- LAND 2 – AFDS redundancy reduced, in some cases only two autopilots available

- NO LAND 3 – indicates a fault condition exists which results in a LAND 2 condition
- NO AUTOLND – AFDS unable to make an automatic landing.

With a LAND 3 indication, the autopilot system level of redundancy is such that a single fault cannot prevent the autopilot system from making an automatic landing (fail operational).

With a LAND 2 indication, the level of redundancy is such that a single fault cannot cause a significant deviation from the flight path (fail passive).

Below 200 feet radio altitude the ASA display cannot change except to indicate a NO AUTOLND condition. Faults not requiring immediate crew action or awareness are annunciated after touchdown.

AFDS Flight Mode Annunciations

Flight mode annunciations are displayed on the ADI. Mode annunciations include:

- autothrottle
- pitch
- roll
- AFDS status

Active modes are displayed in green letters. When a mode changes the new active mode is highlighted with a green rectangle around it for several seconds. Armed modes display in smaller white letters.

Autothrottle Modes

Autothrottle annunciations are:

- SPD – autothrottle controlling thrust to maintain speed selected in IAS/Mach or, if VNAV engaged, the speed as programmed by the FMC
- IDLE – autothrottle is reducing or has reduced thrust to flight idle. It may engage in a VNAV descent. It will, after FLARE is engaged
- THR HLD – thrust levers remain in existing position or where manually placed
- N1 – autothrottle controlling to the selected N1 reference thrust
- FLCH – autothrottle controlling to a maximum of the selected mode reference thrust during climb, and to a minimum thrust during descent
- GA – autothrottle controlling to a maximum reference thrust to maintain a climb rate of at least 2000 fpm. If both flight directors and the autopilot are off, autothrottle controls to go–around reference thrust subject to flap and VMO limit speeds

Roll Modes

Roll annunciations are:

LNAV –

Arm LNAV by pushing the L NAV switch. The light illuminates and LNAV annunciates on the FMA roll mode annunciator in white characters below the current roll mode.

- LNAV (armed) – LNAV is armed to activate when parameters are met
- LNAV (active) – LNAV activates when in position to turn onto the active route leg. In flight, selection causes immediate activation if within 2 1/2 NM of the active leg.

HDG –

- HDG SEL (active) – airplane turns to or maintains the heading selected in the MCP heading window
- HDG HOLD (active) – AFDS holds present heading. When turning, AFDS holds the heading reached after rolling wings level.

N316LA
ATT –

- ATT (active) – when the autopilot is first engaged or the flight director is first turned on in flight, AFDS holds a bank angle between 5 and 30 degrees and will not roll to wings level
- when the bank angle is less than 5 degrees, AFDS returns to wings level HDG HOLD
- when the bank angle is greater than 30 degrees, AFDS returns to 30 degrees of bank.

LOC –

- LOC (armed) – AFDS captures the localizer when within range and within 120 degrees of the localizer course
- LOC (active) – AFDS follows the localizer course.

N316LA
B/CRS –

- B/CRS (armed) – AFDS is armed to capture and track inbound on backcourse of localizer after localizer capture
- B/CRS (active) – AFDS tracks inbound on backcourse of localizer.

TO –

- On the ground, TO annunciates by selecting either F/D switch ON when both flight directors are OFF
- TO roll and pitch guidance become active at lift–off.

GA –

- In flight, go–around arms with flaps out of up or at glideslope capture. There is no flight mode annunciation for go–around armed in flight; although the reference thrust limit changes to GA. Go–around is activated in flight by pushing a GA switch. The roll steering indication provides guidance to maintain the ground track present at mode engagement.

ROLLOUT –

- ROLLOUT (armed) – displays below 1500 feet radio altitude and activates below 5 feet
- ROLLOUT (active) – after touchdown, AFDS uses rudder and nosewheel steering to steer the airplane on the localizer centerline.

Pitch Modes

Pitch annunciations are:

TO –

On the ground, TO annunciates by selecting either F/D switch ON when both flight directors are OFF. The flight director pitch bar indicates an initial pitch of approximately eight degrees up.

After takeoff, the AFDS commands a pitch attitude to maintain:

- pitch command greater of V2 + 15 knots or liftoff speed + 15
- if current airspeed remains above the target speed for 5 seconds, target airspeed resets to current airspeed, to a maximum of V2 + 25 knots
- IAS/MACH window speed if IAS/MACH window speed is changed to a speed greater than the target speed.

Note: AFDS uses the speed set in the IAS/MACH window prior to takeoff for V2

GA –

Go-around arms and the reference thrust limit changes to GA when flaps are out of up or glideslope is captured.

When a go–around is initiated, the commanded speed is the MCP IAS/Mach window or current airspeed, whichever is higher. If the airspeed increases and remains above the initial target airspeed for five seconds, target airspeed resets to current airspeed to a maximum of the IAS/MACH window speed plus 25 knots. If airspeed at initiation of go–around is greater than IAS/Mach window plus 25 knots, that speed is maintained. GA displays as the reference thrust limit on the primary EICAS engine display.

VNAV –

Arm VNAV by pushing the V NAV switch. The light illuminates and VNAV annunciates on the FMA pitch mode annunciator in white characters below the current pitch mode.

VNAV provides pitch commands to maintain the FMC computed airspeed/path:

- VNAV SPD (active) – the AFDS maintains the FMC speed displayed on the FMA and/or the CDU CLIMB or DESCENT pages. During speed intervention, use the MCP IAS/MACH selector to manually set the speed
- VNAV PTH (active) – the AFDS maintains FMC altitude or descent path with pitch commands. For a non–entered headwind, thrust may increase to maintain the VNAV descent path. If the MCP altitude window is set to the current cruise altitude as the airplane approaches the top of descent, the CDU scratchpad message RESET MCP ALT displays

N422LA through N526LA

- VNAV ALT (active) – when a conflict occurs between the VNAV profile and the MCP altitude, the airplane levels and the pitch flight mode annunciation becomes VNAV ALT. VNAV ALT maintains altitude
- when a VNAV descent is initiated before the top of descent (T/D) and the airplane descent path subsequently intercepts the VNAV descent path, the pitch annunciation changes from VNAV SPD to VNAV PTH.

V/S –

Pushing the V/S switch opens the vertical speed window and displays the current vertical speed. It also opens the IAS/MACH window (if blanked). Pitch commands maintain the rate of climb or descent selected in the V/S window.

SPD –

Pushing the SPD switch opens the IAS/MACH window (if blanked). Pitch commands maintain IAS/MACH window airspeed or Mach.

ALT CAP –

A transition maneuver entered automatically from a V/S, FLCH, or VNAV climb or descent to selected MCP altitude. Engages but does not annunciate during VNAV transition.

ALT HOLD –

Altitude hold mode is activated by:

- pushing the MCP altitude HOLD switch, or
- capturing the selected altitude from a V/S or FLCH climb or descent.

G/S –

Autopilot flight director system follows the ILS glideslope.

FLARE –

- FLARE (armed) – during autoland, FLARE displays below 1500 feet radio altitude
- FLARE (active) – during autoland, flare activates at 50 feet radio altitude. FLARE deactivates at touchdown and the nosewheel smoothly lowers to the runway.

Autothrottle System

The autothrottle system provides thrust control from takeoff through landing.

Autothrottle mode and speed selection is controlled from the MCP and the thrust mode select panel (TMSP). When in VNAV, the FMC selects autothrottle modes and target thrust values. Refer to Chapter 11, Flight Management, Navigation, for FMS and CDU operation.

With a command speed of VREF + 5 knots and landing flaps, there is sufficient wind and gust protection available with the autothrottle engaged. The autothrottle adjusts thrust quickly when the airspeed decreases below the command speed. The autothrottle decreases thrust slowly when the airspeed is more than the command speed. In turbulence, the result is that the thrust average is higher than necessary to keep the command speed. This causes the speed average to be more than the command speed.

The autothrottle can be operated without using the flight director or the autopilot.

The autothrottle can be manually overridden or disconnected by using either A/T disconnect switch.

Thrust Management Computer

The thrust management computer (TMC) controls the autothrottle system through manual inputs from the MCP or automatically from the FMCs while VNAV is engaged. The basic TMC functions are to:

- calculate thrust limits and settings or follow FMC thrust settings
- detect and transmit autothrottle failures
- actuate the thrust levers

Thrust Mode Select Panel

The thrust mode select panel (TMSP) provides the following functions:

- selection of reference thrust modes (TO, GA, CLB, CON, CRZ)
- selection of fixed and assumed temperature derated reference thrust values

Autothrottle Thrust Lever Operation

The autothrottle system moves both thrust levers together to control speed or thrust, depending on the engaged mode.

Thrust levers can be manually positioned without disconnecting the autothrottle. After manual positioning and release, the autothrottle repositions the thrust levers to comply with the engaged mode. The autothrottle system does not reposition the thrust levers while in THR HLD mode.

Autothrottle Disconnect

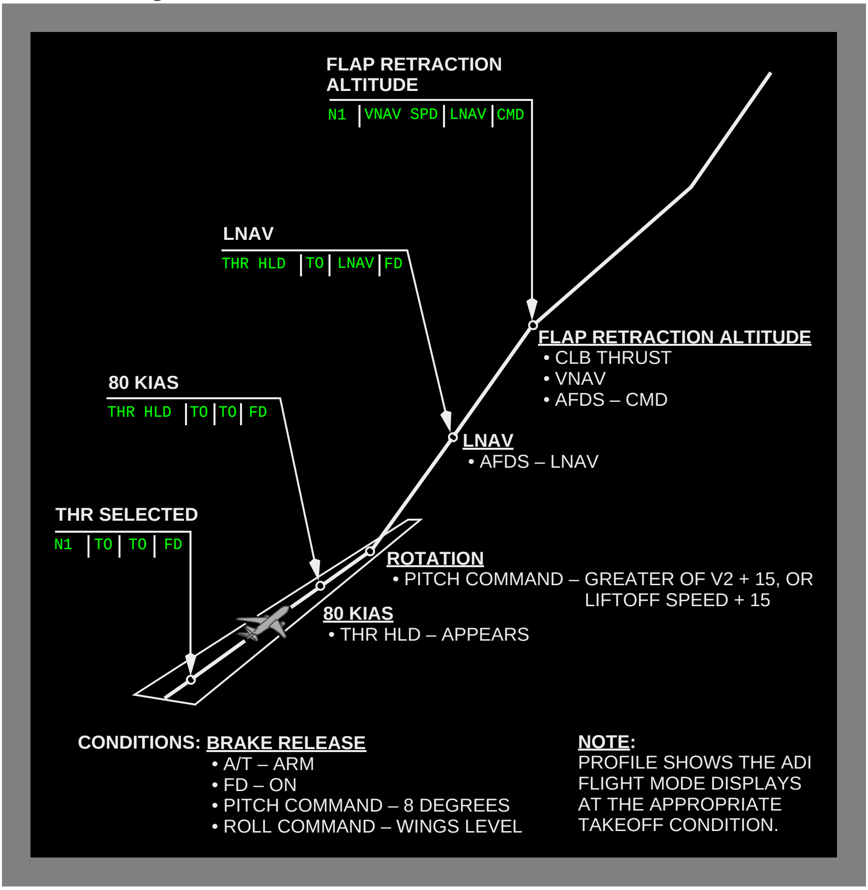
The autothrottle system can be disconnected manually by positioning the A/T arm switch to OFF or by pushing either thrust lever A/T disconnect switch.

Autothrottle disconnect occurs if a fault in the active autothrottle mode is detected, or when a reverse thrust lever is raised to reverse idle.

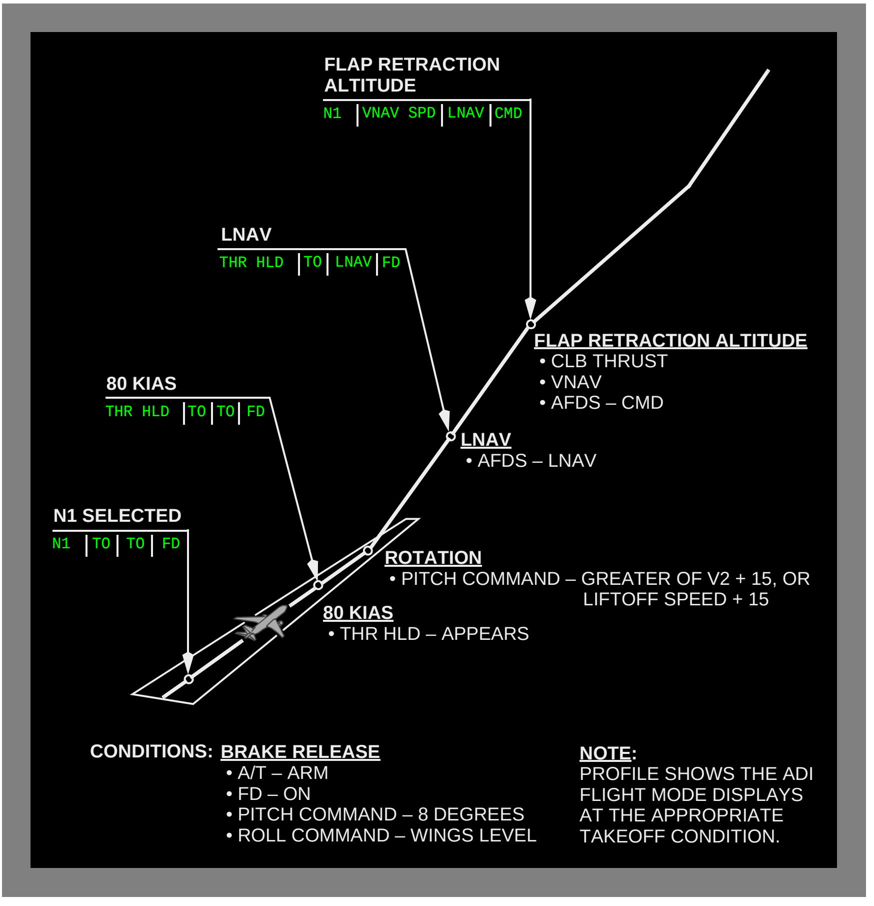
The A/T DISC light illuminates and the EICAS caution message AUTOTHROT DISC displays.

Automatic Flight Operations
Automatic Flight – Takeoff and Climb Profile

N422LA through N526LA



N316LA



Takeoff is a flight director only function and can only be engaged on the ground. The autopilot is not used during the takeoff roll but may be engaged after liftoff.

During preflight:

- with the autopilot disengaged and both F/D switches OFF, activation of TO roll and pitch mode occurs when the first F/D switch is positioned ON
- FD displays as AFDS status and TO as the pitch and roll flight mode annunciations
- command steering bars come into view

On takeoff, prior to 80 knots IAS:

- pitch command is set to approximately eight degrees up
- roll command is wings level

N316LA

- autothrottle is engaged by pushing N1 switch, thrust levers advance to selected takeoff power

N422LA through N526LA

- autothrottle is engaged by pushing THR switch, thrust levers advance to selected takeoff power
- FMAs display N1 for autothrottle and TO for both pitch and roll modes.

During takeoff prior to lift–off:

- at 80 knots, autothrottle annunciation changes to THR HLD.

At lift–off:

- pitch command greater of V2 + 15 or liftoff speed + 15
- if an engine failure occurs on the ground, the pitch command target speed at lift–off is V2 or airspeed at lift–off, whichever is greater
- roll command maintains ground track.

After lift–off:

- FD TO modes are terminated by engaging an A/P in CMD, or selecting any other pitch or roll mode
- A/T remains in THR HLD mode at takeoff thrust until a pitch mode, A/T mode, or thrust reference mode select switch is pushed. The A/T then sets climb thrust or the selected reference thrust

Note: Autopilot elevator authority during a single autopilot operation is limited to reduce the effects of an autopilot malfunction. During altitude capture, there may be insufficient elevator authority and stabilizer trim rate to counteract pitch down, caused by the combination of thrust reduction, flap retraction and aft c.g.

Note: An altitude capture from a climb that includes a significant airspeed increase or thrust reduction may result in the autopilot descending away from the selected altitude in an attempt to increase the airspeed.

Automatic Flight – Cruise

The autopilot and/or flight director can be used after takeoff to fly a lateral navigation track (LNAV) and a vertical navigation track (VNAV) provided by the FMC. Using LNAV and VNAV ensures the most economical operation.

Automatic Flight – Approach and Landing

The AFDS provides guidance for multiple autopilot precision approaches. Pushing the APP switch arms localizer in the roll mode and glideslope in the pitch mode. Also, with an autopilot engaged, the remaining two autopilots automatically arm for a multiple autopilot approach.

Either localizer or glideslope can be captured first.

Pushing the LOC switch arms the AFDS for localizer tracking. Descent on the localizer can be accomplished using VNAV, FLCH, or V/S pitch modes. The localizer mode cannot capture if the intercept angle exceeds 120 degrees. All other nonprecision approaches can be flown using LNAV and VNAV modes, or HDG SEL or V/S modes.

N316LA
Pushing the B/CRS switch in conjunction with the LOC switch will enable localizer backcourse tracking.

Runway Alignment and Asymmetric Thrust Compensation

AFDS controls rudder during multiple autopilot ILS approaches to compensate for engine–out asymmetric thrust conditions during an ILS approach.

With LAND 3 or LAND 2 annunciated, autopilot control of the rudder is active.

The runway align submode is operative during multiple autopilot ILS approach. It reduces the crab angle established during crosswind conditions prior to automatic landing. The submode operates as follows:

- actuated at 500 feet radio altitude with LAND 3 or LAND 2 annunciated
- activation not displayed
- autopilot systems initiate a slip with a maximum bank angle of two degrees when the crab angle exceeds five degrees
- wing leveling from the slip is initiated when the ROLLOUT mode is engaged.

If the autopilots are disengaged, manually or automatically, in an asymmetric thrust condition with rudder control active, the rudder moves to the trimmed position. The pilot may need to exert rudder pedal force to maintain a smooth transition to manual flying.

Flare

The flare maneuver brings the airplane to a smooth automatic landing touchdown. The flare submode is a multiple autopilot mode, and is not intended for single autopilot or flight director only operation.

At approximately 50 feet radio altitude, the autopilots start the flare maneuver. FLARE replaces the G/S pitch flight mode annunciation.

Flare arms when LAND 3 or LAND 2 annunciates.

During flare:

- at 15 feet radio altitude the autothrottle retards thrust levers to idle
- IDLE replaces the SPD autothrottle flight mode annunciation
- if slip exists due to runway align submode, wings leveled when ROLLOUT mode engaged

- autopilots start lowering nose wheel to runway at five feet radio altitude plus two seconds with pitch attitude less than two degrees
- at touchdown, the FLARE annunciation no longer displays, and the nose lowers to the runway.

Note: During an approach with LAND 2 annunciated and below 100 feet radio altitude an increment of nose up trim is automatically applied for flare. If the autopilots are subsequently disengaged in the approach, a forward control column force of 20–30 pounds may be required to counter the automatic trim condition. If an automatic multi–autopilot go–around is performed, the increment of automatic trim is removed.

Rollout

Rollout arms when LAND 3 or LAND 2 annunciates.

At approximately five feet radio altitude, rollout activates. ROLLOUT replaces the LOC roll flight mode annunciation.

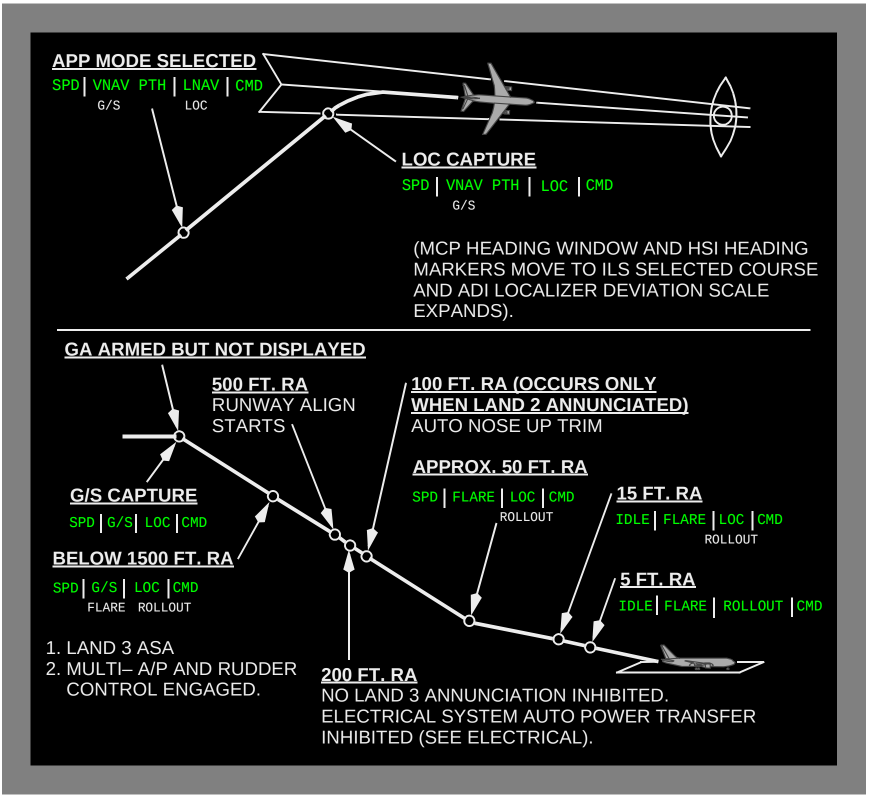
The autopilot controls the rudder and nose wheel steering to keep the airplane on the localizer centerline.

Roll command bar provides directional steering.

Rollout guidance continues until a full stop or until the autopilots are disengaged.

During rollout, autothrottle IDLE mode remains active until the autothrottle disengages. Autothrottle disengagement occurs when either thrust lever is set in reverse thrust position. When selecting reverse thrust the A/T DISC caution light, AUTOTHROT DISC EICAS message and aural warning will not be activated.

Automatic Flight – Approach Profile



Automatic Flight – Go–Around

Pushing either GA switch activates a go–around using multiple autopilot, single autopilot or flight director only.

When the F/D switches are not on, pushing either GA switch displays the flight director bars.

Go–around arms and the reference thrust limit changes to GA when the flaps are out of up or glideslope is captured. Arming is not annunciated. GA remains armed until two seconds after five feet radio altitude. Pushing either GA switch during this period of the approach engages the GA mode. The mode remains active even if the airplane touches down while executing the go–around.

If the airplane is floating within five feet radio altitude for more than two seconds when the GA switch is pushed, the autopilot pitch mode will remain in FLARE and the autothrottle go–around mode will engage.

If the airplane is on the ground but has been below five feet radio altitude for less than two seconds when the GA switch is pushed, the autopilot GA pitch mode will engage but the A/T mode will remain IDLE.

The GA switches are interlocked with the thrust reversers to prevent go–around mode engagement during reverse thrust operation.

When pushing either GA switch:

- roll and pitch activate in GA on the FMA
- autothrottle increases thrust to maintain a climb rate of at least 2000 fpm
- roll commands bank to maintain ground track
- AFDS increases pitch to hold existing speed or the selected MCP speed, whichever is higher, as thrust increases
- if flap setting is 20 or less, a thrust mode other than go–around can be selected.

Note: Autopilot elevator authority during a single autopilot approach is limited to reduce the effects of an autopilot malfunction. If a go–around is initiated during a single autopilot approach, there may be insufficient elevator authority and stabilizer trim rate to counteract pitch up, caused by a rapid application of full go–around thrust. There is sufficient elevator authority to counteract pitchup when the go–around is flown using multiple autopilots, or manually (no autopilot), or when the autothrottle go–around mode is used to set a 2000 FPM climb rate.

GA level–off:

- at the selected altitude, the AFDS pitch flight mode annunciation changes to ALT CAP, then to ALT HOLD and autothrottle mode changes to SPD
- GA remains the active roll mode until another mode is selected
- landing gear and flaps must be operated manually.

GA Mode Termination:

Below 400 feet radio altitude –

- if flap setting is 25 or 30, autothrottle remains in GA mode unless disengaged
- disengaged autopilot and turn off both flight directors.

Above 400 feet radio altitude –

- select a different roll or pitch mode; all autopilots, except first in CMD, disengage.

Note: If the autopilot systems are compensating for an asymmetric thrust condition when they revert to a single autopilot in CMD configuration, the rudder will return to the trimmed position unless the pilot exerts the rudder pedal force required to maintain the rudder position.

Automatic Flight – Windshear Recovery

The AFDS provides windshear recovery guidance by means of the normal go–around pitch and roll modes. With go–around armed, pushing a GA switch commands a pitch–up of 15 degrees or slightly below the pitch limit, whichever is lower.

When the autopilot is not engaged when go–around is initiated, the pilot must fly the windshear recovery following the flight director commands. If the autothrottle is not armed or engaged, the thrust levers must be advanced manually.

Auto Flight Limit Modes

Autothrottle Limit Modes

- FLAP LIM
- ALPHA
- SPD LIM

Pitch Limit Modes

- FLAP LIM
- SPD LIM

Flap placards speeds, airplane maximum angle of attack and maximum speed limit are automatically monitored by the AFDS and TMC in all modes except V/S pitch. The appropriate speed limit mode annunciation of FLAP LIM, ALPHA, or SPD LIM is displayed when a speed limit is approached and the MCP selected speed or FMC target speed is set to exceed a limit. When the limit mode is displayed, the limit speed becomes the reference speed for the autothrottle and AFDS.

When the AFDS is engaged in a speed mode (FLCH, GA), the speed limit monitoring is accomplished by the AFDS. When approaching a speed limit, the appropriate limit mode annunciation, replaces the existing pitch mode.

The AFDS will not annunciate ALPHA when approaching maximum angle of attack speed, however, the alpha safe speed will be maintained by AFDS pitch.

When the AFDS is not controlling speed, speed limit monitoring is accomplished by the TMC. When a speed limit is exceeded, the appropriate limit mode annunciation appears at the autothrottle mode position. The speed limit mode annunciations may appear only when the autothrottles are engaged.

Automatic Flight EICAS Messages

The following EICAS messages can be displayed.

Message	Level	Light	Aural	Condition
AUTOPILOT	Caution	AUTO PILOT	Beeper	The engaged autopilot is operating in a degraded mode. Engaged roll and/or pitch mode may have failed.
AUTOPILOT DISC	Warning	A/P DISC	Siren	The autopilot has disconnected.
AUTOTHROT DISC	Caution	A/T DISC	Beeper	The autothrottle has disconnected.

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Communications — Chapter 5

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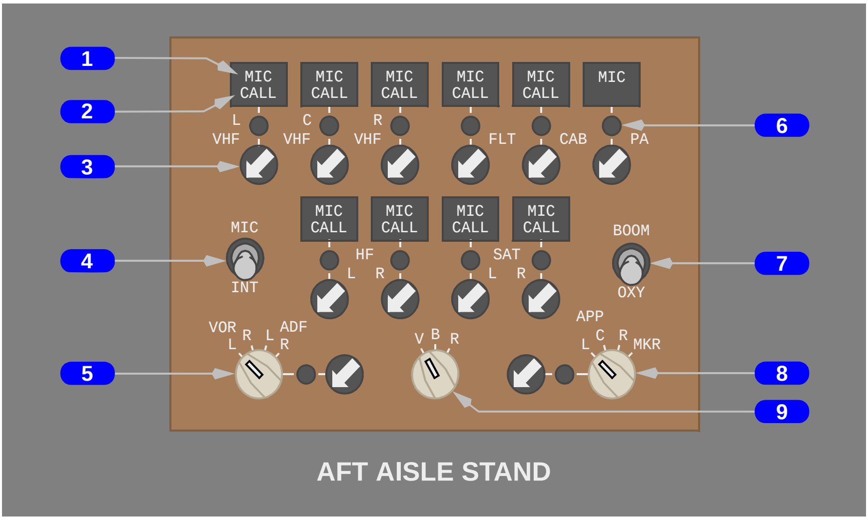
Audio Control Panel (ACP)

N422LA through N526LA



1 Microphone Selector Switches/Lights

Push –

- the selected transmitter MIC light illuminates
- the MIC light for any other transmitter extinguishes
- selects the respective transmitter (radio or intercommunications) for transmission from this crew station (only one can be selected at a time for each crew station)
- selects the receiver audio on, if not already manually selected on

2 CALL Lights

Illuminated (white) –

- indicates a call on SELCAL (VHF or HF radio), the flight interphone (FLT), the cabin interphone (CAB), or SATCOM (SAT)
- resets when the respective transmitter select switch is pushed or, if already pushed, by pressing a MIC/INTERPHONE switch (the SATCOM CALL light remains illuminated until the call ends)
- PA does not have a CALL light

3 Receiver Control

Push – turns respective receiver ON/OFF at any volume setting.

Rotate – varies respective receiver volume.

Note: Will not select off when 121.500 is tuned in the RTP Active Frequency Indicator.

4 Microphone/Interphone (MIC/INT) PTT Switch

MIC – keys microphone for transmission on system selected with MIC select switches.

INT – keys microphone for transmission on flight interphone system.

5 VOR/ADF Receiver Selector

Selects the left or right VOR or ADF receiver to be monitored.

6 Receiver Selected Lights

Illuminated – indicates respective receiver audio volume control is manually selected on.

7 Boom/Oxygen (BOOM/OXY) PTT Switch

BOOM – transmit from the boom microphone.

OXY – transmit from the oxygen mask microphone.

8 Approach Receiver (APP) Selector

Selects respective receiver to be monitored.

- L – left ILS is monitored
- C – center ILS is monitored
- R – right ILS is monitored
- MKR – marker beacon is monitored

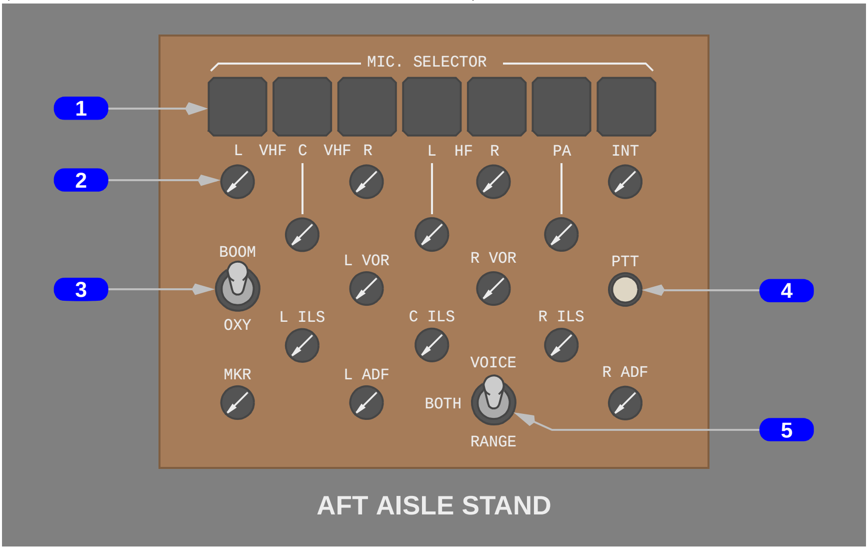
9 NAV Filter Selector

Filters VOR, ADF, ILS, or DME audio

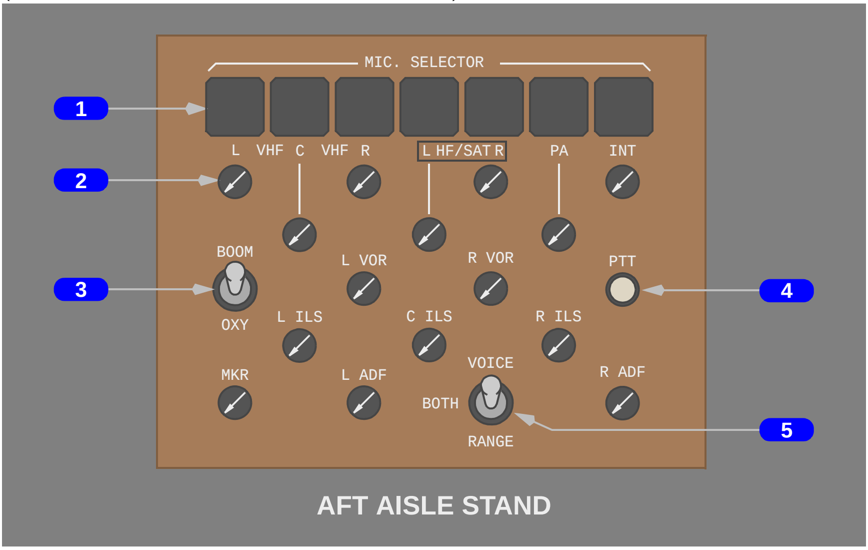
- V (Voice) – only the voice audio is heard
- B (Both) – both the voice and range audio are heard
- R (Range) – range audio (navigation aid Morse code identifier) is heard

N316LA

(SB Deletes N316LA with SATCOM installed.)



(SB Adds N316LA with SATCOM installed.)



1 Microphone Selector Switches/Lights

Push –

- the selected transmitter light illuminates
- the light for any other transmitter extinguishes
- selects the respective transmitter (radio or intercommunications) for transmission from this crew station (only one can be selected at a time for each crew station)
- selects the receiver audio on, if not already manually selected on

(SB Adds N316LA with SATCOM installed.)

- the HF/SAT (L or R) transmitter switch selects the associated HF (L or R) or SATCOM (1 or 2) for voice communication.

2 Receiver Control

Push – turns respective receiver ON/OFF at any volume setting.

Rotate – varies respective receiver volume.

3 Boom/Oxygen (BOOM/OXY) Switch

BOOM – transmit from the boom microphone.

OXY – transmit from the oxygen mask microphone.

4 Push–To–Talk (PTT) Switch

Push and hold – transmits on selected system.

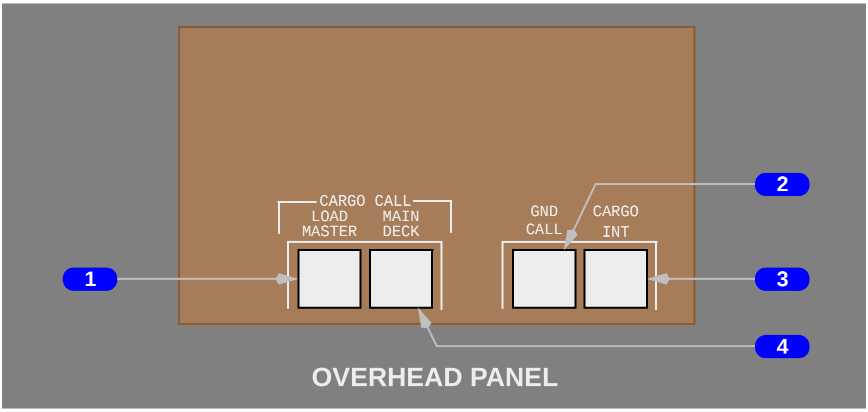
5 Navigation Filter Selector

Filters VOR, ADF, or ILS audio:

- VOICE – only voice transmissions can be heard
- BOTH – voice transmissions and station identifiers can be heard
- RANGE – only station identifiers can be heard

Pilot Call Panel

N422LA through N526LA



1 LOAD MASTER Switch/Light

Illuminated – flight crew being called from Master Cargo Control Panel:

- remains illuminated until reset

Push – illuminates FLIGHT DECK call light on Master Cargo Control Panel:

- sounds chime in Load Master headset

2 Ground Call (GND CALL) Switch/Light

Illuminated – indicates a call from ground personnel:

- extinguishes after 30 seconds

Push – calls ground personnel as long as switch is pushed.

3 Cargo Interphone (CARGO INT) Switch/Light

Push – interconnects flight and cargo interphone systems.

Illuminated – flight and cargo interphone systems are connected.

Push again – returns to normal operation – light is extinguished

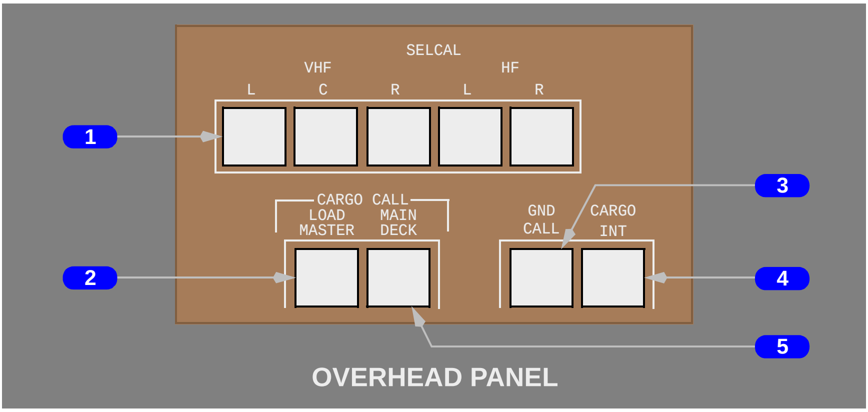
4 MAIN DECK Switch/Light

Illuminated – flight crew being called from one of six main deck cargo stations:

- remains illuminated until reset

Push – illuminates call light at six main deck cargo stations.

N316LA



1 Selective Calling (SELCAL) Switch/Lights

Illuminated – indicates a radio call on SELCAL:

- resets when the respective transmitter is keyed or when light is pushed

2 LOAD MASTER Switch/Light

Illuminated – flight crew being called from Master Cargo Control Panel:

- remains illuminated until reset

Push – illuminates FLIGHT DECK call light on Master Cargo Control Panel:

- sounds chime in Load Master headset

3 Ground Call (GND CALL) Switch/Light

Illuminated – indicates a call from ground personnel:

- extinguishes after 30 seconds

Push – calls ground personnel as long as switch is pushed.

4 Cargo Interphone (CARGO INT) Switch/Light

Push – interconnects flight and cargo interphone systems.

Illuminated – flight and cargo interphone systems are connected.

Push again – returns to normal operation – light is extinguished

5 **MAIN DECK Switch/Light**

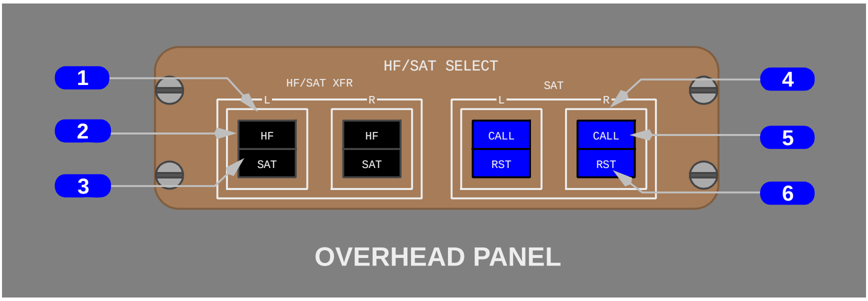
Illuminated – flight crew being called from one of six main deck cargo stations:

- remains illuminated until reset

Push – illuminates call light at six main deck cargo stations.

HF/SATCOM Select Panel

(SB Adds N316LA with SATCOM installed.)



1 **HF/SATCOM Transfer (HF/SAT XFR) Switch**

Push – alternates HF radio and SATCOM radio audio signal.

Note: HF/SATCOM audio circuits connecting to the flight interphone system are switched at the audio control panels.

2 **HF Transfer Light**

Illuminated (white) – indicates HF radio is being used to transmit/receive on the associated audio channel.

3 **SATCOM (SAT) Transfer Light**

Illuminated (white) – indicates SATCOM is being used to transmit/receive on the associated audio channel.

4 **SATCOM (SAT) Switch**

Push - terminates the current SATCOM voice call on the associated audio channel.

5 **SATCOM (SAT) CALL Light**

Illuminated (blue) – indicates incoming call via associated SATCOM radio channel:

- flashing - incoming SATCOM call is waiting
- steady - incoming SATCOM call is active
- flashing (10 cycles) then steady - outgoing call is being placed

6 SATCOM Reset (RST) Light

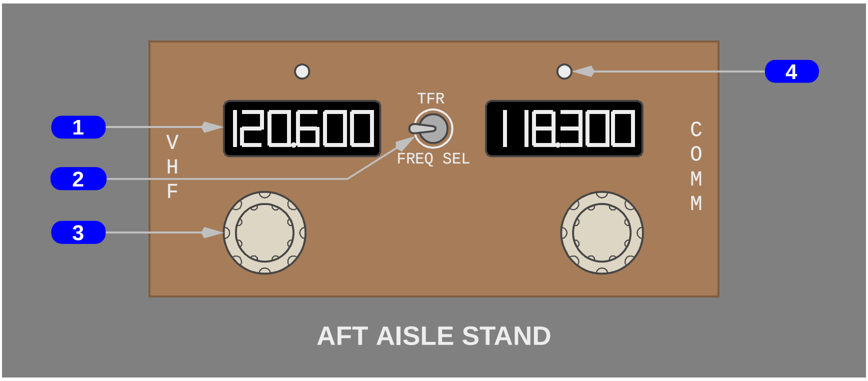
Illuminated (blue) – indicates that an active call on the associated SATCOM radio channel (L or R) may be terminated.

- flashing - incoming SATCOM call is waiting
- steady - incoming SATCOM call is active
- flashing (10 cycles) then steady - outgoing call is being placed

Radio System

VHF Communication Panel

N316LA



1 Frequency Window

Indicates the selected frequency.

2 Frequency Transfer (TFR) Switch

Selects which frequency is active for the transceiver.

3 Frequency Selector

Rotate – changes frequency in the window above:

- outer selector changes digits to the left of the decimal point
- inner selector changes digits to the right of the decimal point

4 Active Frequency Light

Illuminated – indicates which frequency has been selected by the frequency transfer switch.

HF Communication Panel

N316LA

1 Frequency Window

Indicates the selected frequency.

2 Frequency Selectors

Selects the frequency shown in the Frequency Window:

Rotate left knob – changes the digits to the left of the decimal point.

Rotate right knob – changes the digits to the right of the decimal point.

3 Mode Selector

OFF – power removed from unit.

USB – sets the upper side band (USB) mode.

AM – sets the amplitude modulation (AM) mode.

4 Radio Frequency Sensitivity (RF SENS) Control

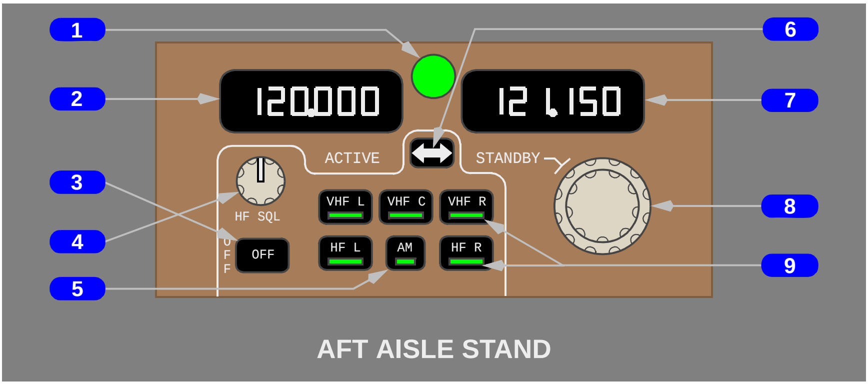
Rotate – adjusts the sensitivity of the HF receiver:

- (clockwise) increases sensitivity for reception of weak or distant stations
- (counter clockwise) decreases sensitivity to reduce noise and static

Note: Decreasing sensitivity too far prevents reception, including SELCAL monitoring of HF radio.

Radio Tuning Panel

N422LA through N526LA



1 Offside Tuning Light

Illuminated –

- the radio normally associated with this panel is being tuned by another radio tuning panel, or
- the radio tuning panel is being used to tune a radio not normally associated with this radio tuning panel

Note: The left RTP is normally associated with VHF L and HF L. The right RTP is normally associated with VHF R and HF R. The center RTP is normally associated with VHF C.

2 ACTIVE Frequency Window

Displays the tuned frequency of the selected radio.

Displays DATA if the selected radio is in the data mode (shows only when selected radio is the ACARS radio).

3 Radio Tuning Panel OFF Switch/Light

Push – connects/disconnects the panel from the communications radios.

Illuminated – the RTP is OFF.

4 HF Sensitivity (HF SQL) Control

Rotate – adjusts the sensitivity of the on–side HF receiver.

Note: Decreasing sensitivity too far prevents reception, including SELCAL monitoring of HF radio.

5 AM Switch/Light

Push – sets the AM (amplitude modulation) mode.

AM light illuminated – HF AM is selected.

Push again – sets the USB (upper side band) mode for the selected HF.

AM light extinguished – HF USB is selected.

6 Frequency Transfer Switch

Push –

- transfers the STANDBY window frequency to the ACTIVE window and tunes the selected radio to the new active frequency
- transfers the ACTIVE window frequency to the STANDBY window

7 STANDBY Frequency Window

Displays the preselected or previously tuned frequency of the selected radio.

Displays DATA when selection of the frequency transfer switch has placed the ACARS radio to the voice mode (shows only when selected radio is ACARS radio). Voice frequency shows in the ACTIVE frequency window.

8 Frequency Selector

Rotate – selects the standby frequency of the selected radio:

- outer knob – selects the portion of the STANDBY frequency to the left of the decimal point
- inner knob – selects the portion of the STANDBY frequency to the right of the decimal point

9 Radio Selection Switch/Lights

Push – selects the radio to be tuned:

- the tuned frequency is displayed in the ACTIVE frequency window
- the standby frequency is displayed in the STANDBY frequency window

Push and hold – removes automatic squelch on selected VHF radio until switch is released.

Illuminated (green) – indicates which radio is selected.

Radio Tuning Panel Failure Indications

1 Panel Fail

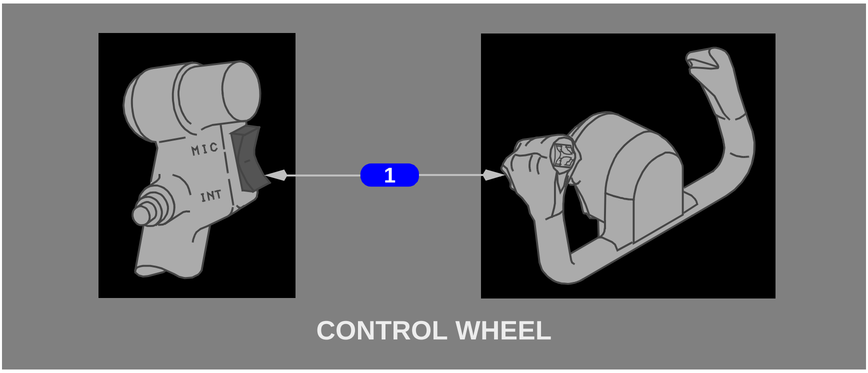
The radio tuning panel has failed.

Radio Tuning Panel ACARS Indications

1 DATA Mode

Displays DATA in the ACTIVE frequency window when the selected radio is being used in the data mode.

Miscellaneous Communication Controls
Control Wheel Microphone/Interphone Switch



1 **Control Wheel Microphone/Interphone (MIC/INT) Switch**

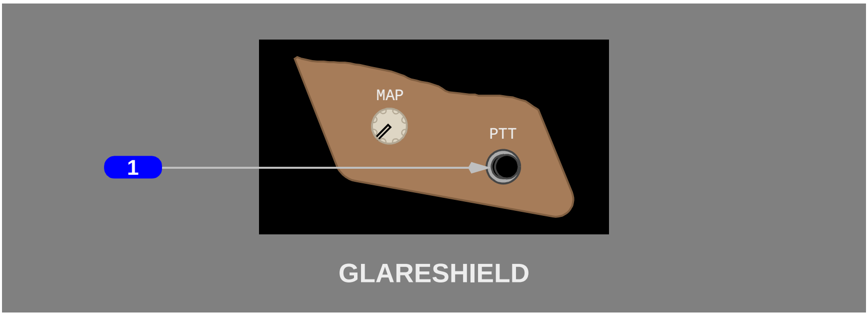
Spring loaded to center (off) position.

MIC – allows transmission on the selected transmitter.

INT – allows transmission on the flight interphone system.

Glareshield Push–To–Talk Switch

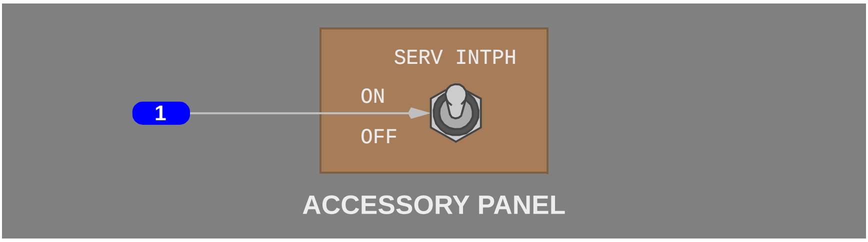
N422LA through N526LA



1 **Glareshield Push–To–Talk (PTT) Switch**

Push – allows transmission on the selected transmitter.

Service Interphone Switch

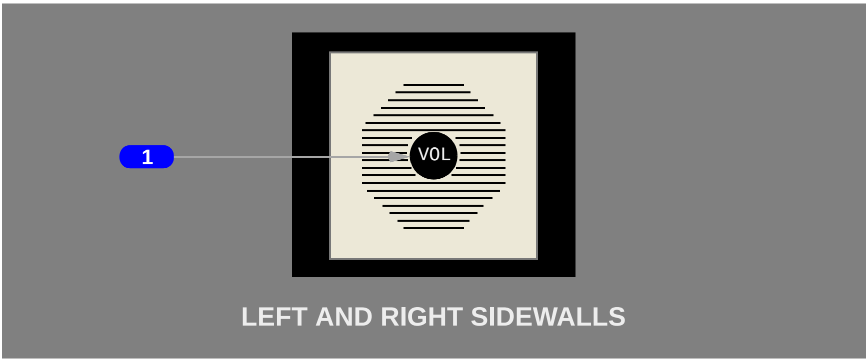


1 **Service Interphone (SERV INTPH) Switch**

ON – adds external (unpressurized area) headphone jacks to cabin interphone system.

OFF – deactivates external (unpressurized area) headphone jacks, except jack marked FLIGHT at the APU ground control panel.

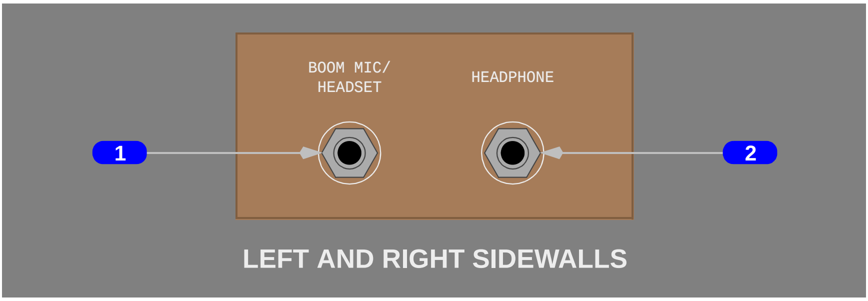
Flight Deck Speaker



1 Flight Deck Speaker Volume Control

Rotate – adjusts speaker volume.

Captain/First Officer Jack Panels



1 BOOM MIC/HEADSET Jack

Accepts a flight crew boom microphone/headset plug.

2 HEADPHONE Jack

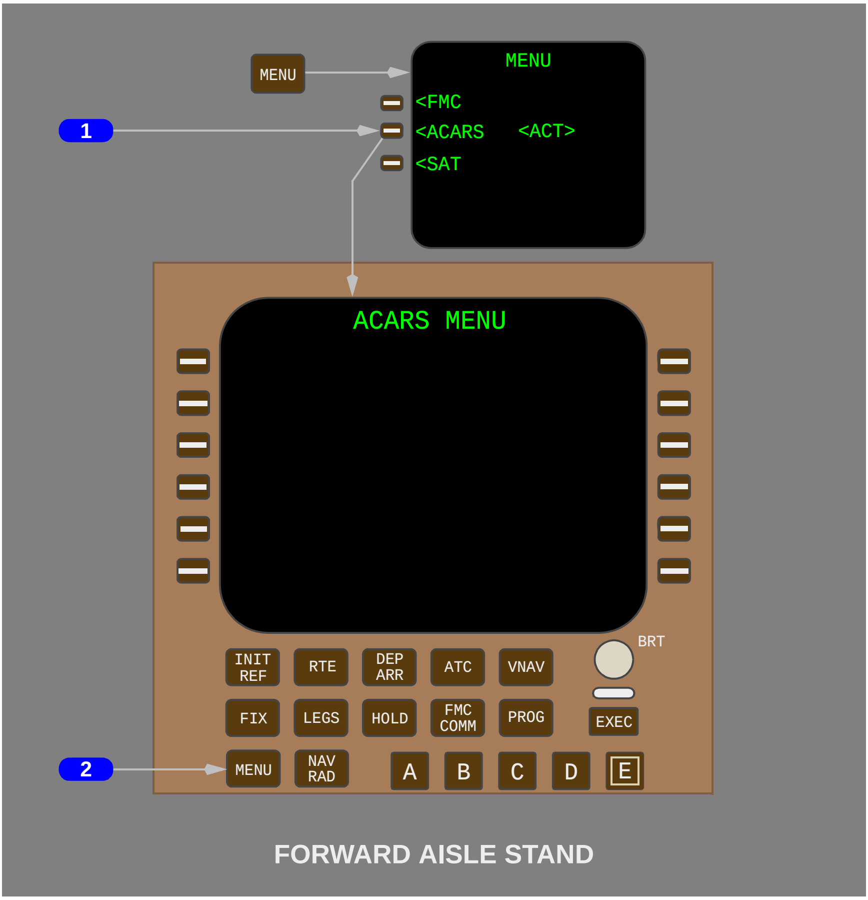
Accepts a flight crew headphone plug.

ACARS or SATCOM Control

N422LA through N526LA
(SB Adds N316LA with ACARS.)

ACARS Access Through Control Display Units (CDU)

N422LA through N526LA



1 ACARS Line Select Key

Push – displays ACARS MENU page.

See section 40 of this chapter for description of ACARS operation.

2 MENU KEY

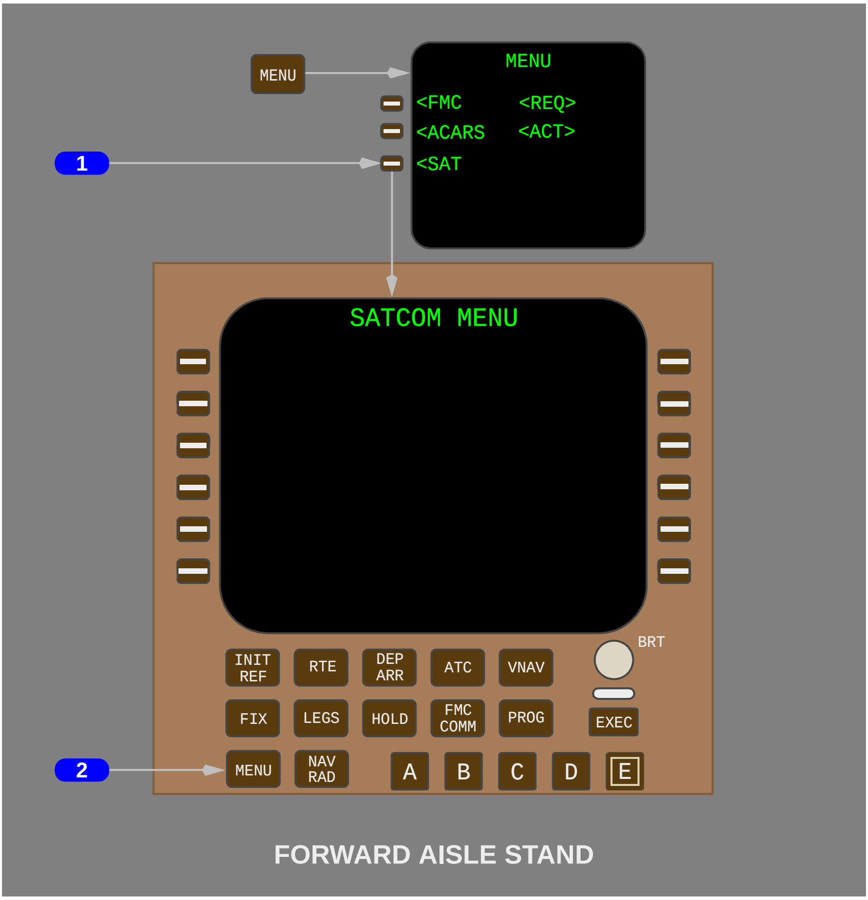
Push – displays MENU page.

See Chapter 11, Flight Management, Navigation for description of the FMC and associated software functions.

Note: ACARS control also available through separate ACARS control panel (IDU or CU) located on the Aft Aisle Stand.

SATCOM Access Through Control Display Units (CDU)

N422LA through N526LA



1 SAT Line Select Key

Push – displays SATCOM MENU page.

See section 25 of this chapter for description of SATCOM operation.

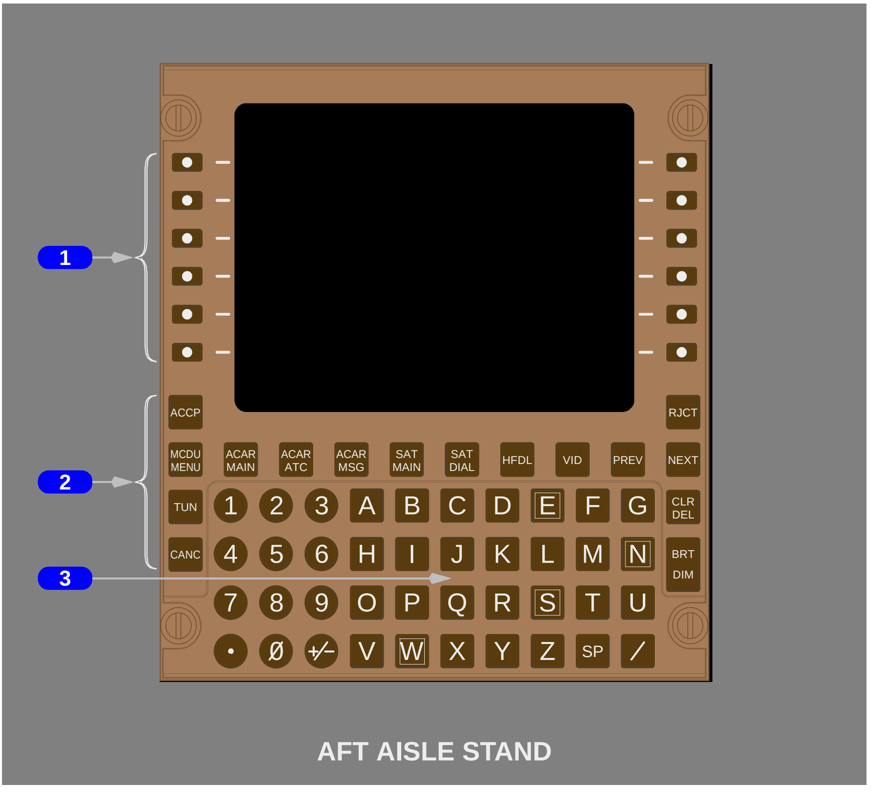
2 **MENU Key**

Push – displays MENU page.

See Chapter 11, Flight Management, Navigation for description of the FMC and associated software functions.

ACARS Multipurpose Interactive Display Unit (MIDU)

N422LA through N526LA



1 **Line Select Keys**

– Accesses desired Control pages from display.

2 **Function Keys**

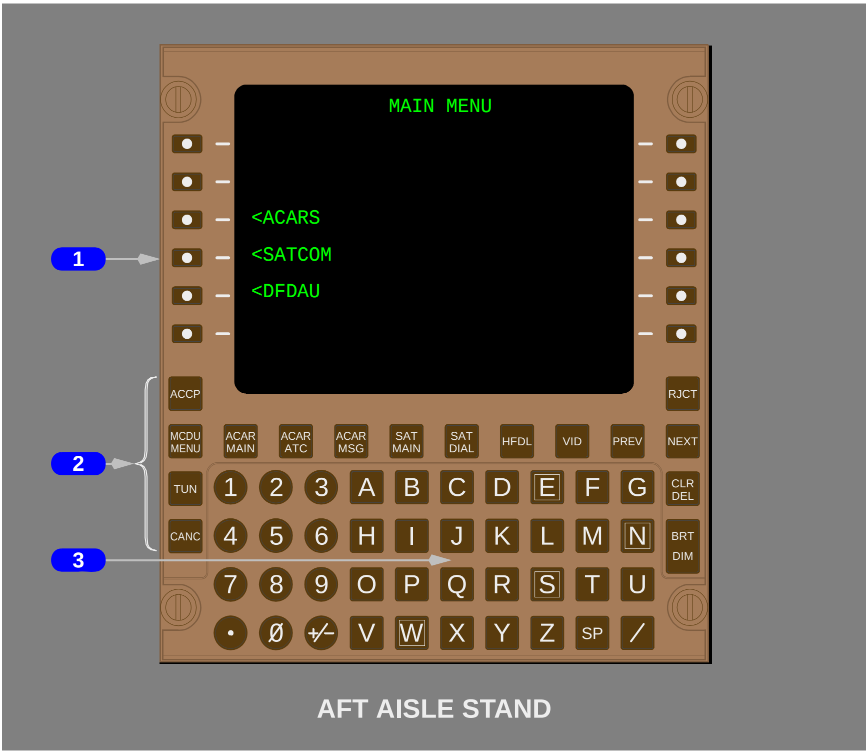
– Displays Control pages for selected function.

3 **Alphanumeric Keyboard**

– Selects Alphanumeric characters for display.

SATCOM Multipurpose Interactive Display Unit (MIDU)

(SB Adds N316LA with SATCOM installed.)



1 SATCOM Line Select Key (LSK)

Push - provides access to SATCOM Main Menu page.

- When selected the MIDU displays SATCOM status information, allows selection of stored air-to-ground telephone numbers, allows manual dialing of telephone numbers, or provides a means for the flight crew to answer incoming calls.
- During SATCOM initialization or if the SATCOM system detects a failure, this LSK will display "<?????". If this display fails to revert to the normal SATCOM prompt, maintenance action is required.
- Refer to section 5.26 of this chapter for detailed description.

2 **Function Keys**

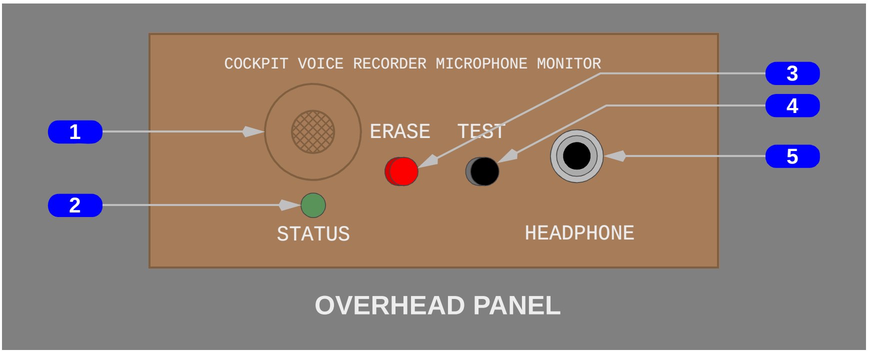
Push - displays control pages for selected function

- The SAT MAIN and SAT DIAL keys are inactive. FUNCTION NOT AVAILABLE will be displayed if either of these keys are depressed.

3 **Alphanumeric Keyboard**

Selects alphanumeric characters for display.

Cockpit Voice Recorder Panel



1 **Microphone**

Area microphone for the voice recorder.

2 **STATUS Light**

Illuminated – test completed successfully. Extinguished after one second.

3 **ERASE Switch**

Push and hold – erases the voice recorder (if on the ground, AC power on, and the parking brake is set).

4 **TEST Switch**

Push and hold – initiates cockpit voice recorder test.

5 **HEADPHONE Jack**

A headphone may be plugged in to monitor playback of voice audio, or to monitor tone transmission during test.

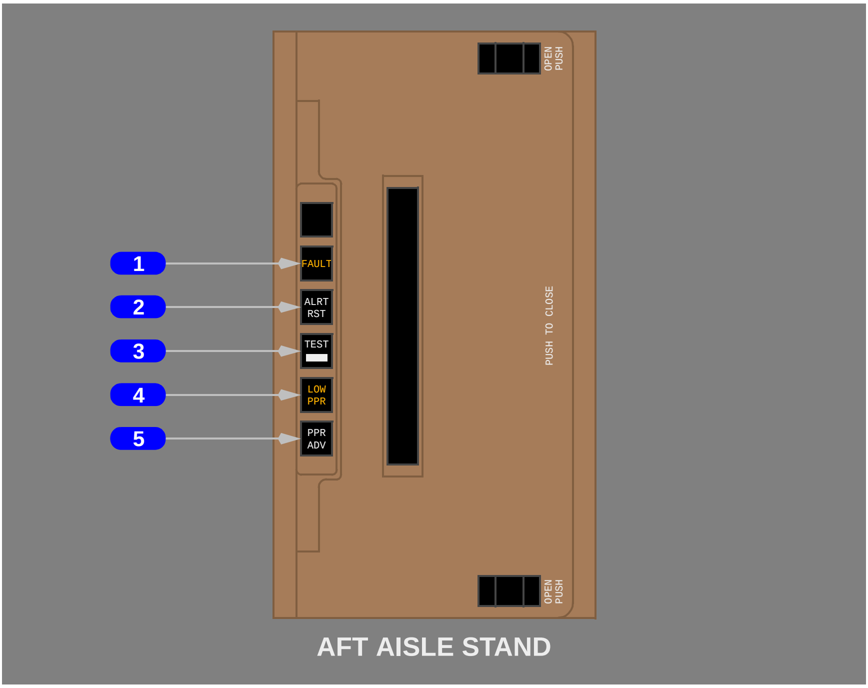
Emergency Locator Transmitter

N422LA through N526LA

Refer to Chapter 1, Section 30 for emergency locator transmitter controls and indicators.

Printer

N316LA



1 FAULT Light

Illuminated – indicates a printer fault.

2 Alert Reset (ALRT RST) Switch

Push – resets the printer if it stops operating.

3 TEST Switch

Push – causes the printer to do a self test and print a test pattern.

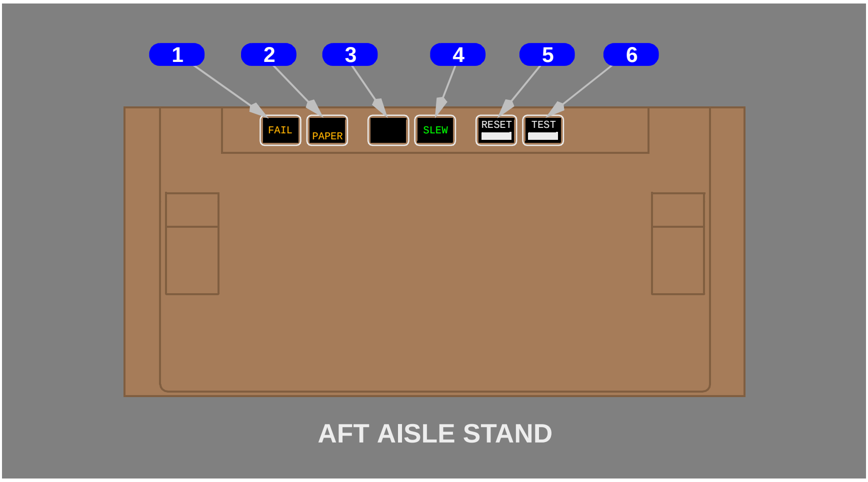
4 Low Paper (LOW PPR) Light

Illuminated – the printer is low on paper.

5 Paper Advance (PPR ADV) Switch

Push – advances the printer paper while the switch is held.

N422LA through N526LA



1 Printer FAIL Light

Illuminated (amber) – the printer has failed.

2 Printer PAPER Light

Illuminated (amber):

- the printer is out of paper, or
- the paper is jammed

3 Switch is not functional

4 Printer SLEW Switch

Push and hold – advances the printer paper.

5 Printer RESET Switch

Push – resets the printer if it stops operating.

6 Printer TEST Switch

Push –

- tests the printer and printer lights
- prints a test pattern

Intentionally
Blank

Introduction

The communication systems include:

- radio communication system
- interphone communication system (refer to section 30 of this chapter)
- SELCAL system
- cockpit voice recorder system
- communication crew alerting system

N422LA through N526LA
- SATCOM system (refer to section 25 of this chapter)

(SB Adds N316LA)
- SATCOM system (refer to section 26 of this chapter)

N422LA through N526LA
- data communication system (refer to section 40 of this chapter)

N422LA through N526LA
- ATC data link system (refer to section 45 of this chapter)

The communication systems are controlled using the:

- audio control panels (ACP)
- pilots call panel (PCP)

N316LA
- control panels for each communication radio

N422LA through N526LA
- radio tuning panels (RTP) for control of all communication radios

N422LA through N526LA
- control display unit (CDU) for controlling the data link (refer to section 40 of this chapter)

N422LA through N526LA
- control panel (MIDU, IDU, or CU) for controlling the data link (refer to section 40 of this chapter)

Audio Control Panels

The audio control panels (ACP) are used to manage the radio and interphone communication systems. Navigation receiver audio can also be monitored.

Systems are monitored using headphones or speakers. Receiver volume is controlled on the ACP by rotating the knob beneath the respective receiver.

A speaker volume control is located in the center of the speaker.

Microphones are keyed by pushing the desired audio control panel transmitter select switch and holding in a push–to–talk (PTT) switch. The PTT switches are located on:

- the control wheels

N316LA
- the audio control panels

N422LA through N526LA
- the audio control panel switch labeled MIC/ INT

N422LA through N526LA
- the glareshield
- any hand microphone

There is a boom microphone on the headset, a microphone in the oxygen mask, and a hand microphone jack at all flight crew member stations.

When the BOOM/OXY switch on the ACP is in the OXY position, the oxygen mask microphone is enabled and the boom microphone is disabled. When the BOOM/OXY switch on the ACP is in the BOOM position, the oxygen mask microphone is disabled and the boom microphone is enabled.

Radio Tuning Panels

N422LA through N526LA

The radio tuning panels (RTP) are used to tune the VHF and HF radios. The panels are designated left, center, and right, and are normally associated with the respective VHF and HF radios. Any radio can be controlled by any RTP. Normally, the right RTP is used for tuning the right VHF (or HF) radio, the left RTP is used for tuning the left VHF (or HF) radio, and the center RTP is used to tune the center VHF radio. This is called “on–side” tuning.

An off–side tuning light on each RTP indicates that a communication radio normally associated with that RTP has been selected by, and may be tuned by, another RTP, or that RTP is selected to a radio normally associated with another RTP.

Each HF radio can be tuned by any radio tuning panel. However, HF radio sensitivity can only be set on the "on–side" RTP.

Radio Communication Systems

The radio communication systems consist of:

- the high frequency (HF) communication system
- the very high frequency (VHF) communication system
- the selective calling (SELCAL) system

HF Communication System

Two independent HF communication radios are installed. These are designated HF L (left) and HF R (right). The ACPs are used to control voice transmission and receiver monitoring.

N422LA through N526LA
Tuning and sensitivity control for the HF radio is provided through a radio tuning panel (RTP).

N316LA
To tune the HF radio, rotate the frequency selectors on the HF communication panel. The left knob changes the digits to the left of the decimal point, and the right knob changes the digits to the right of the decimal point.

The sensitivity is adjusted by rotating the control knob. Rotating clockwise increases the sensitivity to receive weak or distant stations. Rotating counter clockwise decreases the sensitivity to decrease noise and static.

Note: Decreasing sensitivity too far prevents reception, including SELCAL monitoring of the HF radio.

Both HF radios use a common antenna. When either HF radio is transmitting, the antenna is disconnected from the other HF radio, and it cannot be used to transmit or receive. However, both HF radios can receive simultaneously if neither is being used for transmitting.

When an HF transmitter is keyed after a frequency change, the antenna tunes. While the antenna is being tuned, a tone can be heard through the audio system (tuning takes a maximum of 15 seconds).

VHF Communication System

- Three independent VHF radios are installed, designated VHF L (left), VHF C (center), and VHF R (right).

N422LA through N526LA
Tuning is accomplished through the radio tuning panels (RTP).

N316LA
Tuning is accomplished through communication panels (CP) for each radio.

Each VHF radio allows the tuning of two independent frequencies, an active and a standby frequency. These can be interchanged with the frequency transfer switch. The ACPs are used to control voice transmission and receiver monitoring.

Stuck Mic Protection

N422LA through N526LA

In the event an HF or VHF radio transmits for more than 30 seconds, the EICAS advisory message RADIO TRANSMIT is displayed. The message is removed when the transmission stops.

Selective Calling (SELCAL) System

N316LA

The SELCAL system monitors all of the communication radios. When the system receives a properly encoded call from a ground station, the crew is alerted through the illumination of the corresponding light on the pilot's call panel.

N422LA through N526LA

The SELCAL system monitors all of the communication radios. When the system receives a properly encoded call from a ground station, the crew is alerted through the illumination of the corresponding CALL light on the pilot's audio control panel.

The flight crew is also alerted to an incoming call by an aural chime and the SELCAL communication message on the EICAS display. Refer to section 50 of this chapter for a list of possible messages.

Aircraft Communication Addressing and Reporting System (ACARS)

N422LA through N526LA

ACARS data and voice modes provide automatic and manual means to transmit and receive operational, maintenance, and administrative information between the airplane and a ground station. ACARS is operational when electrical power is established. The ACARS systems descriptions provided in this section are limited to manual selection of ACARS radio operating modes. Refer to section 40 of this chapter for additional information about ACARS operation and control.

ACARS communicates incoming and outgoing data and messages through:

- the center VHF radio
- the SATCOM system

ACARS provides for automatic and manual control, including mode selection, of the dedicated ACARS radio through the ACARS management unit. Refer to section 40 of this chapter for description of this function.

The dedicated ACARS radio is normally operated in data mode for automatic transmission of data and message traffic. In the data mode, the radio is controlled by the ACARS management unit. The flight crew should ensure that the ACARS radio is in data mode with an appropriate data frequency selected. An offline voice mode is also available for regular voice communications.

The SATCOM system provides ACARS data communications. The ACARS will automatically switch between VHF and SATCOM as required. Refer to section 25 of this chapter for a description of the SATCOM system.

Manual ACARS Mode Selection

ACARS also provides for manual selection of the ACARS dedicated radio operating mode through:

- the frequency selector and transfer switch on radio tuning panels

Manual ACARS Mode Selection Through Radio Tuning Panels (RTP)

Select data mode by rotating the frequency selector for the standby frequency window either direction until the word DATA is displayed and then transferring DATA into the active frequency window.

- If the selected VHF radio is the dedicated ACARS radio, then the word DATA is displayed in the active frequency window. When a standby voice frequency is transferred to the active window, DATA is now displayed in the standby window. If a new frequency is selected in the standby window when DATA is displayed, DATA is replaced by the new frequency.
- A VHF radio can be set to the voice communication mode by manually transferring a voice frequency into the ACTIVE frequency window.

Voice Recorder System

The cockpit voice recorder records any transmitted or received flight deck audio transmissions from the flight deck made through the audio control panels. It also records flight deck area conversations using an area microphone and crewmember boom, oxygen mask, and hand microphones, independent of microphone/interphone switch positions.

All inputs are recorded continuously anytime AC power is applied to the airplane.

Fuselage Mounted Emergency Locator Transmitter (ELT)

N422LA through N526LA

Refer to Chapter 1, Section 45 for ELT systems description.

Communication Crew Alerting System

The communication crew alerting system provides aural and visual alerts for normal operations requiring crew awareness that may require crew action. Visual alerts are presented as EICAS communication level messages preceded by a white bullet symbol (•). The aural alert is a single chime. The following table shows communication crew alert categories and the respective aural and visual alerts for each category. Refer to section 50 of this chapter for a list of possible messages.

Communication Alert Categories

Alert Category	Aural	Visual	Remarks
Medium	Chime	EICAS communication alert. Illumination of appropriate switch/light on the PCP or ACP.	Message awareness required. Crew action may be required.
Low	None	EICAS communication alert.	Crew action may be required.

Crew Communication or Selective Calling (SELCAL) Messages

The communication crew alerting system also provides a supplementary method of notifying the flight crew about incoming calls from the cabin, ground personnel, or an incoming radio call. The •SELCAL message is a medium category alert. The flight crew should respond by establishing interphone communications with the calling station or transmitting on the corresponding radio.

This Section Applies to N422LA through N526LA

Satellite Communication (SATCOM) System

The SATCOM system can provide both data and voice communications over greater ranges than VHF communication systems and is more reliable over oceanic regions than HF communication systems. SATCOM communication involves three separate elements:

- Airplane Earth Segment (AES) - the airplane based SATCOM system
- Ground Earth Segment (GES) - the ground based SATCOM systems
- Satellite Segment

SATCOM communications are only possible when all three segments are connected together. Connection of the AES to the GES through a satellite (Logon) is controlled by the airplane SATCOM system. The SATCOM system automatically attempts to logon once powered is applied. The GES interfaces with ground based ACARS networks, ATC networks, or telephone systems.

As the airplane flies out of coverage for a satellite or GES station, the system automatically hands over control to the next proper satellite or GES station. Data link service automatically resumes following a successful handover. Automatic handover is not initiated during voice calls.

The SATCOM system is managed by the satellite data unit. The satellite data unit is controlled through the CDUs for both data and voice calls. The SATCOM control pages are displayed by selecting SAT on the CDU Menu page.

SATCOM installations include airline-modifiable buyer furnished equipment (BFE). The SATCOM system descriptions and CDU menu page illustrations presented represent typical installations. Airline configuration of BFE equipment can make significant changes in operational menus which are not presented here.

SATCOM Data Link Communication

The SATCOM system provides ACARS data communications. The ACARS will automatically switch between VHF and SATCOM as required. All data link messages are handled automatically by ACARS without further input from the crew. Refer to section 40 of this chapter for additional information about ACARS operation and control.

SATCOM Voice Communication

The SATCOM system provides multiple channels. One channel is dedicated to system control and ACARS. Normally six channels are available for voice communications. Up to two voice channels are available for flight deck voice communications. Flight deck voice calls are controlled using:

- the CDUs
- audio control panels with integrated SELCAL

The SATCOM system recognizes various levels of voice communication priority. The priority of a call determines access to satellite and GES resources. Higher priority calls can preempt existing calls.

The SATCOM system provides four priority levels:

- priority 1 - emergency and distress calls (activates ground station alarm)
- priority 2 - regulatory and flight safety calls
- priority 3 - non-safety related service calls
- priority 4 - passenger cabin calls.

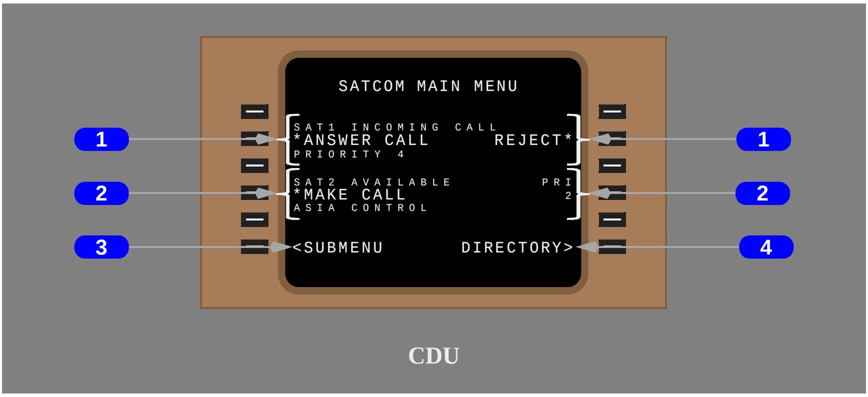
Control Through CDUs

Flight crew access to SATCOM is through a control display unit (CDU). Selecting the line select key adjacent to the <SAT prompt will call up the SATCOM Main Menu Page. From this page all SATCOM functions may be accessed, such as systems status checks, SATCOM channel control, directory page, and SATCOM configuration.

The CDU menu page illustrations presented below represent typical installations. Airline configuration of BFE equipment can make significant changes in operational menus which are not presented here.

SATCOM Main Menu Page [Typical]

The SATCOM main menu page allows the flight crew to initiate, answer and terminate calls, monitor call status, and access lower-level pages. SATCOM pages show both enabled and disabled prompts. Enabled prompts display < or > to display a page. Control functions are active when displayed with an asterisk *.



1 Channel 1 Control Field

Push – selects active control function. Channel 1 status/call information displays in small font.

2 Channel 2 Control Field

Push – selects active control function. Channel 2 status/call information displays in small font.

3 SUBMENU

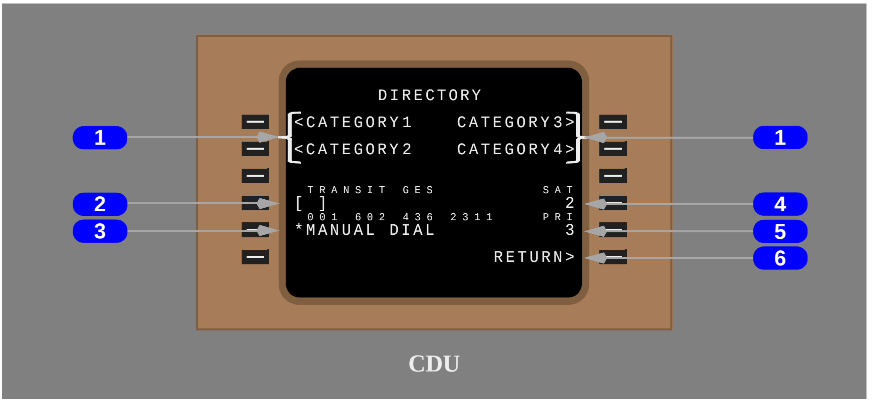
Push – displays SATCOM submenu page which allows access to SATCOM log-on, SATCOM channel status, and SATCOM maintenance pages.

4 DIRECTORY

Push – displays directory page.

Directory Page [Typical]

The directory page is used to access category pages or preselect manual calls (as installed).



1 CATEGORY Pages

Push – displays category numbers page. Category numbers page labels and content are defined by the operator.

2 TRANSIT Ground Earth Station (GES)

Push – enters valid transit GES identification number from scratch pad. Entry results in sending the next flight deck call through displayed GES, then clearing of entry.

Push (after pressing CLR or DEL key with empty scratch pad) – clears entry.

3 MANUAL DIAL

Push – enters valid phone number from scratch pad, preselects call, and returns display to SATCOM main menu page (as installed). System uses displayed phone number if scratch pad is empty.

4 SATCOM Channel (SAT)

Push – toggles between SAT 1 and 2 for selecting voice channel.

5 Priority (PRI)

Push – enters priority level from scratch pad for manually dialed phone number (as installed).

6 RETURN

Push – display returns to SATCOM main menu page.

Category Numbers Page [Typical]

The category numbers page contains a list of phone numbers used for making line-selectable calls.

CDU

1 **Phone Number List**

Push – preselects phone number for making call and returns display to SATCOM main menu page. Phone number labels and content are defined by the operator. Brackets in last position allow manual phone number entry (as installed).

2 **SORT**

Push – sorts phone numbers according to their labels.

3 **RETURN**

Push – display returns to directory page.

Voice Call Annunciations

The SATCOM system annunciates successful initiation of a voice call or receipt of a ground-to-air call by:

- an aural SELCAL chime
- illumination of the CALL light (SAT L or SAT R) on the ACP
- the EICAS communication alert "•SELCAL"
- status messages on the CDU SATCOM Main Menu page

SATCOM voice call annunciations are terminated and CDU status messages change when the SAT microphone selector switch/light button on the ACP is pushed or when the first flight crew SATCOM transmission is made.

Air-to-Ground Voice Calls

To initiate a voice call from the flight compartment:

- Use the SATCOM CDU pages to select an applicable phone number and start the call. When the call is connected, the SATCOM system will annunciate the call and the CALL light on the ACP (SAT L or SAT R) will illuminate.
- Push the applicable microphone selector switch on the ACP and adjust the volume (if required). Push a push-to-talk (PTT) switch for microphone operation.

Use a boom microphone headset or other flight interphone system to speak and listen to the call. You must push and hold the PTT switch while speaking. You may hold or release the PTT while listening.

Ground-to-Air Voice Calls

The SATCOM system annunciates receipt of a ground initiated SATCOM voice call. Received calls are automatically connected and do not require flight crew action from the SATCOM CDU pages. To receive a call push the illuminated SAT L or SAT R microphone selector switch on the ACP, push a PTT switch, and begin the call. You must push and hold the push-to-talk (PTT) switch while speaking. You may hold or release the PTT while listening.

The flight crew may also respond to a ground initiated voice call by selecting the appropriate responses on the CDU SATCOM Main Menu page and pushing the illuminated CALL microphone selector switch on the ACP.

Voice Call Termination

SATCOM voice calls are terminated when the CALL light extinguishes (ground party hang-up or pilot ends call). To disconnect the call, use the END CALL* selection from the SATCOM Main Menu page.

Advisory and Communication Alert Messages

A temporary loss of SATCOM voice connectivity, failure of the SATCOM system, or failure of the SATCOM voice/data subsystems will cause a SATCOM related advisory message to display on EICAS. Refer to section 50 of this chapter for a list of possible messages.

The receipt or initiation of a SATCOM voice call or resumption of SATCOM voice connectivity will cause a SATCOM related communication alert message to display on the EICAS. Refer to section 50 of this chapter for a list of possible messages.

(SB Adds N316LA with SATCOM installed.)

Rockwell Collins Aero-I Satellite Communication System

This systems description is based on the Airplane Flight Manual Supplement for the Rockwell Collins Satellite Communications (SATCOM) system with Aero-I capability as installed on Boeing 767-300/300F series aircraft.

The Rockwell-Collins Operator's Guide for the SAT-200/2100 Satellite Communications System, document number 523-0780363-002117 dated 15 Aug 2005, or later revision, may be referenced for additional operational capabilities and information not addressed in this FCOM systems description.

Description

The installed Satellite Communication (SATCOM) system provides both air-ground or ground-air communications in both data and voice modes. It operates using the Aero-I service of the INMARST geostationary satellite constellation and Ground-Earth-Stations (GES) located throughout the world. Voice communication is available within the areas of the world covered by spot beams from INMARSAT satellites. Data communication is available world-wide except for the extreme polar regions.

System Description

The SATCOM system consists of a Satellite Data Unit (SDU) along with an Intermediate Gain Antenna (IGA) subsystem. The SDU, located on the E12 shelf outboard of the right-aft cargo bay, controls the SATCOM system and interfaces to other SATCOM components and required airplane equipment. The IGA subsystem consists of a Diplexer / Low-noise Amplifier (D/LNSA) and the IGA.

An HF/SAT audio select panel (HF/SAT SELECT) is located in the P5 pilots overhead panel to select either HF or SATCOM channel routing to the cockpit audio select panels.

Circuit Breakers

The SATCOM system components are protected by the following circuit breakers located on the P11 Circuit Breaker Panel.

Label	Function	Location	Rating	Bus
SATCOM	SDU Power	P11 Panel 8-H	7.5 Amp	115V AC Left Bus
SATCOM IGA	Antenna and D/LNA Power	P11 Panel 9-H	1 Amp	115V AC Left Bus
HF/SAT AUDIO SW	HF/SAT Switching Relay Power	P11 Panel 7-H	1 Amp	28V DC Left Bus

Data Loader Port

The SATCOM Data Loader Port is located on the P61 Right Side pane The data loader port allows maintenance to upload data and programs changes for the SATCOM system.

System Operation

Before communications between the airplane and the ground can occur, SATCOM must be Logged-On. Log-On occurs automatically once airplane power is applied to the SATCOM system and IRS-L is aligned. SATCOM will then select and Log-ON to the highest preference GES associated with a satellite that is visible to the airplane, as determined by an airline specific Owner Requirement Table (ORT) stored within the SATCOM system.

Voice Communication

Two channels of satellite voice are provided for flight deck use and are used interchangeably with the HF-L and HF-R transceivers. SATCOM (telephone) calls may be originated from either the airplane by the flight crew or from the ground by ATC/FIR/Airline Flight Personnel. Three bi-directional SATCOM call priorities are supported:

- priority 1 (EMG) - Emergency (sets alarms at GES)
- priority 2 (HIGH) - Operational High (Flight Safety - Non-routine)
- priority 3 (LOW) - Operational Low (Flight Safety - Routine)

Additionally, if defined as an allowed function in the ORT, the flight crew can initiate a lower priority 4 air-to-ground public telephone call. However, priority 4 ground-to-air public telephone calls are inhibited by the SATCOM system and cannot be received by the flight crew.

No passenger phone or passenger data link services are provided by the SATCOM system.

Additional Information

The SATCOM voice system is approved as a supplement only to the existing HF and VHF communications system. This design approval does not constitute operational approval. The operator is responsible for obtaining operational approval from the appropriate airworthiness authority.

The SATCOM system meets the integrity criteria for non-essential ACARS data link communication equipment. This approval does not constitute operational approval of the ACARS data link through the SATCOM system. The operator is responsible for obtaining operational approval from the appropriate airworthiness authority.

System Control and Display

SATCOM voice calls are controlled using:

- HF/SAT audio select panel (HF/SAT SELECT)
- audio control panels (ACP)
- the Multipurpose Interactive Display Unit (MIDU)

HF/SAT Audio Select Panel (HF/SAT SELECT)

Two channels of satellite flight deck voice may be used independently and interchangeably with the two HF radio channels. Switching between HF and SATCOM for each individual channel is performed using the HF/SAT SELECT panel mounted on the P5 overhead panel. Selection of the Left (1) or Right (2) HF/SATCOM channel for flight crew use is then accomplished by actuation of the HF/SAT L or HF/SAT R buttons on the appropriate audio select panel. Refer to section 5.10 of this chapter for HF/SAT SELECT panel illustration.

Pressing the HF/SAT XFR L switch/annunciator on the overhead HF/SAT SELECT panel will toggle between selection of the HF Left or SATCOM channel 1 audio signal being routed to the audio select panels. The HF/SAT XFR L switch/annunciator will illuminate HF (white) or SAT (white) to indicate which system is currently selected for channel 1 (Left audio channel).

Pressing the HF/SAT XFR R switch/annunciator will toggle between selection of the HF Right or SATCOM channel 2 audio signal being routed to the audio select panels. The HF/SAT XFR R switch/annunciator will illuminate HF (white) or SAT (white) to indicate which system is currently selected for channel 2 (Right audio channel).

The SAT L and SAT R annunciators on the overhead HF/SAT SELECT panel provide status of a SATCOM call and provide a means to terminate a call in progress. Illumination of CALL (blue) on the annunciator associated with SAT L (channel 1) or SAT R (channel 2) indicates an incoming call is waiting (flashing CALL) or a channel has an active call in progress (steady CALL). The RST (blue) annunciators illuminate along with the CALL annunciators to indicate the switch/annunciator can be pressed to end the associated call. The CALL and RST annunciators also flash for 10 cycles on placing an outgoing call, then illuminate steady.

Audio Select Panel (ASP)

Once HF or SATCOM is selected for a specific channel on the HF/SAT SELECT panel, the audio is routed to the Captain's, First Officer's, and First Observers audio select panels. Refer to section 5.10 of this chapter for audio select panel illustrations.

Pressing the HF/SAT L Mic button on the audio select panel will allow the associated crew member to utilize the selected HF L or SATCOM Channel 1 for voice communication.

Pressing the HF/SAT R Mic button on the audio select panel will allow the associated crew member to utilize the selected HF R or SATCOM Channel 2 for voice communication.

Multipurpose Interactive Display Unit (MIDU)

SATCOM is controlled through a multipurpose interactive display unit (MIDU). Selecting the line select key adjacent to the <SATCOM prompt on the MIDU Main Menu page will call up the SATCOM Main Menu Page. Refer to section 5.10 of this chapter for MIDU illustration.

When SATCOM is selected for display the MIDU displays SATCOM status information, allows selection of stored air-to-ground telephone numbers, allows manual dialing of telephone numbers, or provides a means for the flight crew to answer incoming calls.

The MIDU's SAT MAIN and SAT DIAL keys are inactive and are provided to support future growth. FUNCTION NOT AVAILABLE will be displayed on the MIDU if either of these buttons are pressed. During SATCOM initialization or if the SATCOM system detects a failure, the MIDU SATCOM LSK will display "<??????". If this fails to revert to the normal SATCOM prompt, maintenance action s required.

SATCOM Menu Pages

This section provides the information necessary to operate the SATCOM system and make or receive phone calls. For additional information and capabilities, the Rockwell-Collins Operator's Guide for the SAT-2000/2010 Satellite Communications System may be referenced

SATCOM Main Menu Page

The SATCOM main menu page is accessed by selecting <SATCOM from the MIDU Main Menu page. The SATCOM Main Menu page displays status of voice channel 1 and channel 2, allows manual entry of telephone numbers and provides call control for each channel.

SATCOM pages show both enabled and disabled prompts. Enabled prompts display < or > to display a page. Control functions are active when displayed with an asterisk *.

1 SAT 1 LSK

Push (LSK 1L) - selecting with a telephone number, or a label for a stored telephone number, entered in the scratchpad causes that number to be displayed as the currently selected phone number with the priority set to the lowest priority.

Note: The operation of the SAT 2 LSK, associated with voice channel 2, is identical. Selecting LSK 3L (SAT 2) will cause the indicated action on voice channel 2.

1A LABEL 1 Field

Displays the currently selected telephone number or previously selected phone number at power up.

2 LSK 2L

Push - causes the indicated action (ACTION 2 field) to be performed for voice channel 1.

Note: The operation of the LSK 4L, associated with voice channel 2, is identical. Selecting LSK 4L (SAT 2) will cause the indicated action (ACTION 2 field) on voice channel 2.

2A ACTION 2 Field

Displays the current action that will be performed when LSK 2L is selected. Possible actions are:

- PREEMPT
- REJECT

3 Status Channel 1

Current channel 1 status/call information displayed in small font. Possible status conditions for each channel are:

Status (channel 1 or 2)	Status Description
AVAILABLE	Log On is complete, system is operational, and channel is not in use.
NOT AVAILABLE	Log On not complete or system is not operational.
GND INT CALL	Incoming call on channel
IN PROGRESS	Outgoing call connecting through satellite.
ADDR COMPLETE	Outgoing call accepted by GES and being routed.
ANSWERED	Outgoing call answered by end party.

Note: The operation of the Status Channel 2 field, associated with voice channel 2, is identical.

4 LAST DIR LSK

Push (LSK 5L) – displays first SATCOM DIRECTORY page from the displayed directory group and allow the user to select a new number. This prompt will indicate the last directory group accessed other than EMERGENCY.

5 INDEX LSK

Push (LSK 6L) – displays the SACOM DIR INDEX page, allowing the user to select from the list of all directory names.

6 PRIORITY LSK

Push (LSK 1R) - when voice channel 1 is not in use, selecting will cause the display of the SATCOM PRIORITY page for selection of a priority level for an entered telephone number.

Note: The operation of the PRIORITY LSK (LSK 3R), associated with voice channel 2, is identical.

6A PRIORITY Field

Displays the current voice channel 1 priority. Possible priority levels are:

- EMG - emergency and distress calls (activates ground station alarm)
- HIGH - regulatory and flight safety calls
- LOW - non-safety related service calls
- PUB - public telephone calls (if available)

7 LSK 2R

Push - causes the indicated action (ACTION 1 field) to be performed for voice channel 1.

Note: The operation of the LSK 4R, associated with voice channel 2, is identical. Selecting LSK 4R will cause the indicated action (ACTION 1 field) on voice channel 2.

7A ACTION 1 Field

Displays the current action that will be performed when LSK 2R is selected. Possible actions are:

- PLACE CALL
- END CALL
- ANSWER
- CLR STATUS

8 EMERGENCY LSK

Push (LSK 5R) – displays page 1 of the listed SATCOM DIRECTORY. The name of the first directory listed in the index is normally reserved for emergency telephone numbers and labeled EMERGENCY. Selecting LSK 5R will display page 1 of that directory.

SATCOM-DIR INDEX Page

The SATCOM Directory Index (DIR INDEX) page is accessed by selecting INDEX (LSK 6L) from SATCOM Main Menu Page 1/2. The page contains a list of user defined titles for all available directory pages. Selection of a user defined title provides quick access to pre-defined lists of callee telephone numbers and labels in the specific directory group. Up to ten directories can be stored.

MIDU SATCOM-DIR INDEX page (Typical)

1 Directory LSKs

Push (LSK 1L through LSK 5L or LSK 1R through LSK 5R) - allows access to the SATCOM DIRECTORY of pre-defined telephone numbers associated with the directory label.

2 RETURN LSK

Push (LSK 6L) – return display to the SATCOM MAIN MENU Page 1/2.

SATCOM Directory Pages

The SATCOM Directory page is accessed by selecting the desired LSK from the SATCOM-DIR INDEX INDEX menu (such as LSK 2L for SANTIAGO). The SATCOM-DIRECTORY displays the first page of the desired SATCOM Directory directory with an associated callee list. Alternatively, selecting LSK 5L (LAST DIR) from the SATCOM-MAIN MENU page will display the most recently selected SATCOM Directory.

This page displays the labels/numbers for each of the phone numbers stored in the selected SATCOM Directory. Five labels are shown on each page up to a maximum of 20 pages or as many as 100 labels/numbers stored in the SATCOM system, with the numbers organized under a maximum of 10 named directories. Selection of the NEXT key via the MIDU will display the next SATCOM Directory page.

If a voice channel is available and not in use, a star prompt (*) will be displayed and selection of a line select key will cause the MIDU to display the SATCOM-MAIN MENU with the indicated call label selected for possible call placement. An ORT option (IMMEDIATE CALL ON SELECTION ENABLE) allows the call to be initiated immediately when a new label is selected. If this option is selected and the voice channel is in use, the voice channel star prompts (*) will not be displayed.

Selection of the NEXT or PREV keys on the MIDU will display the next or previous sequential SATCOM-DIRECTORY page, respectively. If the new directory page is associated with a different directory area than the previous displayed page the directory name will be updated. The directory name will also be updated on the SATCOM-MAIN MENU next to LSK 5L if the new directory name is not the first directory name in the directory index. The first directory name is already displayed next to LSK 5R.

MIDU SATCOM Directory Page N/20 (Typical)

1 SAT 1 Directory LSKs

Push (LSK 1L through LSK 5L) - causes selection of the associated label for use on voice channel 1 and automatic transition to the SATCOM-MAIN MENU 1/2 page with selected callee label displayed for SAT 1.

2 RETURN LSK

Push (LSK 6L) – return display to the SATCOM MAIN MENU Page 1/2.

3 SAT 2 Directory LSKs

Push (LSK 1R through LSK 5R) - causes selection of the associated label for use on voice channel 2 and automatic transition to the SATCOM-MAIN MENU 1/2 page with selected callee label displayed for SAT 2.

Normal Procedures

Answering Ground-To-Air Calls

When a call is received from the ground, the SELCAL chime will sound (single chime) and the CALL lamp on the HF/SAT SELECT panel for the channel to which the incoming call is routed will illuminate (flashing).

Answer a SATCOM voice call as follows:

- press the HF/SAT XFER L or R switch-light for the channel associated with the flashing CALL lamp to select and display SAT, or
- press the HF/SAT L or R Mic Select button on the ACP for the voice channel associated with the illuminated CALL lamp (L or R), or
- press any PTT to answer the call (CALL lamp will illuminate steady once call is answered), or
- select LSK 2R (or LSK 4R) ANSWER prompt on the SATCOM Main Menu Page.

Note: The crew may reject the call without answering by taking no action. The call will be rejected automatically if it is not acknowledged in 120 to 240 seconds. Alternately, the call can be immediately rejected by selecting REJECT (LSK 2L or 4L) on the SATCOM-MAIN MENU page.

Terminating Calls

A ground initiated call will be automatically terminated after the ground party hangs up.

To initiate termination:

- select the SAT L or R RST switch-light on the HF/SAT SELECT panel, or
- select LSK 2R or LSK 4R (END CALL) on the SATCOM-MAIN MENU Page 1/2, or

Placing Air-To-Ground Calls

The flight crew selects telephone numbers to be called using the MIDU SATCOM Directory pages. Telephone numbers are stored in the ORT within SATCOM system memory. Alternatively, the flight crew can make a manual call.

Place a SATCOM call as follows:

- verify status of desired SATCOM channel indicates AVAILABLE
- press the HF/SAT XFER L or R switch-light on the overhead HF/SAT SELECT panel for the desired channel to display SAT
- press the HF/SAT L or R Mic Select button on the ACP for the voice channel associated with the desired channel (L for 1 or R for 2)
- select the SATCOM-MAIN MENU Page 1/2 on the MIDU

- if the callee label is already displayed adjacent to LSK 1L(for channel 1) or 4L (for channel 2) and the associated available action adjacent to LSK 2R (for channel 1) or LSK 4R (for channel 2) is PLACE CALL, initiate call on desired channel by selecting LSK 2R or 4R
- if the callee label is not already displayed adjacent to LSK 1L or 4L, select last accessed directory adjacent to LSK 5L or INDEX LSK (LSK 6L) from the SATCOM-MAIN MENU Page 1/2 to access the SATCOM-DIRECTORY or SATCOM-DIR INDEX pages. From the SATCOM-DIR INDEX page select the directory associated with the desired callee label. Then from the SATCOM-DIRECTORY page select the desired callee label. After selecting the callee label the display will return to the SATCOM-MAIN MENU page with the new number inserted adjacent to SAT 1 (LSK 1L) or SAT 2 (LSK 4L). Initiate call on the desired channel by selecting PLACE CALL (LSK 2R or 4R)
- once the call is placed, the pilot will hear the far-end tones (ringing, busy, etc.) and the CALL lamp on the HF/SAT SELECT panel for the channel selected will illuminate for 10 cycles and then illuminate steady until the call is terminated
- transmit by pressing any PTT key

Note: A SATCOM call may be placed on hold if communication with another ASP communication system is needed before the SATCOM call is completed by selecting the ASP Mic select key for the desired system (HF, VHF, etc.). Resume SATCOM communication by re-selecting the HF/SAT (L or R) Mic Select button on the ASP.

Note: SATCOM has been designed to operate similar to other flight deck communication systems except the SATCOM permits voice from the pilot and ground simultaneously (full duplex) rather than one direction at a time. The PTT key must be pressed for the ground reception of the pilot's voice, however, reception of the ground party voice can be heard by the pilot with the PTT depressed or not depressed. Also a busy signal will be received by the ground party if two calls or equal or higher priority are in progress or if a call is made to the airplane prior to satellite/GES Log-On.

Advisory Messages

Advisories are automatic prompts and warnings generated by the SATCOM system and are displayed on the SATCOM menu pages of the MIDU. The advisories are ranked by priority within their class. In the event of more than one advisory of a class being active at the same time, the highest priority advisory will be displayed. If no advisories of a class are active, the display area will be blank. All advisories when triggered, will display for a minimum of one second.

Inactive Advisories

Advisories that are informational in nature are called inactive advisories. In active advisories are displayed at the bottom center of the SATCOM pages until the condition that activated the message is no longer in effect.

Inactive Advisories	
SAT INOP	Displayed under the following conditions: • system failure • log-on halted, awaiting valid aircraft ID • all channel modes show a failure
PWR	Displayed following a system cold start. Displayed for 20 seconds following a power-up from a cold start.
LOGGED	Displayed following successful log-on to a GES. Displayed for 10 seconds following successful lon-on.
SEARCH	Displayed upon initiation of the log-on search. Cleared upon successful selection of a SAT ID and GES ID.
WAITING	Displayed while in the WAITING USER INPUT state at log-on. Indicates that the SRT is awaiting user input to proceed with the log-on process. Cleared upon entry of a SAT ID/GES ID or selection of AUTO LOG from the WAITING USER INPUT state.

Active Advisories

Advisories associated with a crew response are called active advisories. Active advisories inform the operator of a condition requiring attention or that a function is available. The active advisories are displayed adjacent to LSK 6R. When displayed pressing LSK 6R will perform the action listed below. In the event that the conditions causing the setting of an active advisory are detected while SATCOM is not active on the MIDU, the indication SATCOM <REQ> will appear on the MIDU Main Menu page.

Active Advisories	
LOG ON>	Displayed when the log-on search process is awaiting operator command to continue Log-On. Selecting LSK 6R will display the SATYCOM-LOG MENU on the MIDU. Selection of LOG-ON or an entry onto the LOG menu clears the advisory.
CALL>	Displayed when a ground initiated voice call is received by the SATCOM system and awaiting a cockpit crew answer and the MIDU is not already displaying the SATCOM-MAIN MENU page 1/2. Selection of LSK 6R causes the SATCOM-MAIN MENU page to be displayed so that the call may be answered. The advisory is cleared upon answer or rejection of ground initiated call.

Incomplete Call Cause Code Messages

The following messages may be displayed while a call is attempted. Message indicates a reason for a call not being completed or a call ending.

MIDU Message	Function	Action
UNASSIGNED NUMBER	Unassigned number	The GES or PSTN (Public Service Telephone Network) was unable to place a call with the given number. Verify the number is entered correctly. Verify the network ID is set correctly (1 for PSTN or as required for private network).
NO ROUT TO DSTN	No route to destination	The GES or PSTN was unable to place a call with the given number. Verify the number is entered correctly. Verify the network ID is set correctly (1 for PSTN or as required for private network).
NORM CLEARING	Normal clearing	Seen at end of call. No error was detected in call termination. The user may have hung up before the AES user began talking.
USER BUSY	User busy	The line is busy. Call again later.
NO ANSWER	No user responding	The called party did not answer within the timeout from call initiation. The timeout period is typically four minutes. Try again later.

MIDU Message	Function	Action
CALL REJECTED	Call rejected	The GES or PSTN was unable to place a call with the given number. Verify the number is entered correctly. Verify the network ID is set correctly (1 for PSTN or as required for private network).
DEST OUT SERV	Destination out of service	The PSTN was unable to place a call with the given number. Verify the number is entered correctly. Verify the network ID is set correctly (1 for PSTN or as required for private network).
INVALID FORMAT	Invalid number format	The GES or PSTN was unable to place a call with the given number. Verify the number is entered correctly. Verify the network ID is set correctly (1 for PSTN or as required for private network).
NORM UNSPECIF	Normal unspecified	Seen at end of call. No error was detected in call termination. The user may have hung up before the AES user began talking.
NO CHAN AVAIL	No circuit/channel available	This may be seen if the GES has all channel units in use. Try call again later.
NTK OUT OF ORD	Network out of order	This would be due to a GES failure. Try call again. If still no call placement, log-on to another GES.
EQUIP CONGEST	Switching equipment congestion	The GES has all lines in use or the GES is not assigning a channel for operation while the AES is requesting. Try call again. If still no call placement, log-on to another GES.
CHTYP NOT IMPL	Channel type not implemented	The GES does not support the type of call being made. Verify the number is entered correctly. Verify the network ID is set correctly (1 for PSTN or as required for private network). If all appear OK, log-on to another GES.
NO CHAN AVAIL	No channel available	Shown if the GES has all channels in use of if a channel module fails during a call. Try call again.

MIDU Message	Function	Action
NO UNIT AVAIL	No channel unit available	Shown if the GES has all channels in use of if a channel module fails during a call. Try call again. Failed module will be removed from operation.
EQP NOT AVAIL	Equipment not available	Message should not been seen in cockpit. Try call again. If still no call placement, log-on to another GES.
CT CRD NUM REJ	Credit card number rejected	Message should not been seen in cockpit. Try call again. If still no call placement, log-on to another GES.
INVALID ADDR	Invalid/ incomplete address	The PSTN was unable to place a call with the given number. Verify the number is entered correctly. Verify the network ID is set correctly (1 for PSTN or as required for private network).
AES NOT AUTHOR	AES not authorized	The AES does not appear in the GES tables. Log-on to another GES.
CALLS BARRED	Incoming calls barred	The AES does not appear in the GES tables. Log-on to another GES.
SIGNAL	Lost continuity failure	The transmitted or received signal has been lost. Try call again.
BAD CARD TYPE	Credit card type not supported	Message should not been seen in cockpit. Try call again. If still no call placement, log-on to another GES.
RATE NOT SUPPT	Required rate not supported	Message should not been seen in cockpit. Try call again. If still no call placement, log-on to another GES.
TYPE NOT SUPPT	Voice channel type or service type not supported	Message should not been seen in cockpit. Try call again. If still no call placement, log-on to another GES.
AES ABSENT	AES absent	The AES does not appear in the GES tables. Log-on to another GES.
UNDEFINE CAUSE	Undefined cause	Message sent by GES when call is terminated abnormally. Try call again.

Intentionally
Blank

Interphone Communication System

The interphone communication system includes the:

- flight interphone system
- service interphone system
- cargo interphone system

The interphone systems allow the flight crew to communicate with ground personnel, cargo handling personnel, or maintenance technicians. The flight interphone, service interphone, and cargo interphone are normally operated through the audio control panel (ACP) in conjunction with the pilot call panel (PCP).

Flight Interphone System

The flight interphone system (FIS) permits communication between flight deck crew members and, on the ground, with ground personnel.

The system is used by the following methods:

- pushing the interphone (INT) position of a control wheel mic/interphone switch to transmit

N422LA through N526LA
- selecting the flight (FLT) transmitter select switch on the ACP and pushing a PTT switch

N316LA
- selecting interphone (INT) transmitter select switch on the ACP and pushing a PTT switch

Ground personnel are able to communicate on the FIS through a jack located on the APU ground control panel mounted on the nose wheel strut.

The pilots are alerted to an incoming call from the ground crew by the following methods:

- an aural chime sounds in the flight deck
- an illuminated GND CALL light on the PCP
- the EICAS communication message GROUND CALL is displayed

The flight crew should respond to the call using the FIS. Any of the PTT switches may be used to communicate

The flight crew initiates a call to ground personnel by pushing the GND CALL switch. A horn in the nose wheel well activates as long as the switch is pushed. Communication can then take place over the FIS.

Cargo Interphone System

The cargo interphone system (CIS) provides voice communications between the flight deck and any of six main deck cargo stations. Flight deck crew members communicate on the CIS using their ACP and the PCP. The flight crew may use the boom microphones, oxygen mask microphones, or hand microphones to transmit.

On the ground, cargo handling personnel communicate with the flight deck or the six main cargo deck stations through a master cargo control panel located on the main cargo deck immediately forward of the main cargo door, or on the airplane exterior immediately aft of the main cargo door.

The cargo interphone system can be connected to the flight interphone system by pressing the cargo interphone switch on the pilots call panel.

Service Interphone System

The service interphone system consists of additional internal and external jacks connected to the flight/cargo interphone system for use by maintenance personnel. The flight/cargo interphone system can be connected to the service interphone system by placing the service interphone switch in the ON position. To reduce external noise in the flight/cargo interphone system, the service interphone switch can be left OFF during normal flight operations. This disconnects the microphone jacks at all exterior (unpressurized) service interphone stations except the jack on the nose wheel strut. This switch does not affect the interior flight/cargo interphone stations.

This Section Applies to N422LA through N526LA

Aircraft Communication Addressing and Reporting System (ACARS)

The Aircraft Communications Addressing and Reporting System (ACARS) is a data link system designed to automatically communicate flight data, performance data, and routine reports between the airplane and a network of ground stations.

The primary airborne system component is the ACARS management unit (MU). The MU provides the central clock, memory, and data processor for ACARS. For airborne event sensing and flight crew alerting, the MU interfaces with:

- digital flight data acquisition unit (DFDAU)
- the EICAS computers
- the SELCAL system
- the flight deck printer

The ACARS MU collects, controls, and processes incoming and outgoing data and messages through:

- the VHF radio system
- the SATCOM system

The dedicated ACARS radio is normally operated in data mode for automatic transmission of data and message traffic. Refer to section 20 of this chapter for a description of the ACARS capable VHF or HF radio systems.

The SATCOM system provides ACARS data communications. The ACARS will automatically switch between VHF and SATCOM as required. Refer to section 25 of this chapter for a description of SATCOM systems.

Additional ACARS Functionality

Air Traffic Control (ATC) Data Link

The ACARS interface provides for direct data link communications with Air Traffic Control (ATC) agencies. The ATC data link system provides for automatic airplane periodic and event reporting through the Automatic Dependent Surveillance (ADS) system. The ATC data link system also provides for the flight crew and ATC agencies to exchange requests and text messages which may involve clearances, reporting points, climb or descend requests, or other ATC functions. Refer to section 45 of this chapter, Air Traffic Control Data Link, for control and operation of the ATC data link system.

Airline Operation Communication (AOC) Data Link

The ACARS interface provides for company specific data link operations through the Airline Operation Communication (AOC) Data Link system. AOC data link provides for the automatic programming of FMC data, such as performance parameters and flight plan routes. In addition, AOC data link provides for the automatic downlink of FMC data to the company. Refer to section 34 of chapter 11, Company Data Link, for control and operation of the AOC data link system.

Control and Status Display

The flight crew access to ACARS status or control is through:

- control display unit (CDU)
- multipurpose interactive display unit (MIDU)

ACARS installations include airline modifiable buyer furnished equipment (BFE). The ACARS system descriptions and menu page illustrations presented represent typical installations. Airline configuration of BFE equipment can make significant changes in operational menus which are not presented here.

Control Through CDUs

Flight crew access to ACARS is through a control display unit (CDU). Selecting the line select key adjacent to the <ACARS prompt will call up the ACARS Main Menu Page. From this page all ACARS functions may be accessed, such as pre-flight initialization, systems status checks, ACARS radio control, message status or display, printer functions, and ACARS configuration.

The specific software providing ACARS functionality is defined by the airline and is not covered here.

Control Through the MIDU

Flight crew access to ACARS is through a multipurpose interactive display unit (MIDU). In addition to transmitting routine data automatically, the ACARS MIDU allows manual data entry to the MU for subsequent transmission to ground stations. Engine parameters, fuel status, and other information can be conveyed to a ground station. The MIDU also provides access to other airplane data or communication functions, such as ACMS or SATCOM.

Access to ACARS functions and message displays is provided by depressing the appropriate function key on the MIDU. In addition, depressing the MENU or MCDU MENU line select key provides the <ACARS prompt on the display. Selecting the line select key adjacent to the <ACARS prompt will call up the ACARS Main Menu Page. From this page all ACARS functions may be accessed, such as pre-flight initialization, systems status checks, ACARS radio control, message status or display, printer functions, and ACARS configuration.

The specific software providing ACARS functionality is defined by the airline and is not covered in this manual.

Data Mode

ACARS is normally operated in the data mode, allowing automatic transmission of routine reports, engine and performance data. In data mode, the system monitors and stores the times of the following events:

- OUT – airplane departure from the gate, based on customer defined parameters (e.g. closure of all passenger entry doors and parking brake released)
- OFF – takeoff (main gear tilted)
- ON – landing (main gear not tilted)
- IN – airplane arrival at destination gate, based on customer defined parameters (e.g. parking brake set and at least one passenger entry door open)

The system automatically transmits OOOI events at occurrence. In data mode, the MU automatically tunes the ACARS dedicated radio to a standard link frequency. ACARS monitors this frequency for messages addressed to that airplane as well as sending messages to the ground.

In addition to transmitting routine data automatically, ACARS allows manual data entry for subsequent transmission to ground stations. Engine parameters, fuel status, and other information can be conveyed to a ground station by entering values on the appropriate page and pressing the SEND key.

Pre-flight data such as flight number, fuel on board, and departure/destination station can be entered in the ACARS system manually, or received by data uplink.

Message Display

ACARS messages to or from the airplane can be displayed on the CDU through the STORED MESSAGES pages. Message titles appear in large characters until displayed. Messages can be sent to the printer by pressing the PRINT line select key.

ACARS messages can be displayed on the MIDU for review by the flight crew. The MIDU also allows for the entry of data for transmission to the ground stations. Messages can be sent to the printer by pressing the PRINT line select key.

The printer allows data, such as flight plans, to be transmitted by ground stations and printed automatically in flight.

- The EICAS communication message •PRINTER displays when a message is sent to the printer
- the message is accompanied by an aural chime
- The ACARS PTR light on the PCP illuminates when a message is sent to the printer
- the message is accompanied by an aural chime

Voice Mode

The ACARS system provides a voice mode to facilitate voice communications between the airplane and groundstations. The ACARS system descriptions presented are general in scope and represent typical installations. Airline configuration of BFE equipment can make significant changes in operational menus which are not presented here.

Online ACARS Voice Mode

Online voice mode provides an ARINC compatible communication link to ground based telephone systems. ACARS voice mode communications are initiated either from the airplane or the ground. When online voice mode is initiated the ACARS MU will continue to compile, but not transmit, data and message traffic. The MU will notify the flight crew whenever voice mode operations exceed two minutes.

Air-to-Ground Voice Calls (Typical)

To initiate an ACARS voice call, use the ACARS menu pages and request the call. The applicable phone number is automatically dialed with the downlink request and voice mode is automatically selected when the call is connected. When the call is connected, the ACARS system will annunciate the call with an aural chime and the appropriate SELCAL switchlight on the PCP or ACP (VHF C or VHF R) will illuminate.

To complete the call push the applicable microphone selector switch on the ACP and adjust the volume (if required). Push a push-to-talk (PTT) switch for microphone operation. Use a boom microphone headset or other flight interphone system to speak and listen to the call. When the call is stopped the MU will automatically return to data mode.

Ground-to-Air Voice Calls (Typical)

When an ACARS voice radio communication is received, the corresponding SELCAL light illuminates and an aural chime sounds on the flight deck. Received calls are automatically connected. ACARS voice mode is automatically selected and does not require flight crew action from the ACARS menu pages. To receive a call push the illuminated VHF C or VHF R microphone selector switch on the ACP, push a PTT switch, and begin the call.

The flight crew may also respond to a ground initiated voice call by selecting the appropriate responses on the ACARS menu pages and pushing the illuminated CALL microphone selector switch on the ACP.

Manual ACARS Override

Manually tuning the ACARS dedicated radio to a normal voice frequency or deselecting data mode places that VHF or HF radio into voice mode. Refer to section 20 of this chapter, Systems Description, for the operation and control of ACARS compatible radios.

Data Link Related EICAS Messages

Data Link Advisory Messages

A temporary loss of data link connectivity, failure of the data link system, or failure of HF radio data function will cause a data link related advisory message to display on EICAS. Refer to section 50 of this chapter for a list of possible messages.

The EICAS advisory message DATALINK LOST will be displayed when data communication is lost. During the period that communication is lost, information to be transmitted is stored and will transmit automatically when communication is regained.

Data Link Communications Alert Messages

During the routine operation of ACARS, several communication alert messages may be generated to keep the pilots aware of the status and functioning of the data link. Individual airplane software or options may preclude or alter some of these messages. Refer to section 50 of this chapter for EICAS communications alert messages related to data link operations.

An ACARS communication alert message related to Air Traffic Control (ATC) which may involve clearances, reporting points, climb or descend, or other ATC function will cause the •ATC communications alert message to display on EICAS and the aural chime to sound. Refer to section 45 of this chapter for information on the ATC Data Link.

An ACARS communication that is loadable into the FMC, such as winds or route data, will cause the •FMC communication alert message to display on EICAS and the aural chime to sound. A CDU scratchpad message will provide information on the type of uplink.

This Section Applies to N422LA through N526LA

Air Traffic Control Data Link

Air Traffic Control data link provides direct communication between the airplane and an air traffic control facility. ATC data link functions include Air Traffic Services Facilities Notification (AFN), Automatic Dependent Surveillance (ADS), and Air Traffic Control (ATC) data link.

ATC data link communications begins with a logon to the appropriate Air Traffic Control facility. Once the aircraft is logged on, data link messages can be sent from the ATC facility to the airplane (uplinked) and from the airplane to the ATC facility (downlinked).Also, once the aircraft is logged on, the transfer to adjacent ATC facilities is normally automatic.

The flight crew is alerted by a chime and the EICAS communications message •ATC when an uplink message is received. To display a data link message which has just been received, press the ATC function key on the CDU.

The CDU is used to display messages, input data for downlink messages and to respond to uplink messages. Uplink messages which contain route modifications are loaded into the FMC using the LOAD prompts on the ATC CDU pages. Execution of an ATC loaded modification is accomplished using normal FMC modification procedures.

The ATC LOGON/STATUS page provides the capability to establish a downlink connection with a specified ATS facility and to display the ADS, ATC DL, and data link status.

An uplink delay timer feature allows select ability of maximum uplink delay.

The ATC UPLINK pages display messages uplinked by an ATS facility and provide the capability to respond to uplinked messages and to load clearances which contain loadable data.

The ATC REQUEST pages provide the capability to create downlink requests for altitude, route, and speed changes.

The FMC formats reports in response to requests from an ATS facility. These reports are accessible via the ATC REPORT page and are displayed for review or modification on the VERIFY REPORT page. Some reports can be armed for automatic transmission.

The ATC LOG page provides a list of all uplinks and downlinks stored in the log.

Downlink messages are created by inputting data to the ATC communications pages which provide standard formatting and selectable message elements. The message is sent by selecting a SEND prompt. The status of the message is then indicated as follows:

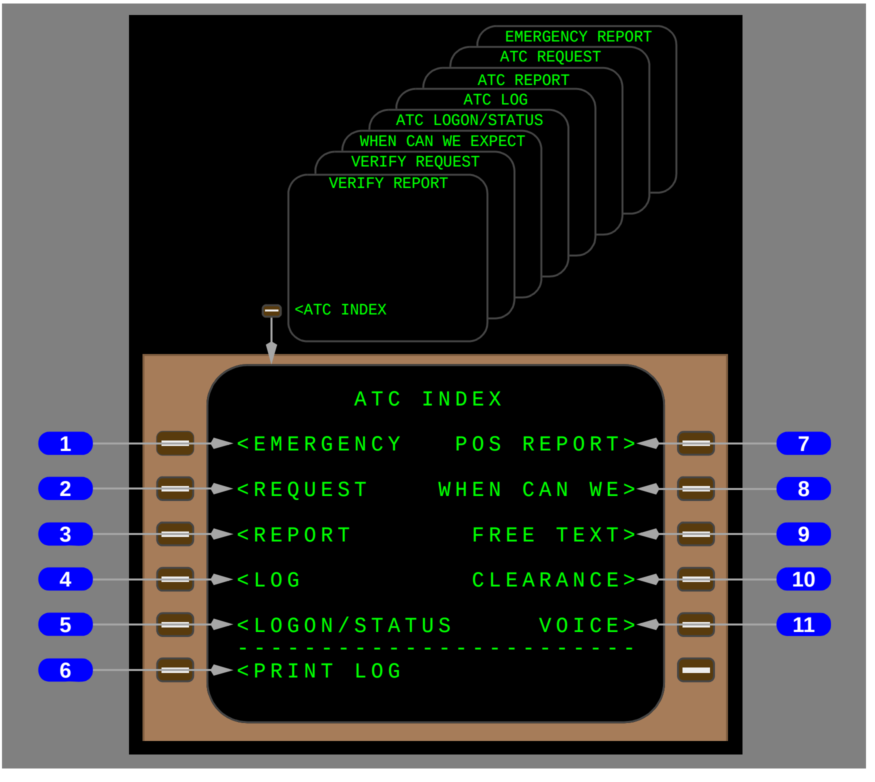
- displays SENDING while waiting for network acknowledgment
- displays NO ATC COMM if not logged on to ATC

ATC Communication Pages

The following graphics show all ATC Communications Pages.

ATC Index Page

The ATC INDEX page provides access to pages for ATC data link functions.



1 EMERGENCY

Push – displays EMERGENCY REPORT page.

2 REQUEST

Push – displays ATC REQUEST page.

3 REPORT

Push – displays ATC REPORT page.

4 LOG

Push – displays ATC LOG page.

5 LOGON/STATUS

Push – displays ATC LOGON/STATUS page.

6 PRINT LOG

Push – transmits contents of ATC log to printer.

7 POSITION REPORT

Push – displays POS REPORT page.

8 WHEN CAN WE

Push – displays WHEN CAN WE EXPECT page.

9 FREE TEXT

Push – displays the verify report page with only the free text message element.

10 CLEARANCE

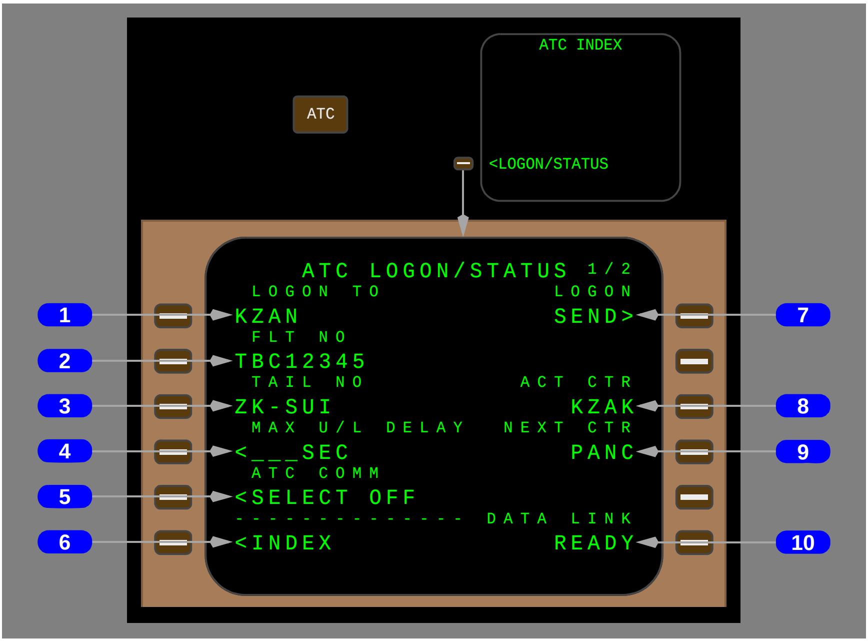
Push – displays VERIFY REQUEST page for clearance request.

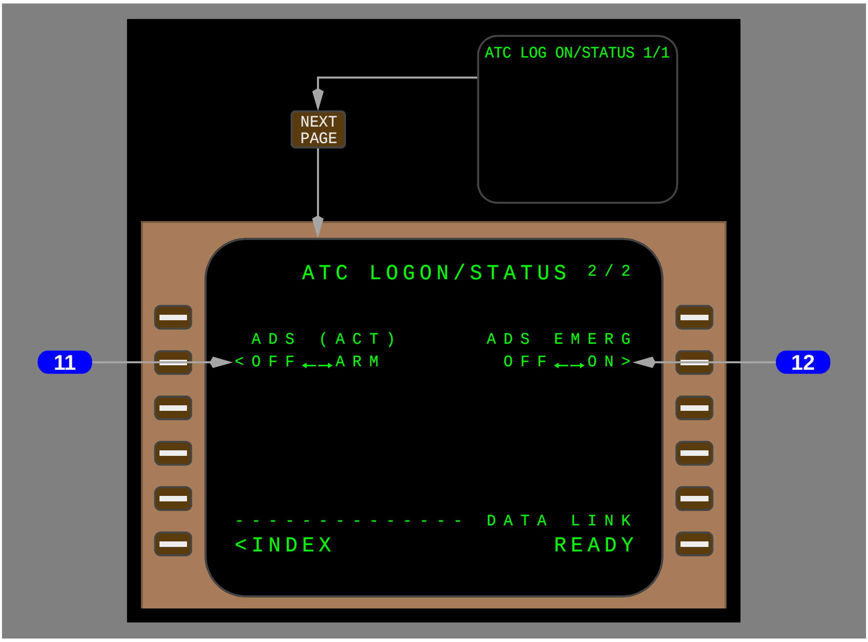
11 VOICE

Push – displays VERIFY REQUEST page for voice contact request.

ATC Logon/Status Pages

The ATC LOGON/STATUS pages are used to initiate ATC data link connection. It displays the status of the data link system, ATC data link connection, Automatic Dependent Surveillance (ADS), and crew-entered maximum uplink delay.





1 LOGON TO

Displays empty character boxes if no ATC COMM connection exists. Dashes display when ATC COMM is established. Valid entry is a four letter ATC center identifier. Entering an identifier and a flight number displays the SEND prompt in the LOGON field (1R) if datalink status is ready.

2 Flight Number (FLT NO)

Displays the flight number entered on the ROUTE page or may be entered directly. The entry is cleared at flight completion. Entering a different flight number during operation terminates ATC COMM connections.

3 Tail Number (TAIL NO)

The airplane tail number is automatically loaded when power is applied to the FMC. Display boxes for pilot input appear if automatic load is not successful. Entering a different tail number terminates any active A TC connections.

4 MAX U/L DELAY

Default display is three dashes followed by SEC. Valid entry is a time in seconds between 1 and 999. Entry of an invalid value results in the display of INVALID ENTRY in the scratch pad. Selection of DELETE to the MAX U/L DELAY field (4L) returns the display to dashes.

5 ATC COMM

Push – the SELECT OFF prompt terminates the A TC data link connection.

Blank with no active ATC COMM connection.

6 INDEX

Push – displays the ATC INDEX page.

7 LOGON

Push – sends logon message to the ATC center listed on the LOGON TO line; displays SENT. If no network acknowledgment is received, displays RESEND.

After ATC response, displays ACCEPTED or REJECTED.

Display is blank without valid entry in LOGON TO line, then displays SEND.

8 Active Center

Displays the four character identifier of the active center.

9 NEXT Center

Displays the four character identifier of the next center if known; otherwise blank.

10 DATA LINK Status

Displays status of the datalink system:

- READY
- NOCOMM
- VOICE
- FAIL

11 ADS

Push – alternates ADS between OFF and ARM. Status is indicated by large font.

(ACT) in the title indicates one or more ADS connection exists.

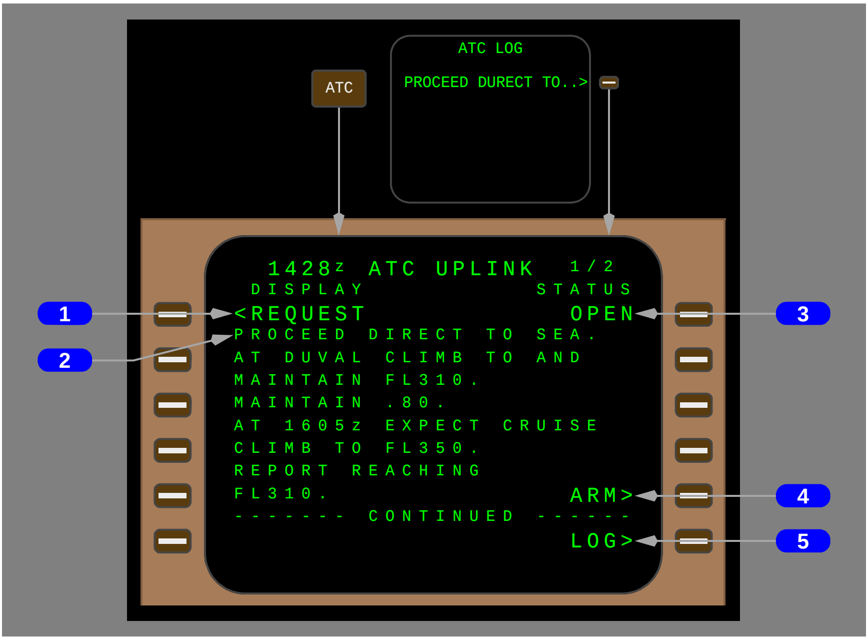
12 ADS EMERGENCY

Push – alternately selects ADS EMERGENCY mode ON or OFF; status is indicated by large font. Operates only when ADS is armed or active. Display is blank when ADS is off.

ATC Uplink Page

The ATC UPLINK page displays messages uplinked by ATC and provides the crew the capability to respond to and load clearances into the FMC. The title displays the time the message was received.

ATC UPLINK page 1/X



1 REQUEST

Displays REQUEST when the displayed uplink is in response to a downlink request which is still listed in the ATC log.

Push – displays the corresponding XXXXZ ATC REQUEST page.

Blank if the displayed message is not in response to a downlink request or if the request has been removed from the log.

2 MESSAGE TEXT

Displays the text of the uplink message in lines 2 through 5. If more space is needed additional pages are added.

3 STATUS

Displays the status of the ATC uplink message. The status is also shown on the ATC LOG page.

4 ARM

Displays ARM adjacent to required reports that are armable.

Push –

- arms the report for automatic transmission
- displays ARMED
- deleting ARMED returns the ARM prompt and disarms the report

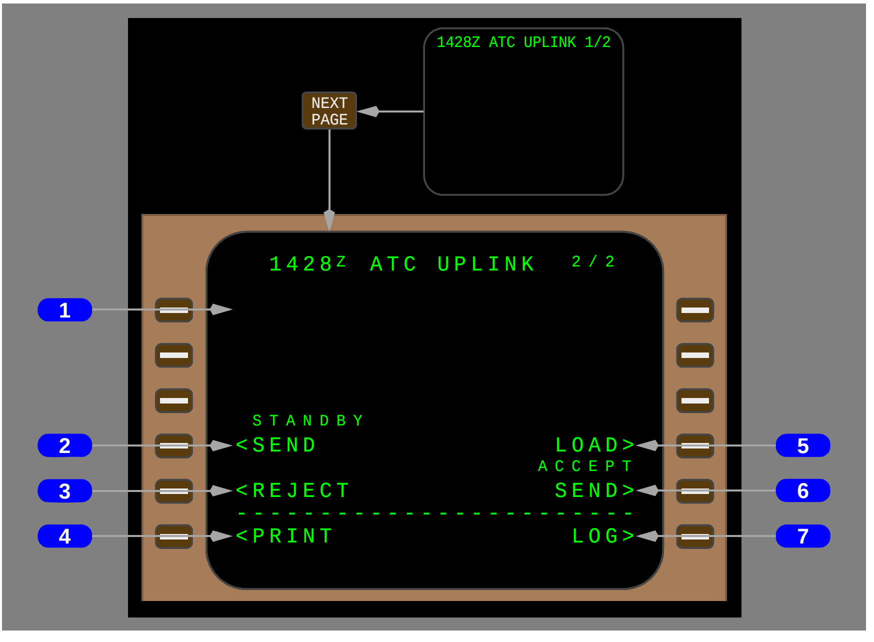
5 **LOG, REPORT**

Displays REPORT when the uplink message includes a REPORT, CONFIRM, or WHEN CAN YOU ACCEPT request. Displays LOG when the uplink message does not contain any of those elements.

Push – displays the ATC LOG or ATC REPORT page as indicated.

ATC UPLINK page X/X

The last ATC UPLINK page continues the text of the uplink message if required. The last page also provides prompts to respond to the message and to load clearances.



1 **MESSAGE TEXT (continued)**

The first 3 lines of the last page are available to continue the text of the message.

2 **STANDBY SEND**

Displayed on the last page if a response is required.

Push – sends a STANDBY response to ATC.

3 REJECT

The REJECT prompt is displayed on the last page if UNABLE or NEGATIVE is a valid response.

Push – displays the REJECT DUE TO page.

4 PRINT

Push – prints complete text of displayed uplink message.

5 LOAD

Displays LOAD on the last page only if the message contains loadable data, otherwise the display is blank.

Push – loads data into route.

6 ACCEPT SEND

Displays ACCEPT SEND on the last page when WILCO, ROGER, or AFFIRM is a valid response to the displayed message, otherwise the line is blank.

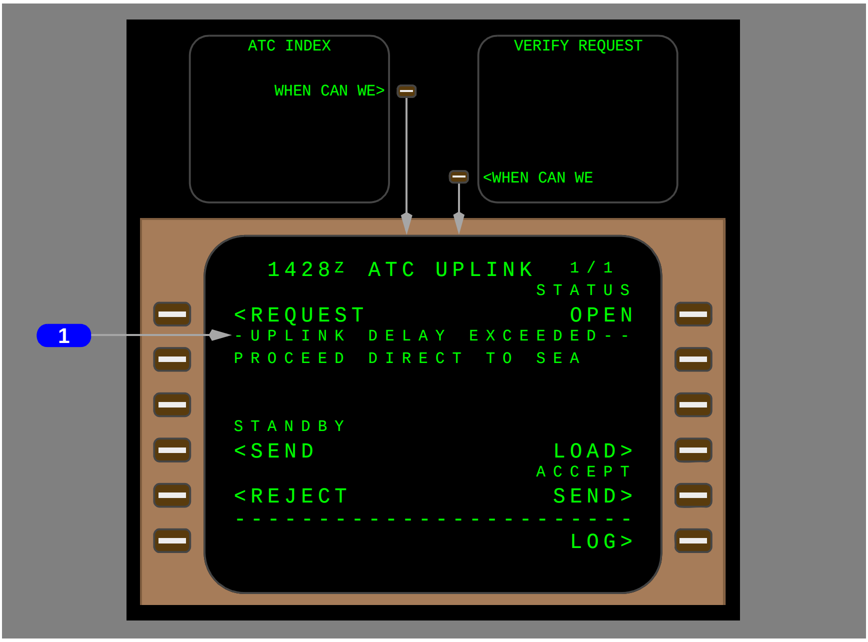
Push – sends a downlink response with WILCO, ROGER, or AFFIRM, as appropriate.

7 LOG, REPORT

Displays REPORT when the uplink message includes a REPORT, CONFIRM, or WHEN CAN YOU ACCEPT request. Displays LOG when the uplink message does not contain any of those elements.

Push – displays the ATC LOG or ATC REPORT page as indicated.

Uplink Delay Exceeded message

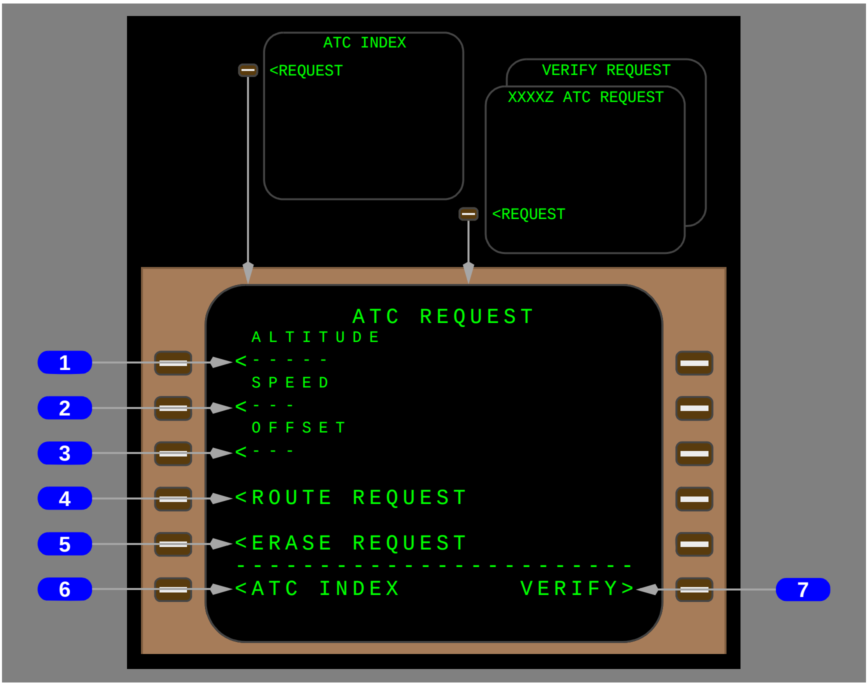


1 UPLINK DELAY EXCEEDED

When a received uplink message exceeds the MAX U/L DELAY time entered on the ATC LOGON/STATUS page, the UPLINK DELAY EXCEEDED message is displayed in the message text.

ATC Request Page

Provides access to various ATC REQUEST pages and allows entry of altitude, speed, and offset information to be requested.



1 ALTITUDE

Push – displays ATC Altitude Request (ALT REQUEST) page.

If selected with valid altitude in the scratch pad, that altitude will be displayed on the ALTITUDE REQUEST page.

Valid entry is XXX (feet), FLXXX, XXXXX (flight level), XXXXXM (meters), XXXXX/XXXXX (block altitude feet), FLXXX/FLXXX (block altitude flight level), or XXXXXM/XXXXXM (block altitude meters).

If selected with dashes displayed and no scratch pad entry, a blank ATC ALT REQUEST page is displayed.

2 SPEED

Push – displays ATC SPEED REQUEST page.

If selected with a valid IAS or Mach number in the scratch pad, that speed will be displayed on the ATC SPEED REQUEST page.

If selected with dashes displayed and no scratch pad entry, a blank ATC SPEED REQUEST page is displayed.

3 OFFSET

Push – displays the ATC OFFSET REQUEST page.

If selected with a valid offset entry in the scratch pad, that offset will display on the ATC OFFSET REQUEST page. Valid entry format denotes offset Left, Right, or Either side and the offset distance: LXX, RXX, or XX for either side. (where XX is any number between 0 and 99 nautical miles).

If selected with dashes displayed and no scratch pad entry, a blank ATC OFFSET REQUEST page is displayed.

4 ROUTE REQUEST

Push – displays ATC ROUTE REQUEST page.

5 ERASE REQUEST

Push – erases all entered or selected data and any of the four ATC REQUEST pages that have data entered.

6 ATC INDEX

Push – displays the ATC INDEX page.

7 VERIFY

Push – displays the VERIFY REQUEST page.

ATC Altitude Request (ALT REQUEST) Page

The ATC ALT (Altitude) REQUEST page is used to create a downlink message requesting an altitude change.

1 ALTITUDE

Initially displays dashes or the altitude entered on the ATC REQUEST page. Entered value may be deleted or modified.

Entering an altitude selects a message requesting a climb or descent based on the current altitude.

2 STEP AT

Allows the optional entry of a position or time. If an entry is made it is included with the altitude request message to specify a step climb or descent at the specified position or time.

Valid STEP AT entries are: fix name, navaid, airport, latitude/longitude, place bearing/distance, or time.

3 At Pilot's Discretion (AT PILOT DISC)

Push – displays AT PILOT DISC in large font and selects it as a message element in the altitude request.

The DELETE key can be used to return the display to small font and remove the message element.

4 REQUEST

Push – displays the ATC REQUEST page.

5 Request Cruise Climb (REQUEST CRZ CLB)

Push – displays CRZ CLB in large font and selects a message element requesting a cruise climb to the entered altitude.

The DELETE key can be used to return the display to small font and remove the message element.

6 MAINTAIN OWN SEPARATION/VMC

Push – displays SEPARATION/VMC prompt in large font and selects the MAINTAIN OWN SEPARATION/VMC message element.

The DELETE key can be used to return the display to small font and remove the message element.

7 DUE TO PERFORMANCE

Push – displays the PERFORMANCE prompt in large font and selects the DUE TO PERFORMANCE message element.

The DELETE key can be used to return the display to small font and remove the message element.

8 DUE TO WEATHER

Push – displays WEATHER in large font and selects the DUE TO WEATHER message element.

The DELETE key can be used to return the display to small font and remove the message element.

9 VERIFY

Push – displays the VERIFY REQUEST page where all the selected message elements can be confirmed and the message can be sent.

ATC Speed Request Page

The ATC SPEED REQUEST page is used to create a downlink message requesting a speed change.

1 SPEED

Initially displays dashes or the speed entered on the ATC REQUEST page. Entered value may be deleted or modified.

Entering an IAS or Mach number creates a message requesting that speed.

2 REQUEST

Push – displays the ATC REQUEST page.

3 DUE TO PERFORMANCE

Push – displays the PERFORMANCE prompt in large font and selects the DUE TO PERFORMANCE message element.

The DELETE key can be used to return the display to small font and remove the message element.

4 DUE TO WEATHER

Push – displays WEATHER in large font and selects the DUE TO WEATHER message element.

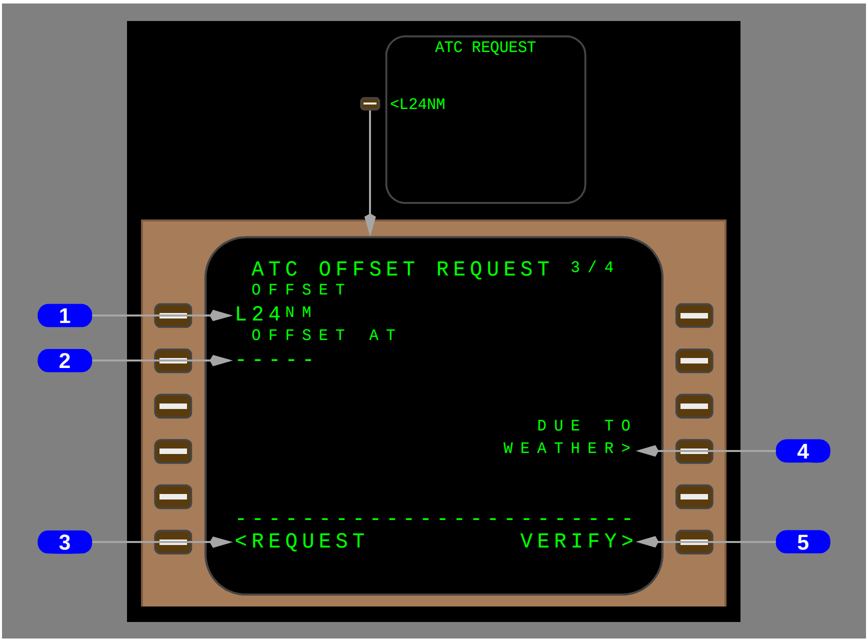
The DELETE key can be used to return the display to small font and remove the message element.

5 **VERIFY**

Push – displays the VERIFY REQUEST page where all the selected message elements can be confirmed and the message can be sent.

ATC Offset Request Page

The ATC OFFSET REQUEST page is used to create a downlink request for an offset.



1 **OFFSET**

Initially displays dashes or the offset entered on the ATC REQUEST page. Entered value may be deleted or modified.

If selected with a valid offset entry in the scratch pad, that offset will display on the ATC OFFSET REQUEST page. Valid entry format denotes offset left, right, or either side and the offset distance: LXX, RXX, or XX for either side. (where XX is any number between 0 and 99 nautical miles) A valid entry creates a message requesting the offset.

2 **OFFSET AT**

Allows the optional entry of a position or time. If an entry is made it is included with the offset request message to specify a position to start the offset.

Valid entries are: fix name, navaid, airport, latitude/longitude, place bearing/distance, or time.

3 **REQUEST**

Push – displays the ATC REQUEST page.

4 **DUE TO WEATHER**

Push – displays WEATHER in large font and selects the WEATHER DEVIATION message element.

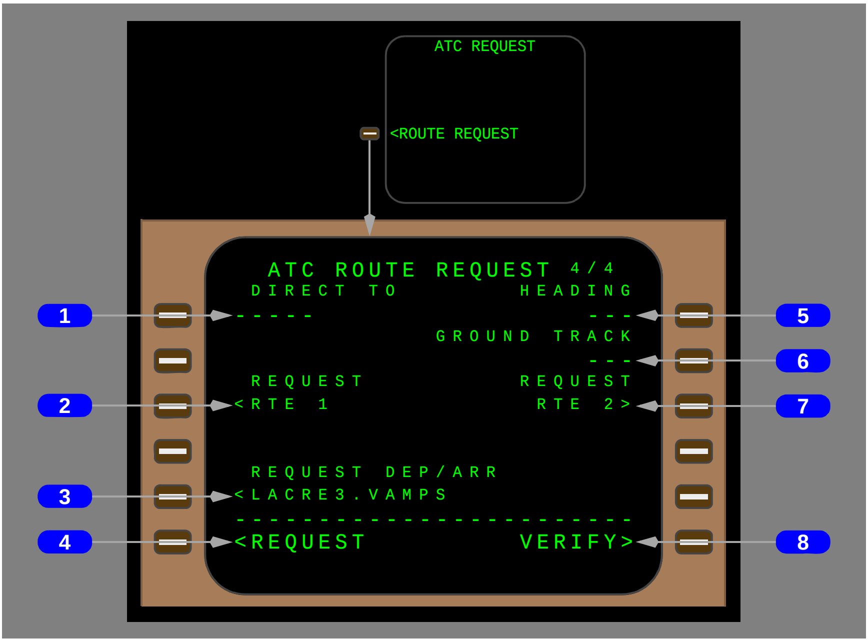
The DELETE key can be used to return the display to small font and remove the message element.

5 **VERIFY**

Push – displays the VERIFY REQUEST page where all the selected message elements can be confirmed and the message can be sent.

ATC Route Request Page

The ATC ROUTE REQUEST page is used to create a downlink request for a route clearance.



1 DIRECT TO

A position entry creates a message requesting a clearance direct to the specified position. Valid entries are: fix name, navaid, airport, latitude/longitude, or place bearing/distance.

2 REQUEST RTE 1

Push – selects the route stored in RTE 1 for the route request message. If the selected route has a pending modification, the modified route is selected for the route request.

3 REQUEST DEP/ARR

Allows entry of a procedure to be included in the route request. A departure or arrival, or approach and, if applicable, a transition may be entered.

If a procedure has been selected on the DEPARTURES or ARRIVALS page, that procedure will be displayed in small font.

Push – when a procedure is displayed in small font, that procedure changes to large font and is included in the PROCEDURE REQUEST.

If no selection is made on the DEP/ARR page, dashes are displayed. If dashes are displayed, a procedure can be entered into the scratch pad and then line selected to be included as a message element in the request.

4 REQUEST

Push – displays the ATC REQUEST page.

5 HEADING

Entering a heading creates a message requesting the specified heading.

6 GROUND TRACK

Entering a ground track selects a message requesting the specified ground track.

7 REQUEST RTE 2

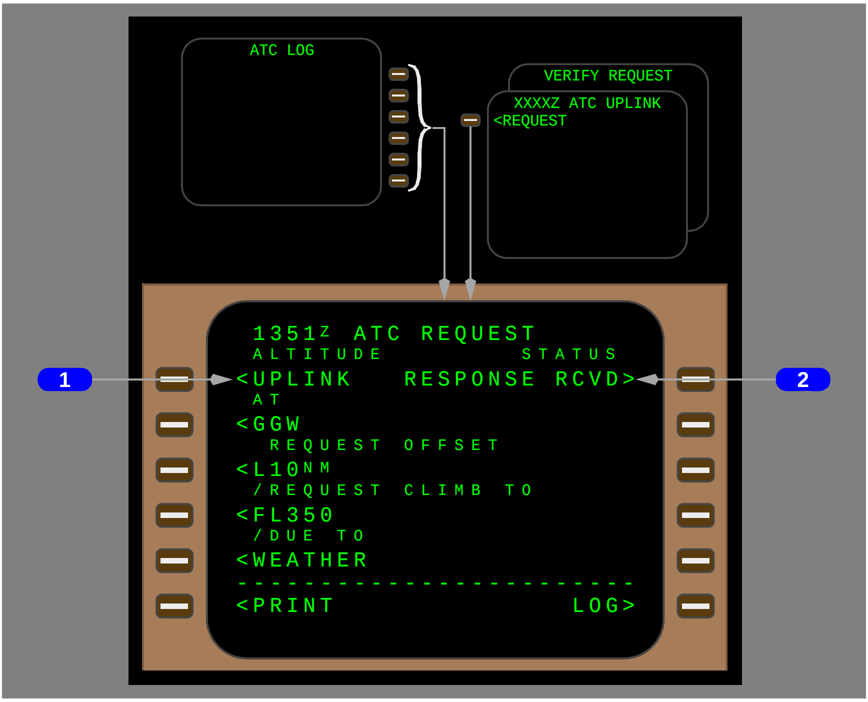
Push – selects the route stored in RTE 2 for the route request message. If the selected route has a pending modification, the modified route is selected for the route request.

8 VERIFY

Push – displays the VERIFY REQUEST page where all the selected message elements can be confirmed and the message can be sent.

XXXXZ ATC Request Page

The ATC REQUEST pages display the transmitted request. XXXXZ is the time request was transmitted.



1 Lines 1- 5

Pages 1/X to X/X display data transmitted to ATC at the time in page title.

Page 1/X line 1 displays UPLINK when ATC response to displayed downlink request exists.

Response time of ATC uplink displays following text.

UPLINK -

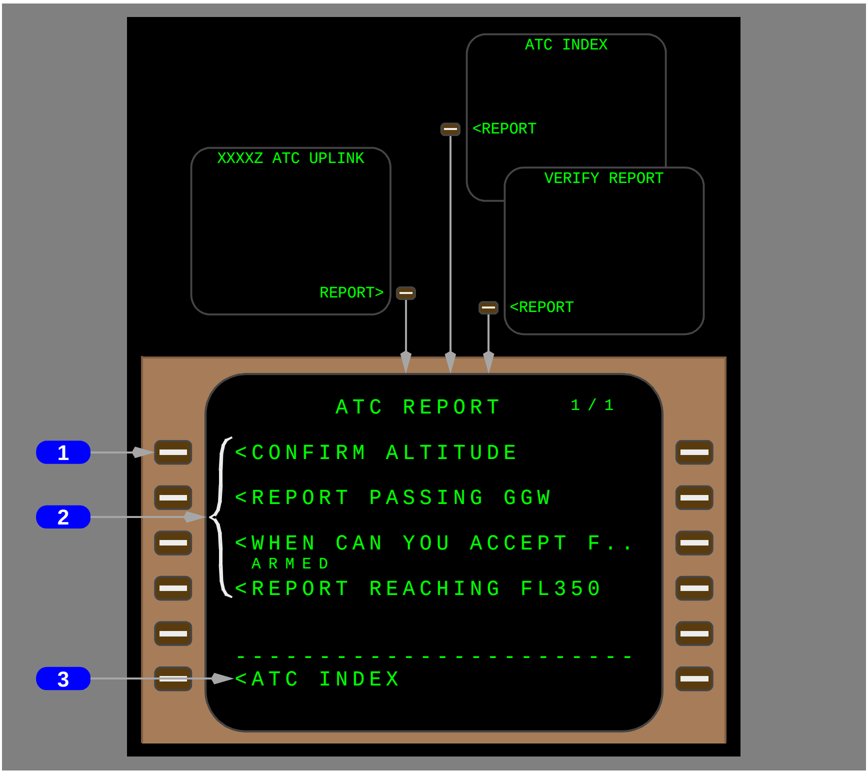
Push - displays the XXXXZ ATC UPLINK 1/X page displaying ATC uplink to displayed request.

2 STATUS

Displays request downlink message status from ATC LOG page.

ATC Report Page

The ATC REPORT page lists all (maximum10) ATC requested reports or confirmations. Provides access to the VERIFY REPORT pages for listed reports.



1 VERIFY REPORT Line Select Keys

Push – displays the VERIFY REPORT page for the report listed. There is a separate page for each report.

2 List of ATC Requested Reports

Lists all reports or confirmations requested by ATC with the most recent request at the bottom of the list. A maximum of 10 report requests can be listed. If a report request is received while the list is full, the ATC REPORT LIST FULL scratch pad message is displayed. Long messages are abbreviated and followed by two periods.

Items are removed from the list when the report has been sent.

ARMED is displayed in the header if the report armed for automatic transmission.

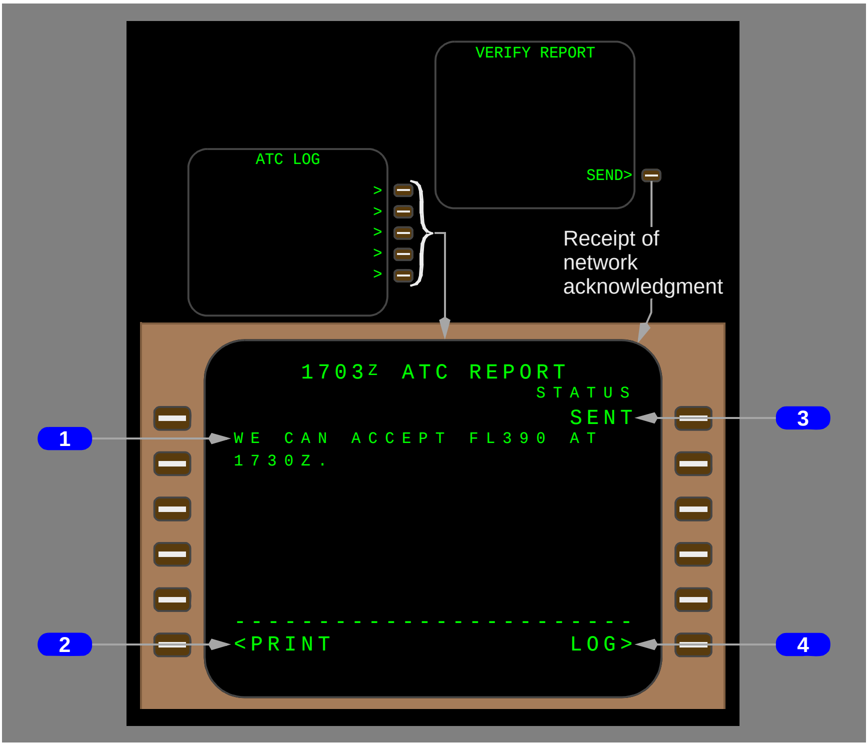
Deleting a line deletes the report.

3 ATC INDEX

Push – selects the ATC INDEX page.

XXXXZ ATC Report Page

Displays text of message downlinked to ATC, where XXXXZ is the time the transmission was initiated.



1 Message Text

Displays the message text which was transmitted to ATC at the time indicated in the page title.

2 PRINT

Push – prints the displayed report.

3 MESSAGE STATUS Line

Displays the status of the downlinked message. The status is also displayed on ATC LOG page.

4 **LOG**

Push – displays the ATC LOG page.

Reject Due To Page

The REJECT DUE TO page allows the crew to include a reason for rejecting an ATC UPLINK message.

1 **DUE TO PERFORMANCE**

Push – selects the DUE TO AIRCRAFT PERFORMANCE message element to be included in the downlink response. Displays PERFORMANCE in large font after selected.

2 **UNLOADABLE CLEARANCE**

Push – selects the UNLOADABLE CLEARANCE message element to be included in the downlink response. Displays UNLOADABLE CLEARANCE in large font after selected.

3 **NOT CONSISTENT. RESEND**

Push – selects the NOT CONSISTENT. RESEND message element to be included in the downlink response. Displays NOT CONSISTENT. RESEND in large font after selected.

4 FREE TEXT

Allows free text to be included in the downlink message.

5 UPLINK

Push – displays the ATC UPLINK page.

6 WEATHER

Push – selects the DUE TO WEATHER message element to be included in downlink response. Displays WEATHER in large font after selected.

7 VERIFY

Push – displays the VERIFY RESPONSE page to review the response message prior to sending.

Verify Report Page

Displays text of message to be sent to ATC in response to a report request. Allows insertion, modification and review of free text before the report is sent.

1 Message Text

Message text is displayed in line titles and specific data elements are displayed on data lines 1 through 4.

2 Data Line

Displays data elements to be included in message. Empty input boxes or dashes are displayed for pilot entry. Deleting entered data returns boxes or FMC default data.

3 CANNOT ACCEPT Line Select Key

Push – selects a CANNOT ACCEPT message. A selected message may be deleted prior to sending.

Displayed only in response to WHEN CAN YOU ACCEPT uplink messages.

4 FREE TEXT

Allows entering free text to the scratchpad. Every VERIFY REPORT page has at least one line available for free text. If the VERIFY REPORT page is accessed from the FREE TEXT prompt on the ATC INDEX page, all 4 data lines are provided for a free text message.

5 REPORT

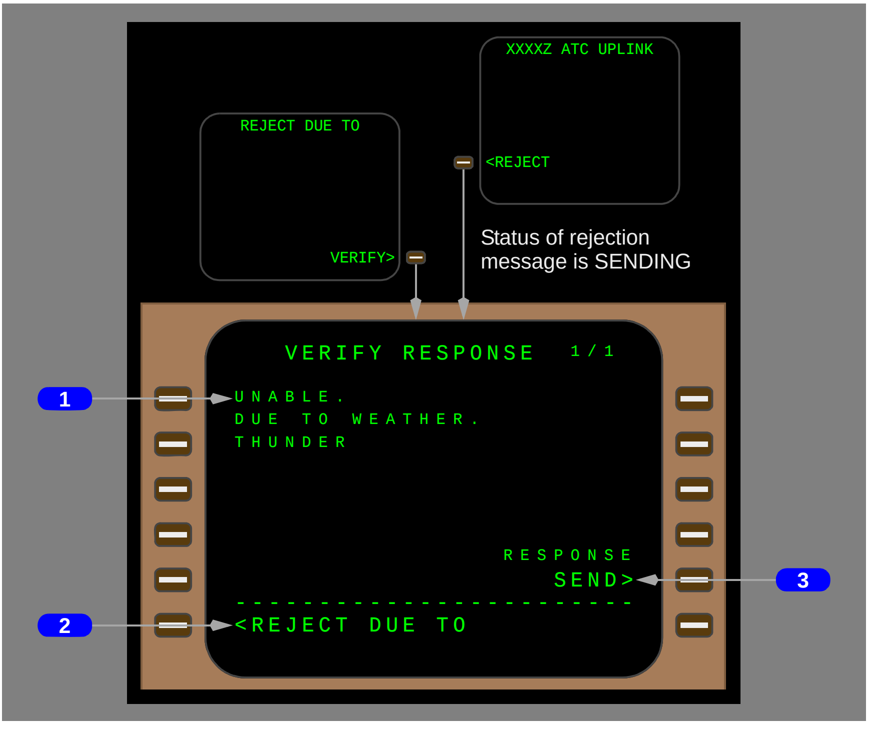
Push – displays the ATC REPORT page.

6 REPORT SEND

Push – transmits ATC REPORT and creates an ATC LOG entry of transmitted message.

Verify Response Page

The VERIFY RESPONSE page allows the crew to create and review a rejection response to an ATC UPLINK message before sending it.



1 UNABLE or NEGATIVE

Displays the message text as selected or entered on the REJECT DUE TO page. Message elements are displayed in the order they were selected. Selected elements are followed by free text.

2 REJECT DUE TO or UPLINK

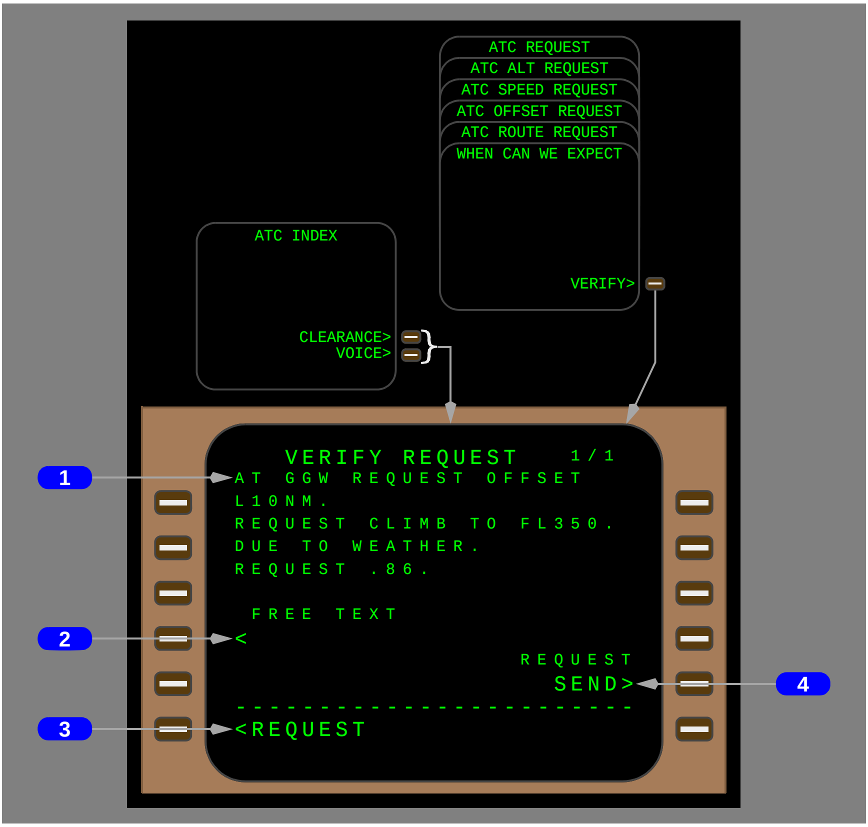
Push – if REJECT DUE TO is displayed, selects the REJECT DUE TO page. If UPLINK is displayed, selects the XXXXZ ATC UPLINK page.

3 RESPONSE SEND

Push – transmits the downlink response.

Verify Request Page

The VERIFY REQUEST page is used to confirm the elements included in a downlink request, add free text and send the request.



1 Message Text

Displays the text and data as created on any of the request pages or the WHEN CAN WE EXPECT page. Message elements are listed in the order they were entered.

2 FREE TEXT

At least one line is available for free text entry. Entered text is included in the downlink request. Additional pages are added as required to provide for additional free text.

3 ATC INDEX, REQUEST, WHEN CAN WE

Displays the prompt for the page from which the VERIFY page was selected.

Push – displays the listed page.

4 **REQUEST SEND**

Push – sends the ATC REQUEST downlink message, creates a log entry of transmitted message and displays standard SEND information.

When Can We Expect Page

The WHEN CAN WE EXPECT page is used to create a downlink query about the timing of a clearance or request.

1 **CRZ CLB TO**

Entering an altitude creates a message asking when to expect a cruise climb to the entered altitude. Valid entry is in normal altitude format. The entry may be deleted.

2 **CLIMB TO**

Entering an altitude creates a message asking when to expect a climb to the entered altitude. Valid entry is in normal altitude format. The entry may be deleted.

3 **DESCENT TO**

Entering an altitude creates a message asking when to expect a descent to the entered altitude. Valid entry is in normal altitude format. The entry may be deleted.

4 **SPEED**

Entering a speed creates a message asking when to expect clearance to the entered speed. Valid entry is an IAS or Mach number. The entry may be deleted.

5 **ERASE WHEN CAN WE**

Push – erases all entered or selected data and returns default values.

6 **ATC INDEX**

Push – displays the ATC INDEX page.

7 **HIGHER ALTITUDE**

Push – creates a message asking when to expect a higher altitude. Selection may be deleted.

8 **LOWER ALTITUDE**

Push – creates a message asking when to expect a lower altitude. Selection may be deleted.

9 **BACK ON RTE**

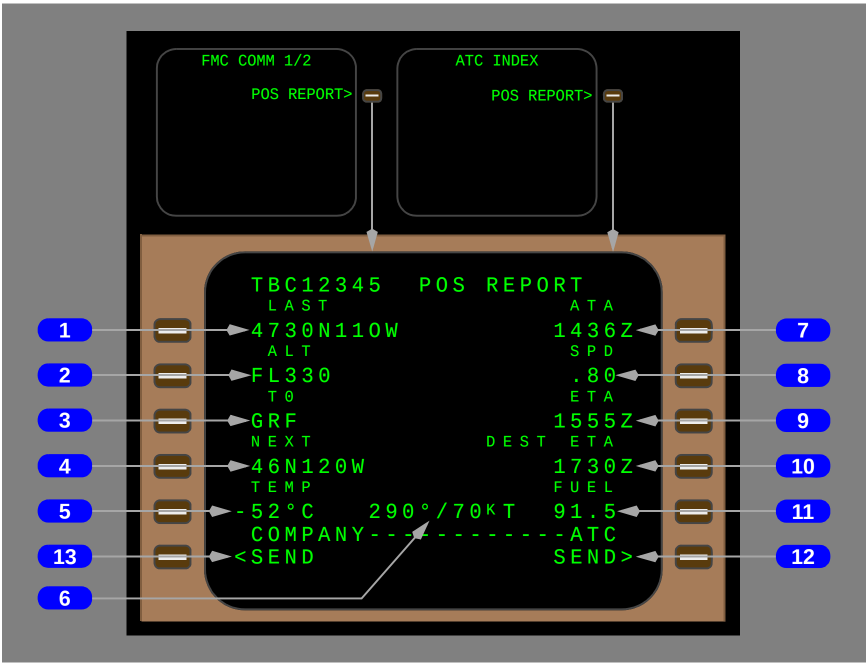
Push – creates a message asking when to expect clearance back to the flight plan route. Selection may be deleted.

10 **VERIFY**

Push – displays the VERIFY REQUEST page where all the selected message elements can be confirmed and the message can be sent.

Position Report (POS REPORT) Page

The XXXXZ POS REPORT page allows review and sending of position report to company and/or ATC. Entered data is sent to ATC only. XXXX is the flight number.



1 LAST Waypoint

Displays waypoint identifier for last sequenced leg.

2 Altitude (ALT)

Displays the altitude at last sequenced FMC waypoint. Displays all asterisks (*). when no FMC data is available.

3 TO Waypoint

Displays waypoint identifier of current leg.

Valid entries are waypoint identifiers in the navigational database or defined geographic points.

Entry overrides displayed waypoint.

Deletion of entry returns current leg waypoint.

4 NEXT Waypoint

Displays waypoint identifier of leg following the TO leg.

Valid entries are waypoint identifiers in the navigational database or defined geographic points.

Entry overrides displayed waypoint.

Deletion of entry returns default waypoint.

5 Temperature

Displays current static air temperature.

6 WIND

Displays current wind direction and magnitude.

7 Actual Time of Arrival (ATA)

Displays ATA at last sequenced waypoint.

8 Speed (SPD)

Displays current airspeed/Mach.

Valid entry is airspeed or Mach.

Entry overrides displayed airspeed/Mach.

Deletion or page change returns default airspeed/Mach.

9 Estimated Time of Arrival (ETA)

Displays ETA at TO waypoint.

Valid entry is XXXXZ.

Entry overrides displayed time.

Deletion of entry returns default time.

10 Destination Estimated Time of Arrival (DEST ETA)

Displays ETA at destination.

Valid entry is XXXXZ.

Entry overrides displayed time.

Deletion of entry returns default time.

11 Fuel

Displays lesser of calculated or totalizer fuel remaining at LAST waypoint.

12 ATC SEND

Push

- sends downlink position report to ATC
- creates ATC LOG entry of transmitted message
- displays SENDING
- displays RESEND when no network acknowledgement within time limit.
- displays SEND with network acknowledgement
- displays NO ATC COM when datalink READY and no ATC connection
- displays DATA LINK header and NO COMM, VOICE, or FAIL as appropriate for data link fault

13 COMPANY SEND

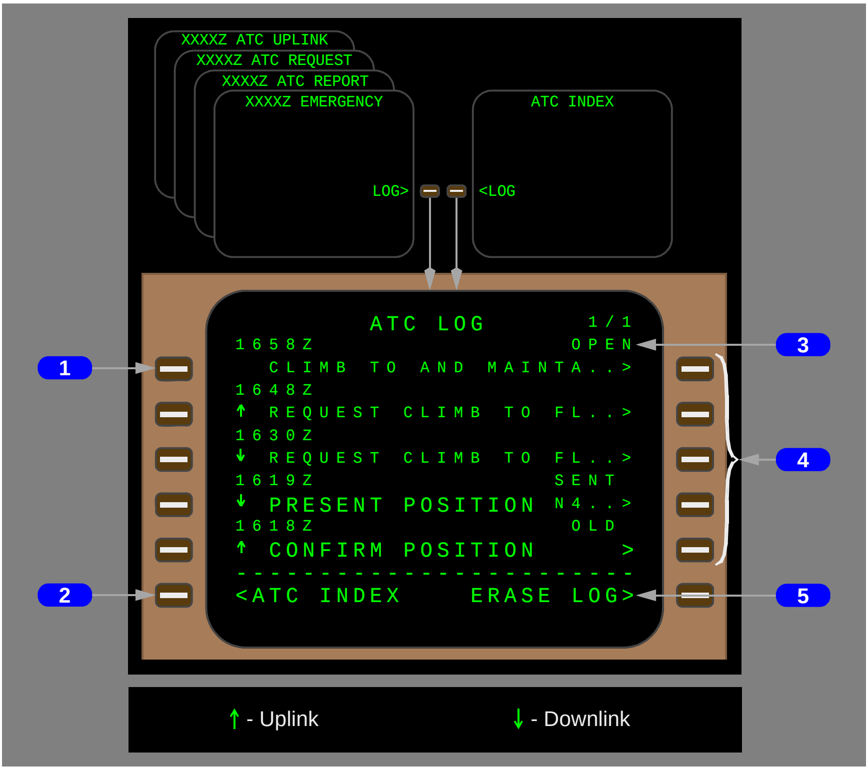
Push

- sends downlink position report to company
- default values are used for TO, NEXT, SPD, and ETA
- creates ATC LOG entry of transmitted message
- displays SENDING
- displays RESEND when no network acknowledgement within time limit
- displays SEND with network acknowledgement
- displays NO ATC COM when datalink READY and no ATC connection
- displays DATA LINK header and NO COMM, VOICE, or FAIL as appropriate for data link fault

ATC Log Page

The ATC LOG pages display stored uplinks and downlinks. Log automatically erases after flight completion.

The page becomes active after contact with ATC and more than one new, or no new and more than one pending uplink.



1 Lines 1 - 5

Display text of uplink and downlink messages. Long messages abbreviated and followed by two periods.

Deleting a line deletes the log entry.

Title displays message receipt (uplink) or transmission (downlink) time.

2 ATC INDEX

Push – displays the ATC INDEX page.

3 Message Status

Title displays one of six possible uplink or six possible downlink states:

Uplink -

- NEW - message not reviewed by crew; message considered pending
- OLD - message reviewed by crew and message does not require response;
- OPEN - message reviewed by crew; message requires response; crew has not sent response or has sent STANDBY or network acknowledgement of response not received; message considered pending
- ACCEPTED - message reviewed by crew; message requires response; positive response sent; network acknowledgement of positive response received; message considered non-pending
- REJECTED - message reviewed by crew; message requires response; negative response sent; network acknowledgement of negative response received; message considered non-pending
- ABORTED - message pending when all connections terminated or transfer of communications performed

Downlink -

- SENDING - SEND prompt selected; network acknowledgement not yet received; message considered pending
- SENT - SEND prompt selected; network acknowledgement received; message does not require response; message considered non-pending
- OPEN - SEND prompt selected; network acknowledgement received; message requires response; response not received or STANDBY response received; message considered pending
- DEFERRED - SEND prompt selected; network acknowledgement received; message requires response; REQUEST DEFERRED response received; message considered pending
- RESPONSE RCVD - SEND prompt selected; network acknowledgement received; message requires response; response other than STANDBY or REQUEST DEFERRED received; message considered non-pending
- ABORTED - message pending when all connections terminated or transfer of communications performed

Push - displays XXXXZ: ATC UPLINK, ATC REQUEST, ATC REPORT, or EMERGENCY page related to line selected.

4 Line 1 – 5 Line Select Keys

Push – displays the corresponding message in its entirety on the associated page. If the message has been ACCEPTED or REJECTED by the flight crew, this page will also show the response and the time that the response was sent.

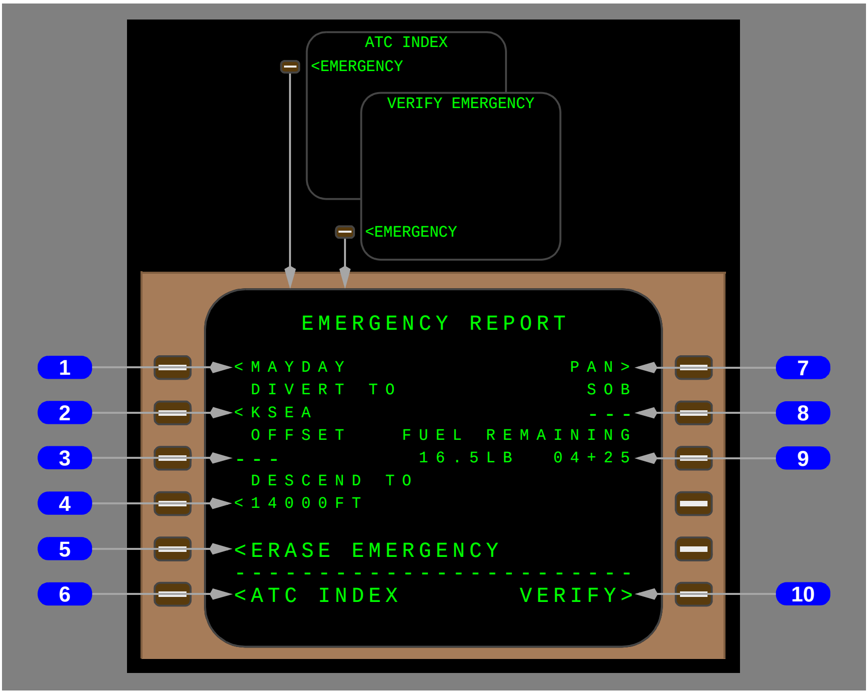
5 ERASE LOG

PUSH -

- arms deletion of all non–pending messages in ATC log
- Displays CONFIRM
- Selection of CONFIRM deletes all non–pending messages in ATC log
- Leaving the page without selecting CONFIRM returns ERASE LOG

Emergency Report Page

The EMERGENCY REPORT page is used to generate an emergency message to ATC.



1 MAYDAY

Push – selects the MAYDAY MAYDAY MAYDAY message element and displays the VERIFY EMERGENCY page.

If the current altitude is more than 150 feet above the altitude shown in 4L, DESCENDING TO is displayed on the VERIFY EMERGENCY page.

2 DIVERT TO

Default display is the active destination airport.

Valid entries are:

- fix name
- navaid
- airport
- latitude/longitude
- or place bearing/distance

Push – if the default airport is displayed, the remainder of the route is included in the message. If a position other than the destination is entered, the direct route to that position is included in the message.

The entered position may be deleted.

3 OFFSET

Valid entry format denotes offset left, right, or either side and the offset distance: LXX, RXX, or XX for either side. (where XX is any number between 0 and 99 nautical miles) A valid entry creates a message requesting the offset.

4 DESCEND TO

Default display is the MCP altitude. Valid entry is XXX (feet), FLXXX, XXXXX (flight level), or XXXXXm (meters). Entered altitude is displayed in large font and may be deleted.

Push – inserts message element indicating intention to descend to the displayed altitude.

If the current altitude is more than 150 feet above the altitude shown in the DESCEND TO prompt (4L), then the DESCENDING TO prompt is displayed on the VERIFY EMERGENCY page.

5 ERASE EMERGENCY

Display is blank until a message element is selected. Entry or selection of data on any line causes the ERASE EMERGENCY prompt to be displayed.

After the EMERGENCY REPORT is transmitted the display changes to the CANCEL EMERGENCY prompt.

Push –

- if ERASE EMERGENCY is displayed, erases all emergency data
- if CANCEL EMERGENCY is displayed, generates a CANCEL EMERGENCY message

The CANCEL EMERGENCY message may be deleted after it is selected.

6 ATC INDEX

Push – displays ATC INDEX page.

7 PAN

Push – selects PAN PAN PAN message and displays the VERIFY EMERGENCY page.

8 Souls On Board (SOB)

Allows entry of the number of people on board. When a number is entered the fuel remaining is displayed and a message element with the number of people on board and the fuel remaining is inserted.

Deleting the entry deselects the message element.

9 FUEL REMAINING

Displays the FMC computed fuel remaining in quantity and time when an number is displayed on the SOB line. Display is blank prior to making the SOB entry.

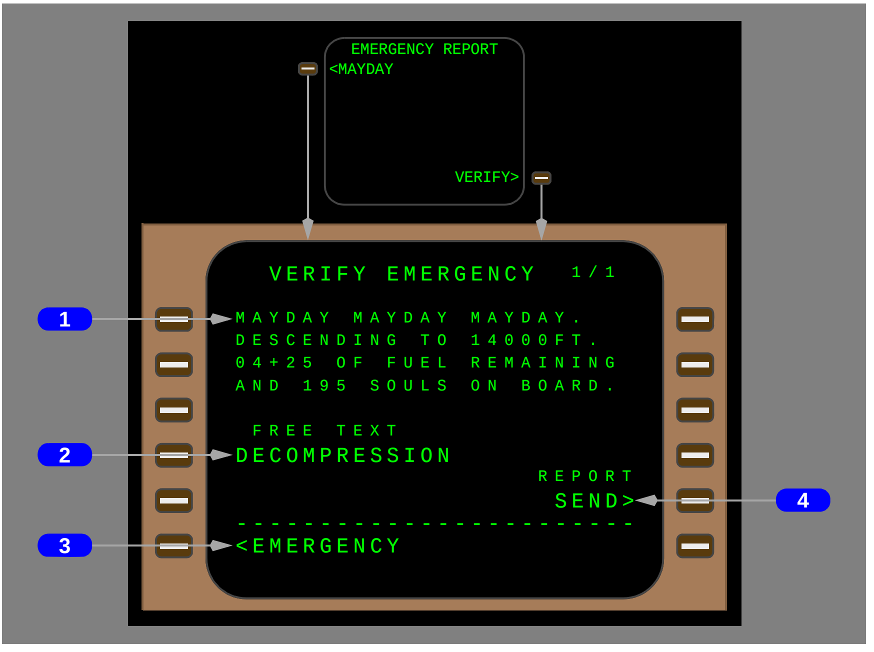
Valid entry is HH+MM. One or two digits can be entered for hours or minutes.

10 VERIFY

Push – displays the VERIFY EMERGENCY page.

Verify Emergency Page

The VERIFY EMERGENCY page is used to verify and transmit an emergency message to ATC after it has been generated on the EMERGENCY REPORT page. It also allows inserting a free text message into the generated message.



1 Message Text

LINES 1 through 5 on all but the last page, and lines 1 through 4 on the last page display the message text. Pages are added as required leaving at least one line for free text on the last page.

The text includes all the elements selected on the EMERGENCY REPORT page.

2 FREE TEXT

At least one line is available for free text on the last page. If the line is filled, an additional page will be generated to provide more space for free text.

3 EMERGENCY

Push – displays the EMERGENCY REPORT page.

4 REPORT SEND

Push –

- transmits EMERGENCY REPORT
- creates a log entry of transmitted message and,

if MAYDAY is selected:

- transmits a POSITION REPORT
- activates ADS in emergency mode
- transmits an AOC emergency report

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EICAS Advisory Messages

N422LA through N526LA

This section describes the various EICAS advisory messages that can be displayed.

Radios

Message	Level	Aural	Condition
RADIO TRANSMIT	Advisory		A VHF or HF radio is keyed for 30 seconds or more.

Data Link

Message	Level	Aural	Condition
DATALINK LOST	Advisory		Data link is temporarily lost.
DATALINK SYS	Advisory		Data link system has failed.

Satellite Communications (SATCOM)

Message	Level	Aural	Condition
SATCOM	Advisory		SATCOM system has failed.
SATCOM VOICE	Advisory		SATCOM voice communication not available. ACARS data communication through SATCOM is available. Loss due to SATCOM voice system failure.
SATVOICE LOST	Advisory		SATCOM voice communication is temporarily lost.
SATCOM DATALINK	Advisory		SATCOM datalink system has failed.

EICAS Communication Alert Messages

This section describes the various EICAS communications alert messages that can be displayed.

Crew Communication Messages

Message	Level	Condition	Crew Action/Remarks
• CARGO CALL	Medium	Pilot call received from cargo compartment.	Respond to the call. Message accompanied by aural chime and LOAD MASTER/MAIN DECK cargo call light.
• GROUND CALL	Medium	Pilot call received from the nose wheel well over the flight interphone.	Respond to the call. Message accompanied by aural chime and GND CALL light.

Selective Calling (SELCAL)

Message	Level	Condition	Crew Action/Remarks

N316LA

• SELCAL	Medium	SELCAL received on VHF or HF radio.	Determine which radio received call. Respond to the call. Message is accompanied by aural chime and VHF/HF SELCAL light.

N422LA through N526LA

• SELCAL	Medium	SELCAL received on VHF, HF or SATCOM radio.	Determine which radio received call. Respond to the call. Message is accompanied by aural chime and VHF/HF/SAT CALL light on the ACP.

Data Link
N422LA through N526LA

Message	Level	Condition	Crew Action/Remarks
• PRINTER	Medium/ Low	A company data link message has been received and sent to the printer.	Review the printed message and press the reset button on the printer. Message is accompanied by aural chime.
• ATC	Medium	An ATC data link message has been received.	Select the ATC mode key on the CDU and respond to the message. Message is accompanied by aural chime.
• FMC	Medium	An FMC communications related data link message has been received.	Select the FMC COMM mode key on the CDU. View the message title in the CDU scratch pad. View the message on the appropriate CDU page. Message is accompanied by aural chime and a MSG light on the CDU.
• DATALINK AVAIL	Low	A lost data link connection has been re-established.	Resume use of data link communication.
• VHF DATA OFF	Low	VHF radio is in voice mode - Data cannot be sent.	Switch radio to data mode to establish data link communication.

Satellite Communication (SATCOM)
N422LA through N526LA

Message	Level	Condition	Crew Action/Remarks
• SATVOICE AVAIL	Low	SATCOM voice capability re–established.	Resume use of SATCOM voice communication.

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Electrical — Chapter 6
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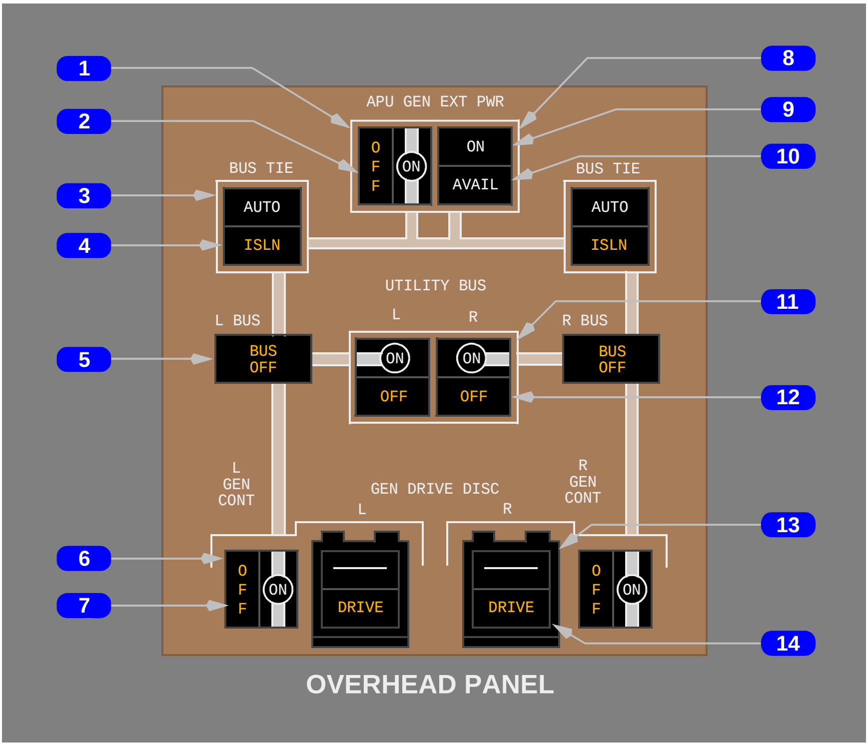
Electrical Panel



1 APU Generator (APU GEN) Control Switch

ON (bar in view) –

- arms APU generator breaker to automatically close.

OFF (bar not visible) –

- opens APU generator breaker
- resets fault trip circuitry.

2 APU Generator OFF Light

Illuminated (amber) –

- the APU generator breaker is open because of a fault with APU running
- the APU generator control switch is selected OFF.

3 BUS TIE Switches

AUTO –

- arms automatic AC bus tie circuits
- arms automatic DC bus tie circuits
- arms automatic flight instrument transfer bus circuits.

OFF (AUTO not visible) –

- commands the AC bus tie open
- commands the DC bus tie open
- commands the flight instrument bus tie open
- resets fault trip circuitry.

4 AC Bus Isolation (ISLN) Lights

Illuminated (amber) –

- a fault has occurred, automatically opening the AC bus tie breaker
- the BUS TIE switch is OFF.

5 AC BUS OFF Lights

Illuminated (amber) – the AC bus is unpowered.

6 Generator Control (GEN CONT) Switches

ON (bar in view) – arms the generator breaker to close automatically when generator power is available.

OFF (bar not visible)

- opens generator breaker
- resets fault trip circuitry.

7 Generator OFF Lights

Illuminated (amber) – the generator breaker is open.

8 External Power (EXT PWR) Switch

Push – if AVAIL light is illuminated, closes external power contactor

Subsequent push – opens external power contactor.

9 External Power ON Light

Illuminated (white) – external power is powering the bus(es).

10 External Power Available (AVAIL) Light

Illuminated (white) – external power is plugged in and power quality is acceptable.

11 UTILITY BUS Switches

ON (bar in view) – if no load shed signal is present, connects utility and galley busses to main AC bus.

OFF (bar not visible) –

- disconnects utility and galley busses from main AC bus
- resets overload load shed circuitry.

12 Utility Bus OFF Lights

Illuminated (amber) – the utility and galley busses are unpowered.

13 Generator Drive Disconnect (GEN DRIVE DISC) Switches

Push –

- disconnects generator drive from the engine
- requires maintenance action on the ground to reconnect the generator drive.

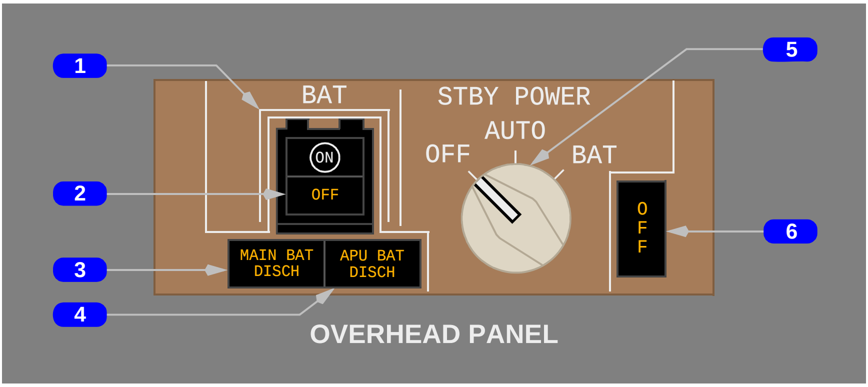
14 Generator DRIVE Lights

Illuminated (amber) –

- the generator drive oil temperature is high
- the generator drive oil pressure is low.

Battery/Standby Control Panel

N316LA



1 Battery (BAT) Switch

ON –

- Unpowered airplane on the ground:
  - a few annunciator lights illuminate
  - allows the APU to be started
- Powered airplane inflight or on the ground when AC power is removed or lost:
  - the standby and battery busses are powered.

OFF (ON not visible) – turns battery power off.

2 Battery OFF Light

Illuminated (amber) – the battery switch is off.

3 MAIN Battery Discharge (BAT DISCH) Light

Illuminated (amber) – the main battery is discharging.

4 APU Battery Discharge (BAT DISCH) Light

Illuminated (amber) – the APU battery is discharging.

5 Standby (STBY) POWER Selector –

OFF – the standby busses are unpowered.

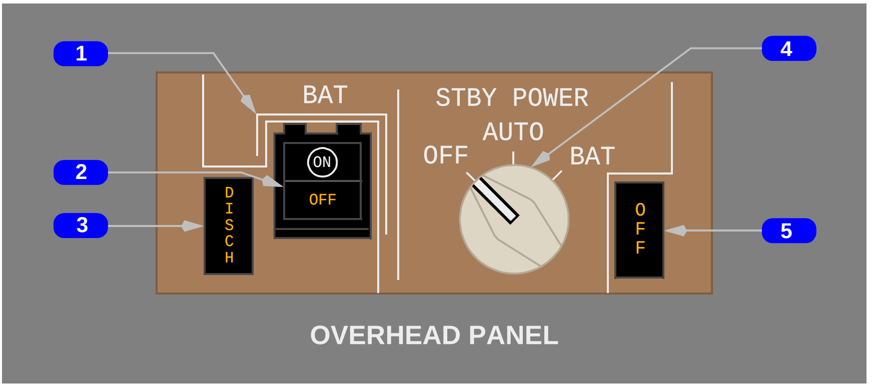
AUTO – the standby busses transfer to battery power if normal AC power is lost.

BAT – the standby busses are powered from the main and APU batteries.

6 Standby Power Bus OFF Light

Illuminated (amber) – the standby AC or DC bus is unpowered.

N422LA through N526LA



1 Battery (BAT) Switch

ON –

- Unpowered airplane on the ground:
  - a few annunciator lights illuminate
  - allows the APU to be started
- Powered airplane inflight or on the ground when AC power is removed or lost:
  - the standby and battery busses are powered.

OFF (ON not visible) – turns battery power off.

2 Battery OFF Light

Illuminated (amber) – the battery switch is off.

3 Battery Discharge (DISCH) Light

Illuminated (amber) – the main battery is discharging.

4 Standby (STBY) POWER Selector –

OFF – the standby busses are unpowered.

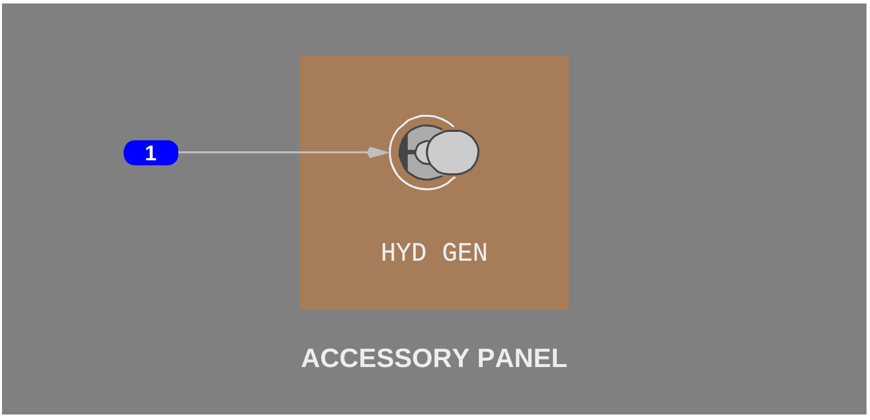
AUTO – the standby busses transfer to battery power if normal AC power is lost.

BAT – the standby busses are powered from the main battery.

5 Standby Power Bus OFF Light

Illuminated (amber) – standby AC or DC bus not powered.

Hydraulic Generator Test Switch



1 Hydraulic Generator Test Switch

Spring-loaded to center.

HYD GEN – initiates hydraulic driven generator system test.

Introduction

The electrical system generates and distributes AC and DC power to other airplane systems, and is comprised of: main AC power, main DC power, and battery/standby power. System operation is automatic. Electrical faults are automatically detected and isolated.

A hydraulic driven generator operates automatically as a backup source of power in the event that both main AC buses become inoperative.

AC Electrical System

The AC electrical system is the main source for airplane electrical power.

AC Electrical System Power Sources

The entire airplane AC electrical load can be supplied by any two main airplane AC power sources.

The main airplane AC electrical power sources are:

- left and right engine integrated drive generators (IDGs)
- APU generator.

The entire airplane AC electrical load also can be supplied by external power.

The power sources operate isolated from one another.

Integrated Drive Generators (IDGs)

Each engine has an IDG. Each IDG has automatic control and system protection functions.

When an engine starts, with the GEN CONT switch selected ON, the IDG automatically powers the respective main bus. The previous power source is disconnected from that bus.

The IDG can be electrically disconnected from the busses by pushing the GEN CONT switch to OFF. The IDG can also be electrically disconnected from its respective bus by selecting external power prior to engine shutdown. (See External Power in this section.)

The OFF light in the GEN CONT switch illuminates, and the EICAS Advisory message L or R GEN OFF displays whenever the generator control breaker is open.

The DRIVE light illuminates and the EICAS Advisory message L or R GEN DRIVE displays when low oil pressure or high oil temperature is detected in an IDG. The IDG drive can be disconnected from the engine by pushing the respective DRIVE DISC switch. The IDG cannot be reconnected by the flight crew.

APU Generator

The APU generator is electrically identical to the IDG generators. The APU generator can power either or both main busses, and may be used in flight as a replacement to an IDG source.

If no other power source is available when the APU generator becomes available, the APU generator automatically connects to both main AC busses. If the external source is powering both main busses, the external source continues to power both main busses.

The APU Generator OFF light illuminates, and the EICAS advisory message APU GEN OFF displays when the APU is operating and the APU generator breaker is open because of a fault or the APU GEN switch is selected OFF. When the APU GENERATOR switch is ON and a fault is detected, the APU generator cannot connect to the busses.

External Power

External power can power the left and right main busses. When the power source voltage and frequency are within limits, the external power AVAIL light illuminates.

Pushing the EXT PWR switch ON connects external power to both main busses and removes the IDGs and the APU generator from the busses, if they were powering the busses. When external power is connected to a main bus, the EXTERNAL POWER ON light illuminates.

AC Electrical Power Distribution

AC power is distributed through the left and right main busses and the ground service bus.

AC Main Busses

The right IDG normally powers the right main bus and the left IDG normally powers the left main bus. The APU normally powers both main busses when they are not powered by any other source. External power may also be connected and will also power both main busses.

Bus tie breakers, controlled by BUS TIE switches, isolate or parallel the right and left main busses. When both BUS TIE switches are set to AUTO, the bus tie system operates automatically to maintain power to both main busses.

The AC bus ISLN light illuminates and the EICAS advisory message L or R BUS ISOLATED displays when the bus tie breaker is open because of a fault or the BUS TIE switch is OFF.

The BUS OFF light illuminates and the EICAS caution message L or R AC BUS OFF displays if an AC bus is unpowered.

The source order for powering left and right main busses is the:

- respective IDG
- APU generator
- opposite IDG.

Utility Busses

Left and right utility busses, powered by their respective main AC bus, are controlled by UTILITY BUS switches. The galley bus is powered by the left utility bus, and has no direct controls or indicators. The utility bus OFF lights illuminate and the EICAS advisory message L or R UTIL BUS OFF displays when the galley and utility busses are unpowered.

Ground Service Bus

The ground service bus is normally powered by the right main bus. Alternate sources of power for the ground service bus are:

- the APU generator
- external power.

The ground service bus powers:

- the main battery charger
- the APU battery charger
- miscellaneous cabin and system loads.

Ground Handling Bus

The ground handling bus can be powered only on the ground and only from the APU generator or from the external power source. It is provided for loads such as cargo handling and equipment energized only during ground operations.

Autoland

During autoland, the busses isolate to allow three independent sources to power the three autopilots:

- the left main system powers the left autopilot and the captain’s flight instrument transfer bus
- the right main system powers the right autopilot and the first officer’s flight instrument transfer bus
- the battery/standby system powers the center autopilot.

Above 200 feet, loss of a generator results in:

- both bus tie breakers closing and the operating generator powers both left and right AC busses
- the left main system powers the center autopilot
- NO LAND 3 appears on the Autoland Status Annunciator.

Below 200 feet, loss of a generator results in:

- both bus tie breakers remaining open
- the autopilot associated with a failed generator is unpowered
- the flight instruments remain powered through the flight instrument transfer busses
- the autoland continues using the remaining two autopilots.

When the autopilots are disengaged or an autopilot go-around is performed, the electrical system reverts to normal, non-isolated operation.

Flight Instrument Transfer Busses

Normally, the captain's flight instruments are powered by the left main AC Bus, and the first officer's flight instruments are powered by the right main AC Bus. If the respective bus tie breakers are in AUTO, the flight instrument transfer busses transfer to the opposite main AC bus in the event power is lost to a main AC Bus.

If power is lost to both main AC busses, the captain's flight instruments are powered by the hydraulic driven generator.

AC Transfer Busses

Left and right AC transfer busses power items considered necessary for ETOPS flights, which are not powered by the battery/standby system. Transfer busses are normally powered by their associated main AC busses, but also can be powered by the Hydraulic Driven Generator when both AC busses are unpowered.

Electrical Load Shedding

Electrical load shedding occurs automatically to ensure power is available to critical and essential equipment.

If the electrical loads exceed the power available, the electrical system automatically sheds AC loads by priority until the loads are within the capacity of the generators. The load shedding is galley power first, then utility busses. Utility busses are followed by individual equipment items powered by the main AC busses. When an additional power source becomes available or the load decreases, the electrical system automatically restores power to the shed systems (in the reverse order).

Examples of load shedding that may be observed during normal operations include:

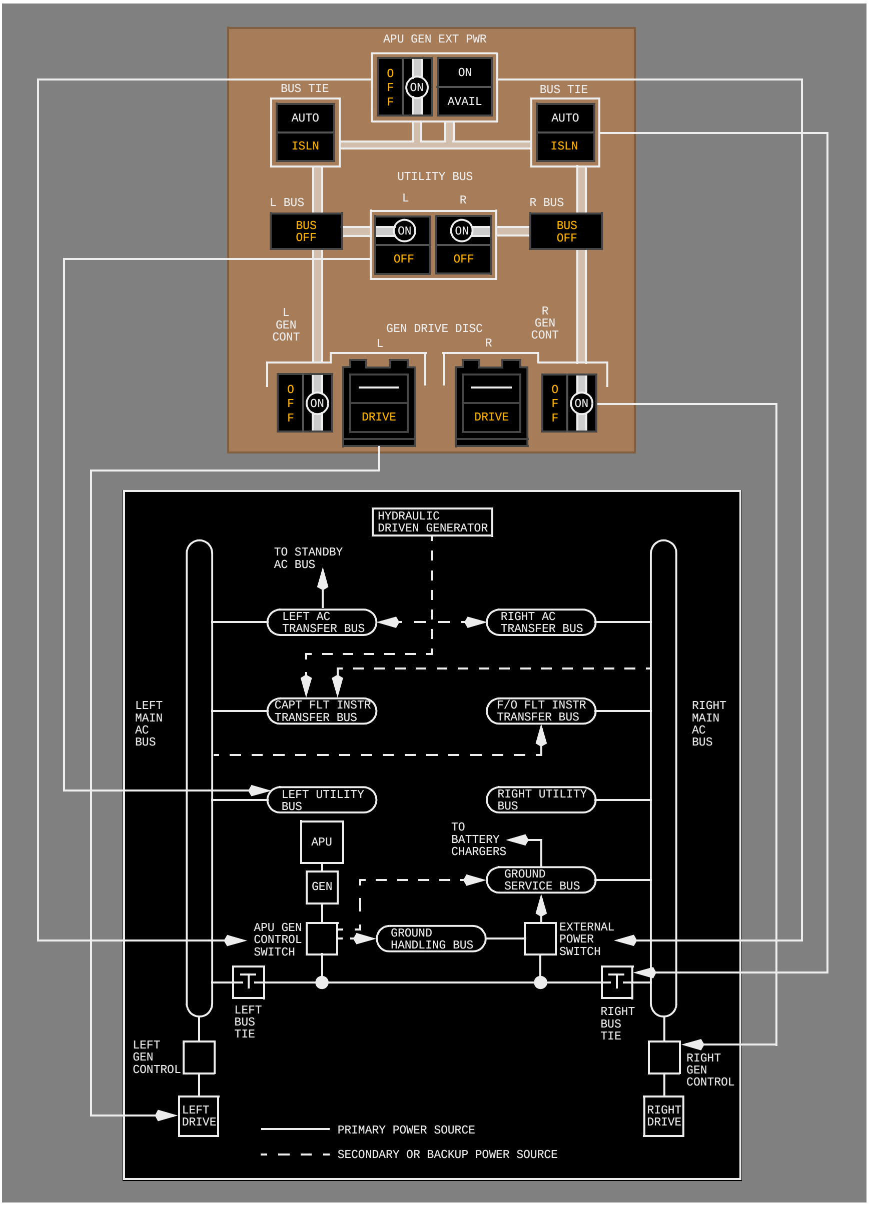
- an electric hydraulic pump prior to engine start
- center tank fuel pumps prior to engine start

Examples of load shedding that may be observed during non-normal operations include:

- utility busses after a generator failure
- center tank fuel pump after an engine failure

On the ground, advancing the thrust levers into the takeoff range with the engines shut down may cause inadvertent load shedding of the utility busses to occur. Returning the thrust levers to idle, then pushing the UTILITY BUS switches OFF, then ON will reset this inadvertent load shedding.

AC Electrical System Schematic (Hydraulic Driven Generator)



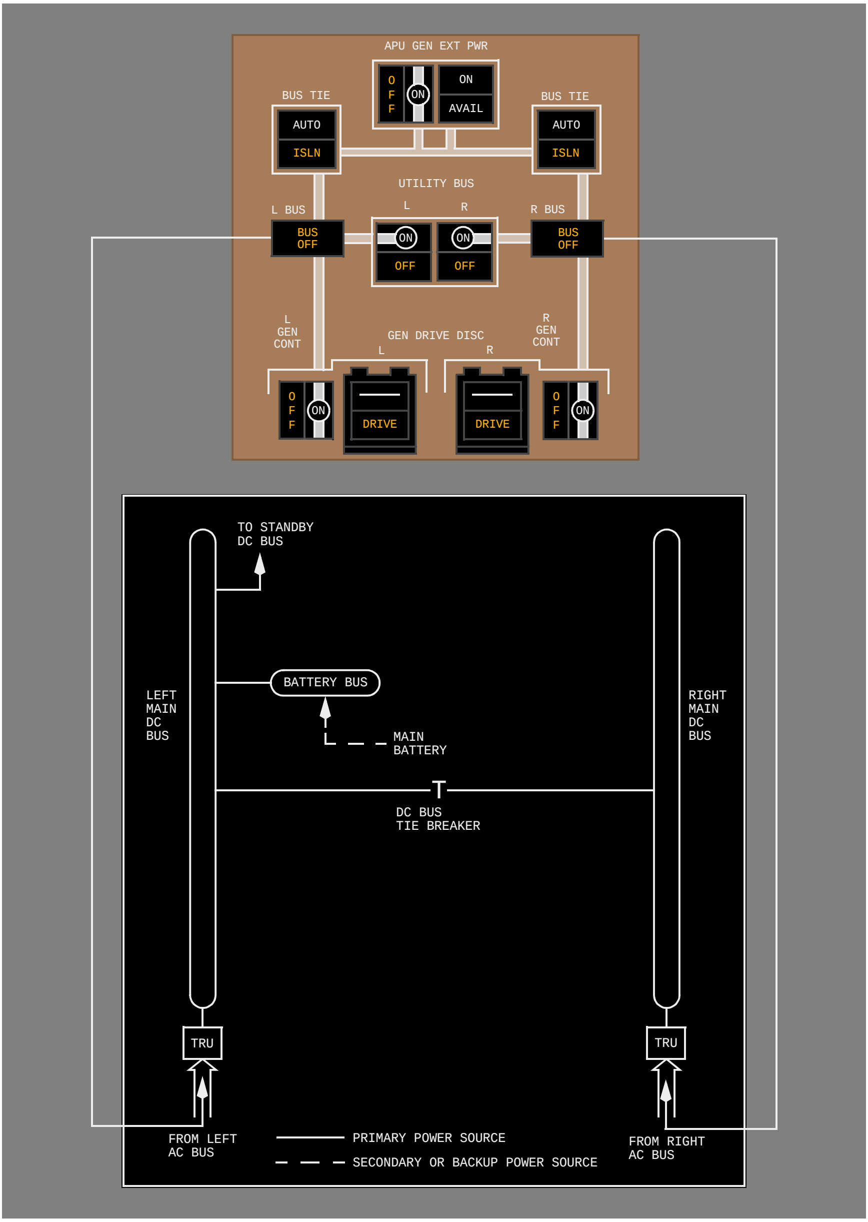
DC Electrical System

The main DC electrical system uses transformer-rectifier units (TRUs) to produce DC power. The TRUs are powered by the main AC busses.

The TRUs operate isolated from one another. If one TRU fails, the DC bus tie breaker closes to keep both DC busses powered. Both BUS TIE switches must be in AUTO for the DC bus tie breaker to close.

There are no flight deck controls for the main DC electrical system.

DC Electrical System Schematic



Battery/Standby Power System

The battery/standby power electrical system can supply DC and AC power to selected flight instruments, communications and navigation systems, and other critical systems, if there are main AC and DC electrical power system failures.

The Battery/Standby Power System consists of the following busses:

- the hot battery bus
- the battery bus
- the standby AC bus
- the standby DC bus

Hot Battery Bus

The hot battery bus provides power to items which must be continuously powered, such as the clock's time reference.

Prior to establishing electrical power, the main battery powers the hot battery bus.

After establishing electrical power, the main battery charger powers the hot battery bus.

Battery Bus

Prior to establishing electrical power, when the battery switch is ON, the main battery powers the battery bus.

After establishing electrical power, the left DC system powers the battery bus, and the main battery provides a backup source of power.

N422LA through N526LA
The Battery DISCH light illuminates when the main battery is discharging. If EICAS is powered, the advisory message MAIN BAT DISCH also displays.

N316LA
The MAIN BAT DISCH light illuminates when the main battery is discharging. If EICAS is powered, the advisory message MAIN BAT DISCH also displays.

The battery OFF light illuminates and the EICAS advisory message BATTERY OFF displays if the battery switch is OFF after electrical power is established.

Standby DC Bus

N422LA through N526LA
The standby DC bus can be powered by several sources. Prior to establishing electrical power, when the battery switch is ON and the standby power selector is in AUTO, the main battery powers the standby DC bus. The Battery DISCH light illuminates when the main battery is discharging. After establishing electrical power, the left DC system powers the standby DC bus and the main battery provides a backup source of power. When the standby power selector is in BAT, the main battery powers the standby DC bus.

N316LA
The standby DC bus can be powered by several sources. Prior to establishing electrical power, when the battery switch is ON and the standby power selector is in AUTO, the main battery and the APU battery are paralleled to power the standby DC bus. The MAIN BAT DISCH light and the APU BAT DISCH light illuminate when the main battery and APU battery are discharging. After establishing electrical power, the left DC system powers the standby DC bus and the main battery and APU battery provide a backup source of power. When the standby power selector is in BAT, the main battery and the APU battery are paralleled to power the standby DC bus.

The standby bus OFF light illuminates and the EICAS advisory message STANDBY BUS OFF displays if the standby DC bus is not powered. In addition, these indications display if power is lost to the battery bus even though the standby DC bus may still be powered.

Standby AC Bus

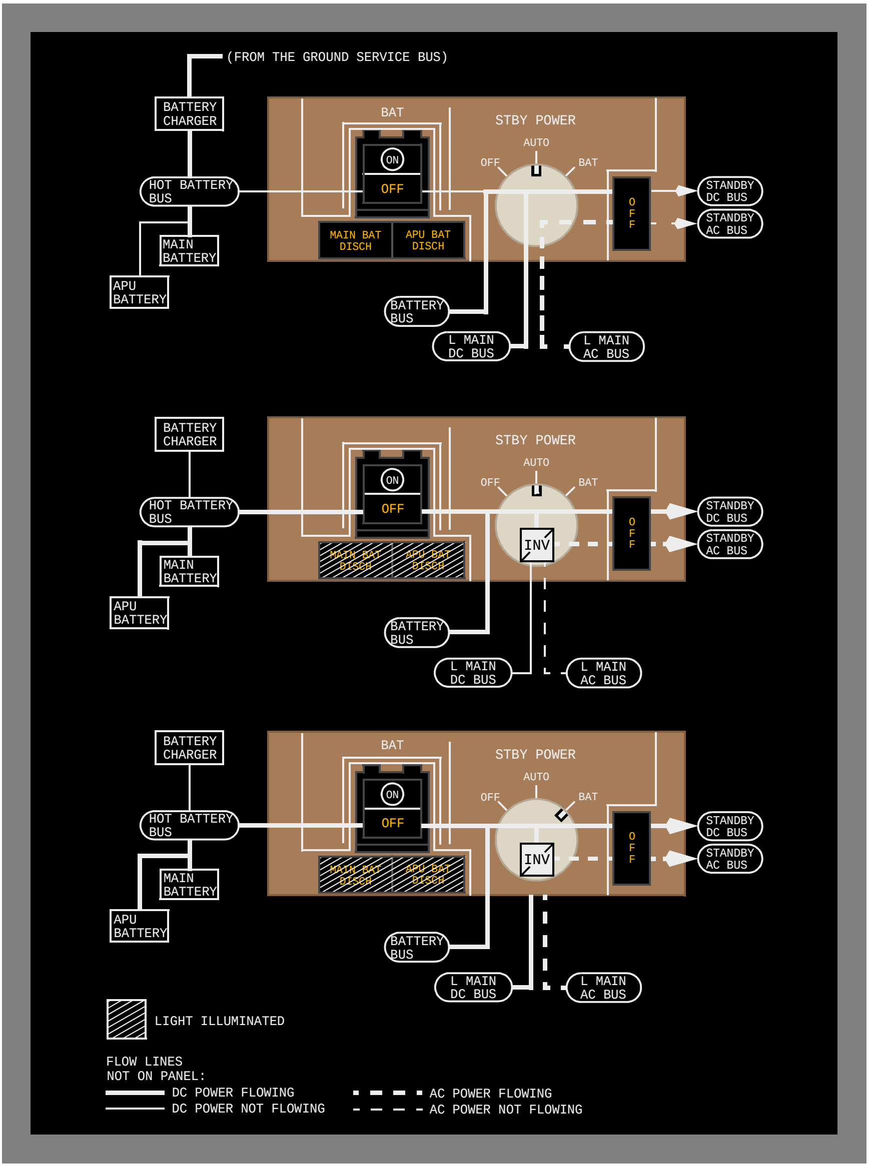
N422LA through N526LA
The standby AC bus can be powered by several sources. Prior to establishing electrical power, when the battery switch is ON and the standby power selector is in AUTO, the main battery powers the standby inverter which provides AC power to the standby AC bus. After establishing electrical power, the left AC system powers the standby AC bus and the main battery and standby inverter provide a backup source of power. When the standby power selector is in BAT, the main battery and standby inverter power the standby AC bus.

N316LA
The standby AC bus can be powered by several sources. Prior to establishing electrical power, when the battery switch is ON and the standby power selector is AUTO, the main battery and the APU battery parallel to power the standby inverter which provides AC power to the standby AC bus. After establishing electrical power, the left AC system powers the standby AC bus and the main battery, APU battery, and standby inverter provide a backup source of power. When the standby power selector is BAT, the main battery, APU battery, and standby inverter power the standby AC bus.

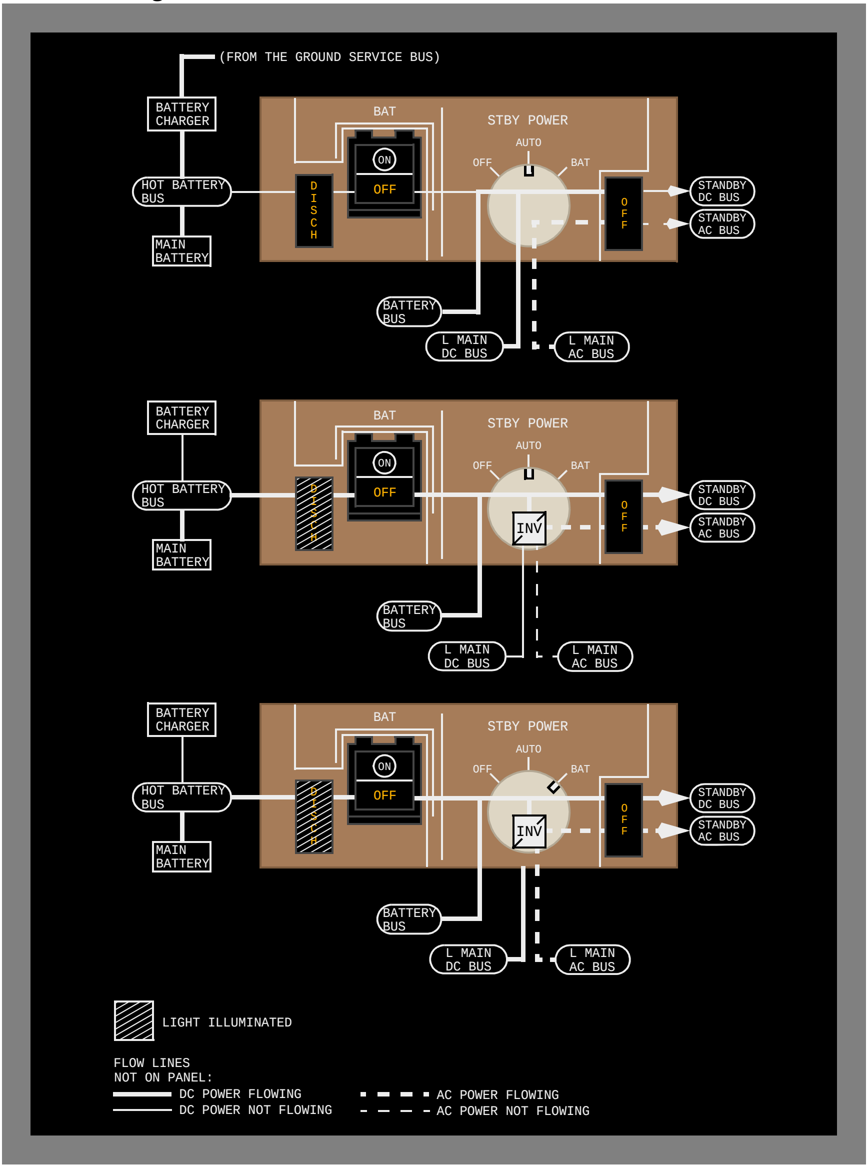
The standby bus OFF light illuminates and the EICAS advisory message STANDBY BUS OFF displays if the standby AC bus is not powered. In addition, these indications display if power is lost to the battery bus even though the standby AC bus may still be powered.

Battery/Standby System Schematic

N316LA



N422LA through N526LA



Hydraulic Driven Generator

The hydraulic driven generator (HDG) activates automatically when both the left and right main AC busses are unpowered. The Hydraulic Driven Generator (HDG) is powered by the Center Hydraulic System.

The HDG provides AC power to:

- the left AC transfer bus
- the right AC transfer bus
- the standby AC bus (through the left AC transfer bus)
- the captain's flight instrument transfer bus

The HDG provides DC power to:

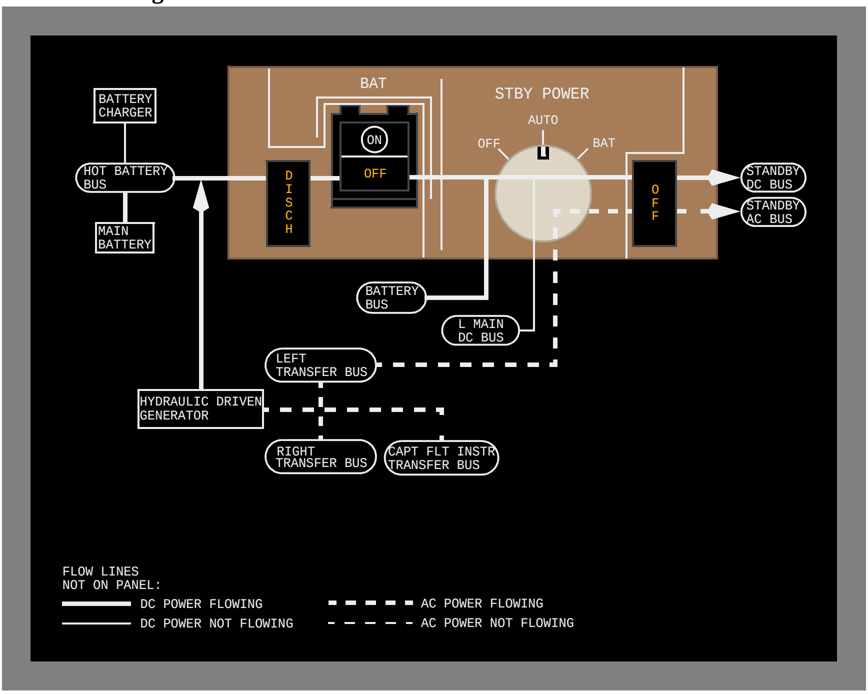
- the hot battery bus
- the battery bus
- the standby DC bus.

N422LA through N526LA
The amount of DC power produced by the HDG is less than the DC power produced by a fully charged battery. When the HDG first begin to operate, the battery DISCH light may illuminate, until the battery power decreases to the power level produced by the HDG.

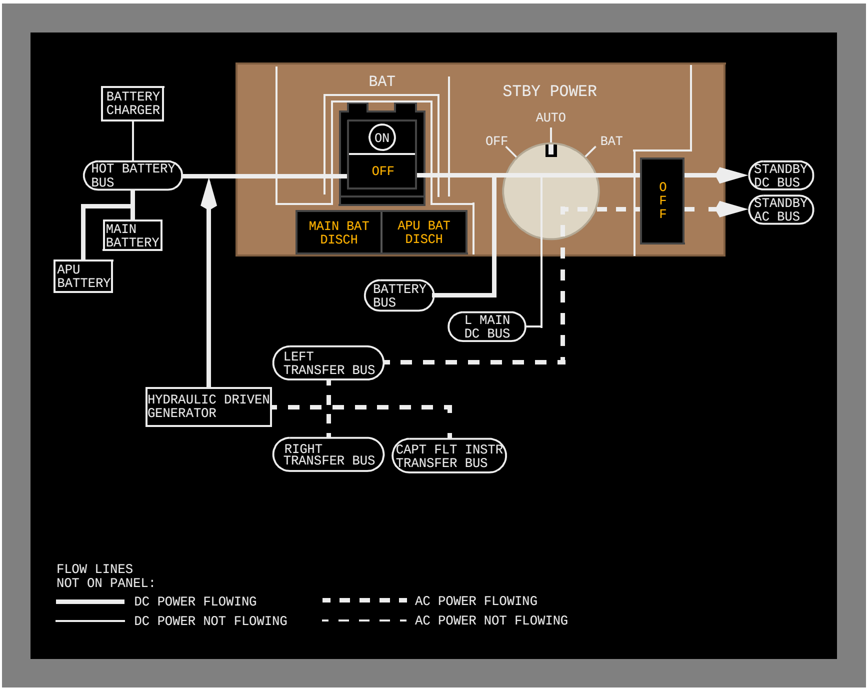
N316LA
The amount of DC power produced by the HDG is less than the DC power produced by fully charged main and APU batteries. When the HDG first begins to operate, the MAIN BAT DISCH and APU BAT DISCH lights may illuminate, until the battery power decreases to the power level produced by the HDG.

Battery/Standby System Schematic (Hydraulic Driven Generator Operating)

N422LA through N526LA



N316LA


BATTERY CHARGER
HOT BATTERY BUS
MAIN BATTERY
APU BATTERY
BAT
ON
OFF
MAIN BAT DISCH
APU BAT DISCH
STBY POWER
AUTO
OFF
BAT
OFF
STANDBY DC BUS
STANDBY AC BUS
BATTERY BUS
L MAIN DC BUS
LEFT TRANSFER BUS
HYDRAULIC DRIVEN GENERATOR
RIGHT TRANSFER BUS
CAPT FLT INSTR TRANSFER BUS
FLOW LINES NOT ON PANEL:
DC POWER FLOWING
DC POWER NOT FLOWING
AC POWER FLOWING
AC POWER NOT FLOWING

Electrical EICAS Messages

The following EICAS messages can be displayed.

Message	Level	Light	Aural	Condition
L AC BUS OFF R AC BUS OFF	Caution	BUS OFF	Beeper	AC Bus is unpowered.

N316LA

Message	Level	Light	Aural	Condition
APU BAT DISCH	Advisory	APU BAT DISCH		APU battery is discharging.

Message	Level	Light	Aural	Condition
APU GEN OFF	Advisory	OFF		APU generator control breaker is open due to a fault with the APU running.
BATTERY OFF	Advisory	OFF		Battery switch is OFF.
L BUS ISOLATED R BUS ISOLATED	Advisory	ISLN		Bus tie breaker is open due to an AC electrical system fault.
L GEN DRIVE R GEN DRIVE	Advisory	DRIVE		Generator drive oil pressure is low or generator drive oil temperature is high.
L GEN OFF R GEN OFF	Advisory	OFF		Generator control breaker is open.

N316LA

Message	Level	Light	Aural	Condition
MAIN BAT DISCH	Advisory	MAIN BAT DISCH		Main battery is discharging.

N422LA through N526LA

Message	Level	Light	Aural	Condition
MAIN BAT DISCH	Advisory	DISCH		Main battery is discharging.

Message	Level	Light	Aural	Condition
STANDBY BUS OFF	Advisory	OFF		Standby AC or DC bus is unpowered.
L UTIL BUS OFF R UTIL BUS OFF	Advisory	OFF		Galley and utility busses are unpowered.

Engines, APU — Chapter 7
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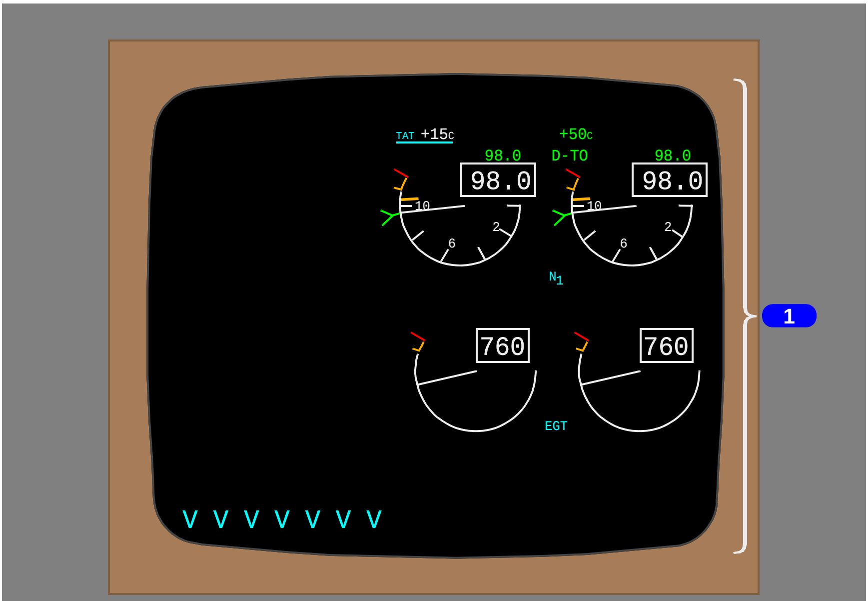
Intentionally
Blank

EICAS Displays
Primary Engine Indications



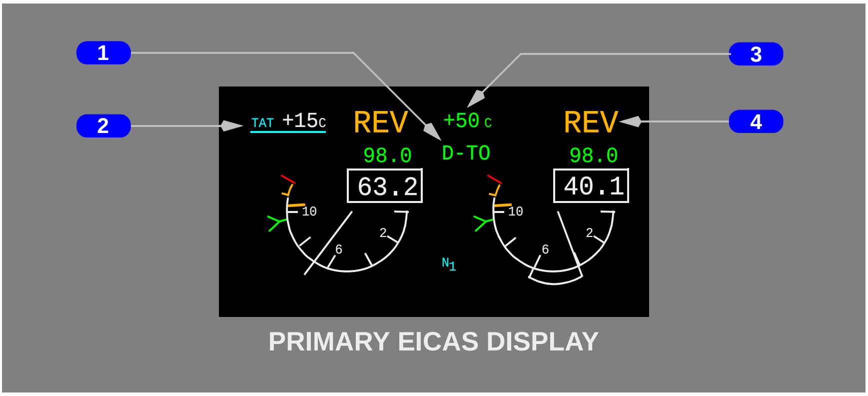
PRIMARY EICAS DISPLAY

1 Primary Engine Indications

Displayed full time on the EICAS display:

- N1
- EGT

Mode Indications



1 Thrust Reference Mode

Displayed (green) – selected FMS thrust reference mode:

Takeoff:

- TO – maximum rated takeoff thrust

N422LA through N526LA
- TO 1 – takeoff thrust one, climb one preselected

N422LA through N526LA
- TO 2 – takeoff thrust two, climb two preselected

N316LA
- TO 1 * – maximum rated takeoff thrust, climb one preselected

N316LA
- TO 2 * – maximum rated takeoff thrust, climb two preselected

Assumed Temperature Takeoff:

- D–TO – assumed temperature derated takeoff thrust

N422LA through N526LA
- D–TO 1 – assumed temperature derated takeoff thrust one, climb one preselected

N422LA through N526LA
- D–TO 2 – assumed temperature derated takeoff thrust two, climb two preselected

N316LA
- D–TO 1 * – assumed temperature derated takeoff thrust, climb one preselected

N316LA
- D–TO 2 * – assumed temperature derated takeoff thrust, climb two preselected

Climb:

- CLB – maximum rated climb thrust
- CLB 1 – climb thrust one
- CLB 2 – climb thrust two

Cruise:

- CRZ – maximum rated cruise thrust

N316LA
- CRZ 1 * – maximum rated cruise thrust, climb one preselected

N316LA
- CRZ 2 * – maximum rated cruise thrust, climb two preselected

Continuous:

- CON – maximum rated continuous thrust

N316LA
- CON 1 * – maximum rated continuous thrust, climb one preselected

N316LA
- CON 2 * – maximum rated continuous thrust, climb two preselected

Go-around and Manual:

- G/A – go–around thrust
- MAN – reference N1 manually selected

N316LA
Note: * WHITE NUMBER – indicates reduced climb thrust is preselected

2 Total Air Temperature (TAT)

Displayed (cyan) – "TAT" and underline

Displayed (white) - temperature (degrees C)

3 Assumed Temperature

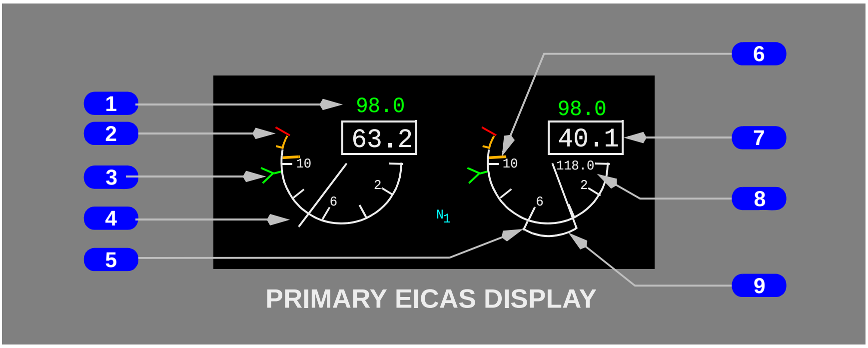
Displayed (green) – selected assumed temperature (degrees C) for reduced thrust takeoff

4 Thrust Reverser Indication

Displayed:

- REV (amber) – reverser in transit
- REV (green) – reverser fully deployed

N1 Indications



1 Reference N1 (Green)

Digital N1 display for Thrust Reference mode selected

2 N1 Red Line Limit

Displayed (red) – N1 RPM operating limit

3 N1 Bug

Displayed (green) – reference N1 for:

- thrust reference mode selected by the FMC
- thrust reference mode selected by the thrust mode select panel
- manual mode selected with thrust reference control

Displayed (magenta) – target FMC commanded N1 when VNAV is engaged

4 N1 Pointer

Displayed:

- (white) – points at value equal to that shown in the N1 counter
- (red) – operating limit reached or exceeded

5 Command Thrust Level

Displayed (white):

- end of command sector
- appears as extension of N1 pointer when engine stabilized
- N1 commanded by thrust lever position

6 Limit N1

Displayed (amber) – maximum limit N1

7 N1

N1 RPM (%), displayed:

- (white) – normal operating range
- (red) – operating limit reached or exceeded

8 Maximum Exceedance

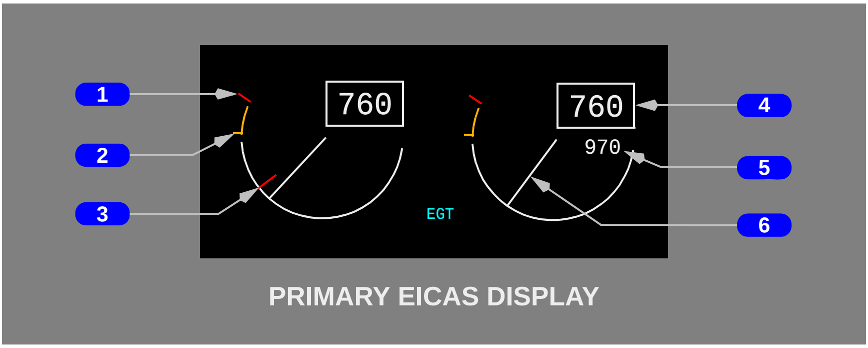
Displayed (white):

- red line limit is reached or exceeded
- highest value attained

9 Command N1 Sector

Displayed (white) – momentary difference between engine N1 and N1 commanded by thrust lever position

EGT Indications



1 EGT Red Line

Displayed (red) – maximum takeoff EGT limit

2 EGT Amber Band

Displayed (amber) – maximum continuous EGT limit

3 EGT Start Limit Line

Displayed (red) – during start until engine is stabilized at minimum idle RPM

4 EGT

EGT (degrees C), displayed:

- (white) – normal operating range
- (amber) – maximum continuous limit reached*
- (red) – maximum start or takeoff limit reached

Note: * Pointer and counter remain white during TO or GA for 5 minutes after amber band is entered. If engine failure occurs during 5 minute amber band inhibit time period then total amber band inhibit time period is extended to 10 minutes.

5 EGT Maximum Exceedance

Displayed (white):

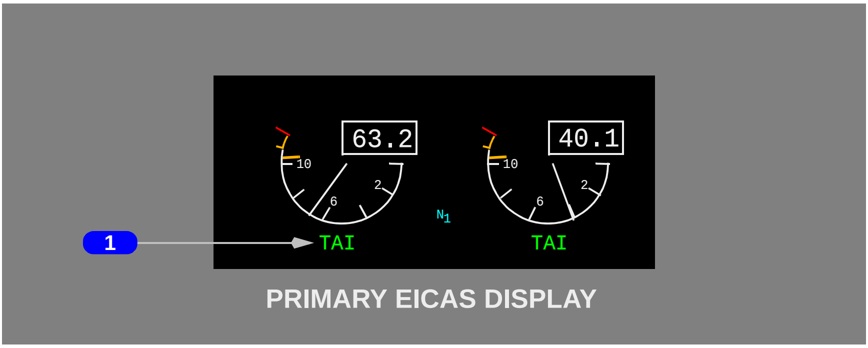
- red line limit or start EGT is reached or exceeded
- displays the highest value attained

6 EGT Pointer

Displayed:

- (white) – normal operating range
- (amber) – maximum continuous limit reached
- (red) – maximum start or takeoff limit reached

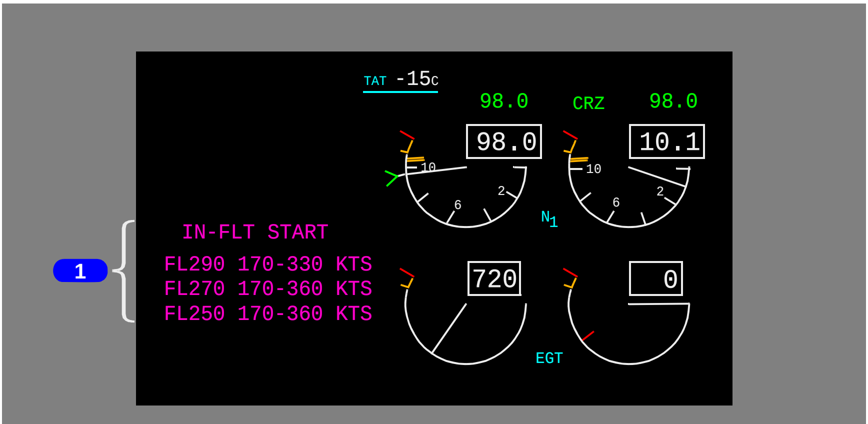
Anti–Ice Indications



1 Thermal Anti–Ice (TAI) Indication

Displayed (green) – engine anti–ice is on

In–Flight Start Envelope



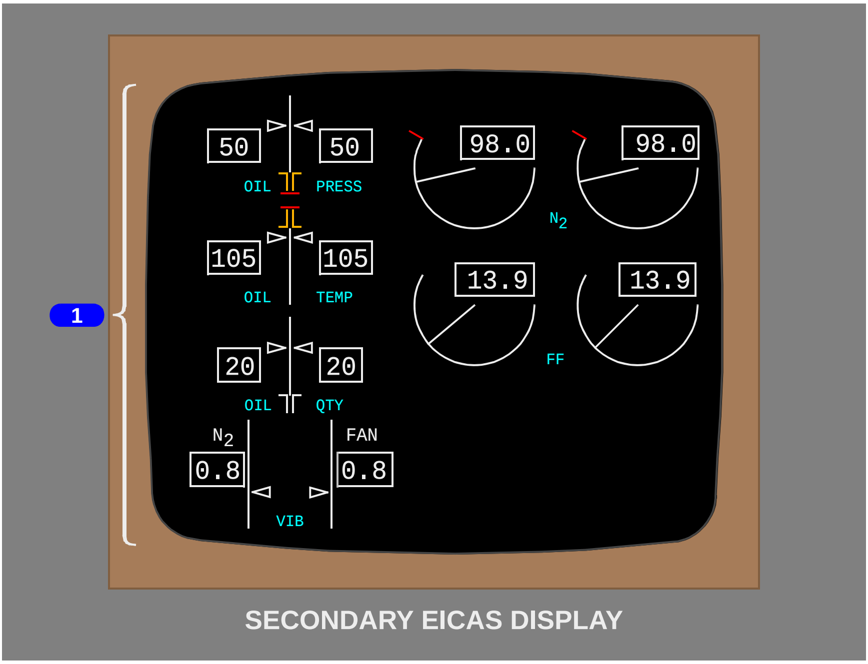
PRIMARY EICAS DISPLAY

1 In–Flight Start Envelope

Displayed (magenta) – airspeed range for an inflight start for the closest starting flight level and two descending flight levels at two thousand foot intervals when the respective engine fire switch is in and:

- a FUEL CONTROL switch is in CUT OFF, and
- engine N2 RPM is below idle, and
- primary and secondary EICAS displayed

Secondary Engine Indications

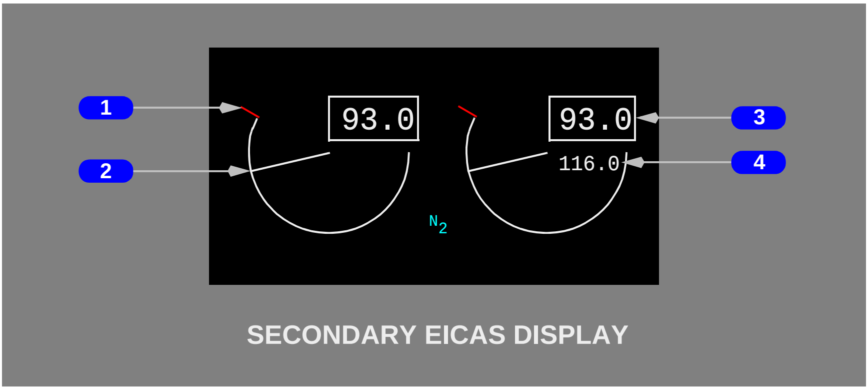


1 Secondary Engine Display

Displays:

- N2 RPM
- fuel flow (FF)
- oil pressure
- oil temperature
- oil quantity
- vibration

N2 Indications



1 N2 Red Line

N2 RPM operating limit, displayed (red)

2 N2 Pointer

N2 RPM, displayed:

- (white) – normal operating range
- (red) – operating limit reached or exceeded

3 N2

N2 RPM (%), displayed:

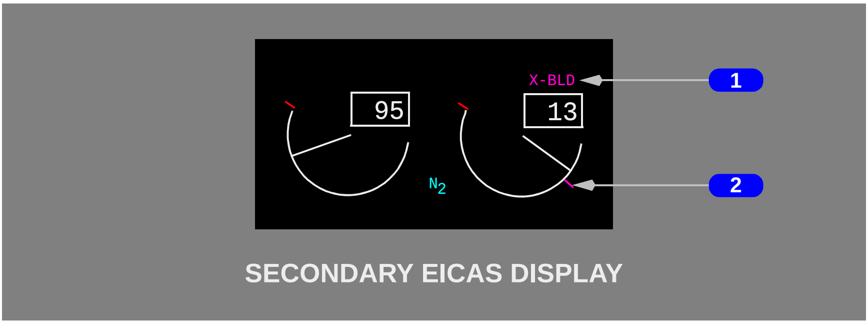
- (white) – normal operating range
- (red) – operating limit reached

4 Maximum Exceedance

Displayed (white):

- red line limit is exceeded
- highest value attained

Crossbleed Start Indications



1 Crossbleed Start (X-BLD) Indication

Indicates crossbleed air is recommended for an inflight start.

Displayed (magenta):

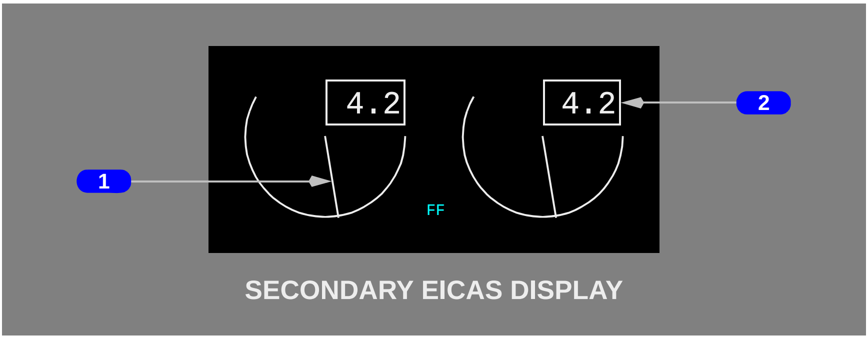
- the inflight start envelope is displayed, and
- airspeed is lower than that for a windmilling start

2 Fuel On Command Bug

Displayed (magenta):

- engine is shutdown on the ground or inflight when X–BLD is displayed
- minimum fuel on selection point during starter cranking

Fuel Flow Indications



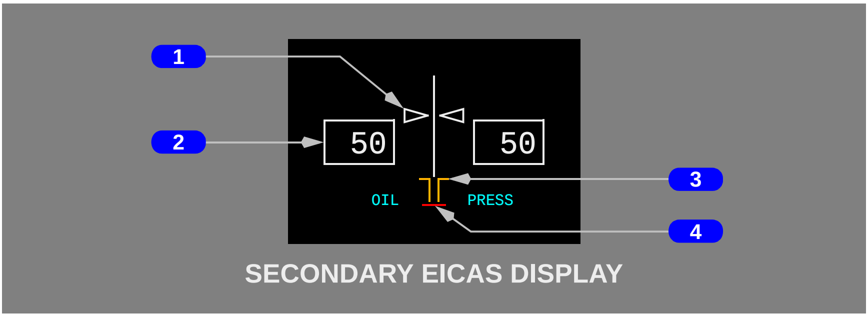
1 Fuel Flow Pointer

Displayed (white) – points at a value equal to that shown in the Fuel Flow

2 Fuel Flow (FF)

Displayed (white) – fuel flow to the engine (kilograms per hour x 1000)

Oil Pressure Indications



1 Oil Pressure Pointer

Engine oil pressure, displayed:

- (white) – normal operating range
- (amber) – caution range reached
- (red) – operating limit reached

2 Oil Pressure (OIL PRESS)

Engine oil pressure (psi), displayed:

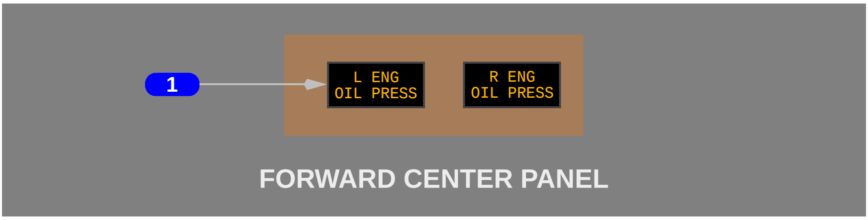
- (white) – normal operating range
- (amber) – caution range reached
- (red) – operating limit reached

3 Oil Pressure Amber Band

Displayed (amber) – caution range for low oil pressure

4 Oil Pressure Red Line

Displayed (red) – low (minimum) oil pressure operating limit

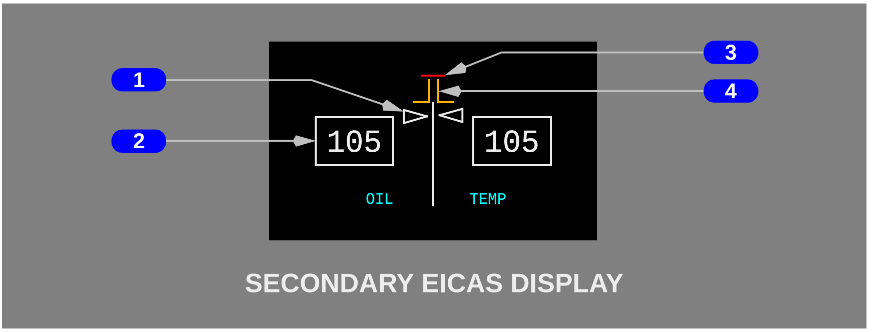


1 Engine Oil Pressure (L or R ENG OIL PRESS) Lights

Illuminated (amber):

- respective engine oil pressure is at or below minimum
- oil pressure switch malfunction

Oil Temperature Indications



1 Oil Temperature Pointer

Engine oil temperature, displayed:

- (white) – normal operating range
- (amber) – caution range reached
- (red) – operating limit reached

2 Oil Temperature

Engine oil temperature (degrees C), displayed:

- (white) – normal operating range
- (amber) – caution range reached
- (red) – operating limit reached

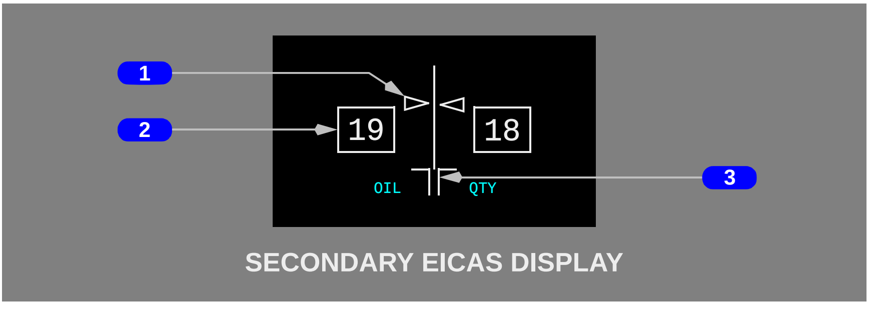
3 Upper Oil Temperature Red Line

Displayed (red) – maximum oil temperature operating limit

4 Oil Temperature Amber Band

Displayed (amber) – oil temperature caution range

Oil Quantity Indications



1 Oil Quantity Pointer

Displayed (white) – points at a value equal to that shown in the Oil Quantity

2 Oil Quantity

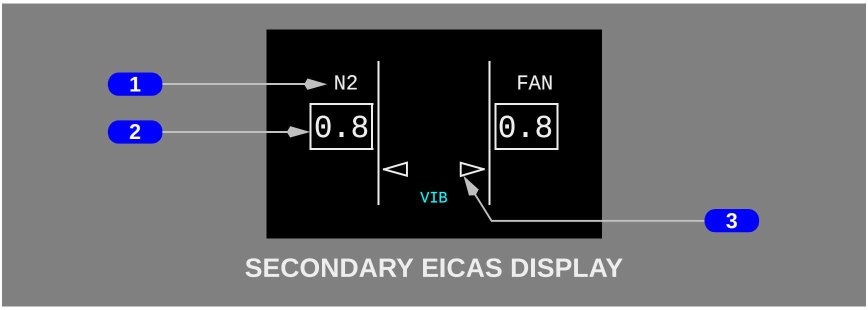
Usable oil quantity (liters), displayed:

- (white) – normal quantity

3 Low Oil Quantity Band

Displayed (white) – awareness range for low oil quantity

Engine Vibration Indications



1 Vibration Source

Identifies the vibration source being displayed.

Displayed (white) – vibration source with the highest vibration:

- FAN – low pressure compressor
- LPT – low pressure turbine
- N2 – high pressure compressor
- BB – broad band engine vibration

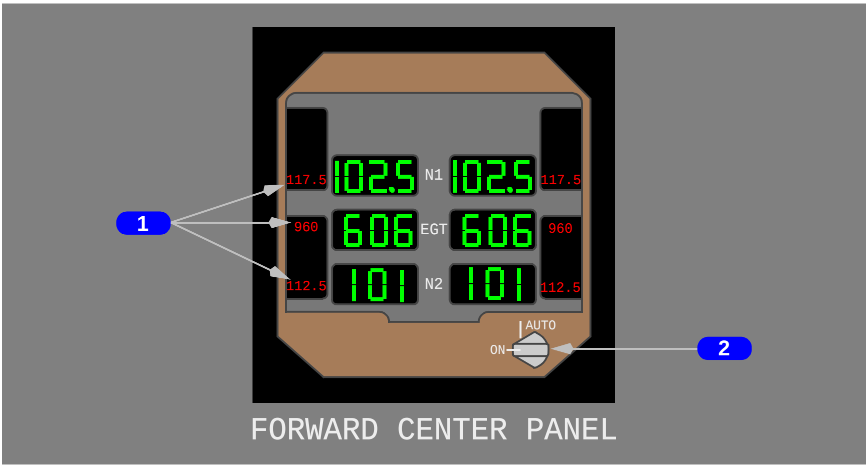
2 Engine Vibration

Displayed (white) – display of engine vibration in units

3 Engine Vibration Pointer

Displayed (white) – engine vibration

Standby Engine Indicator (SEI)



1 Maximum Engine Limits

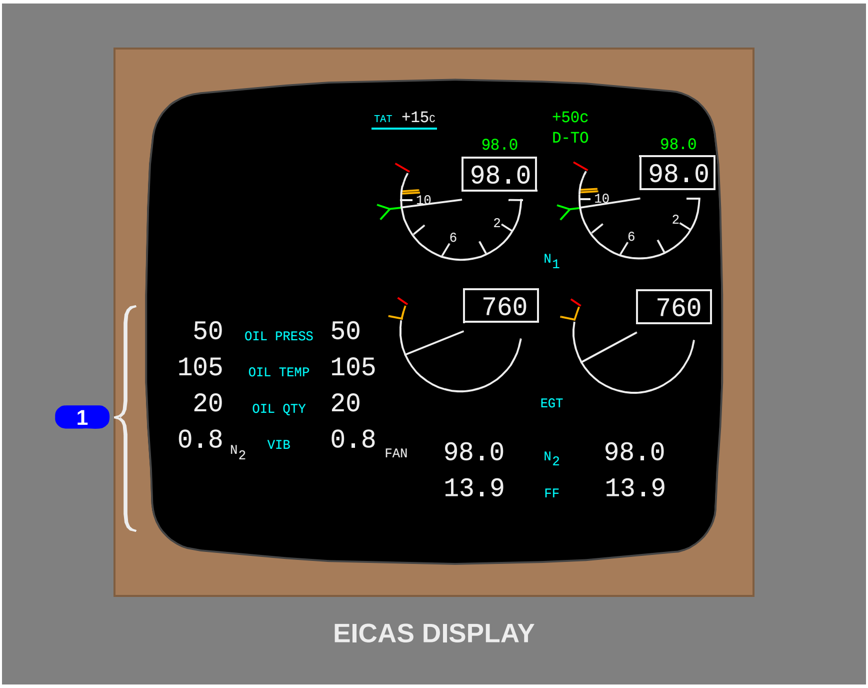
2 Standby Engine Indicator Selector

AUTO –

- display is blank with AC power on the airplane and EICAS operative
- standby engine indications in view when:
  - AC power is lost
  - either CRT failed and STATUS selected on the ground
  - EICAS failed

ON – standby engine indications in view

Compact Engine Indications



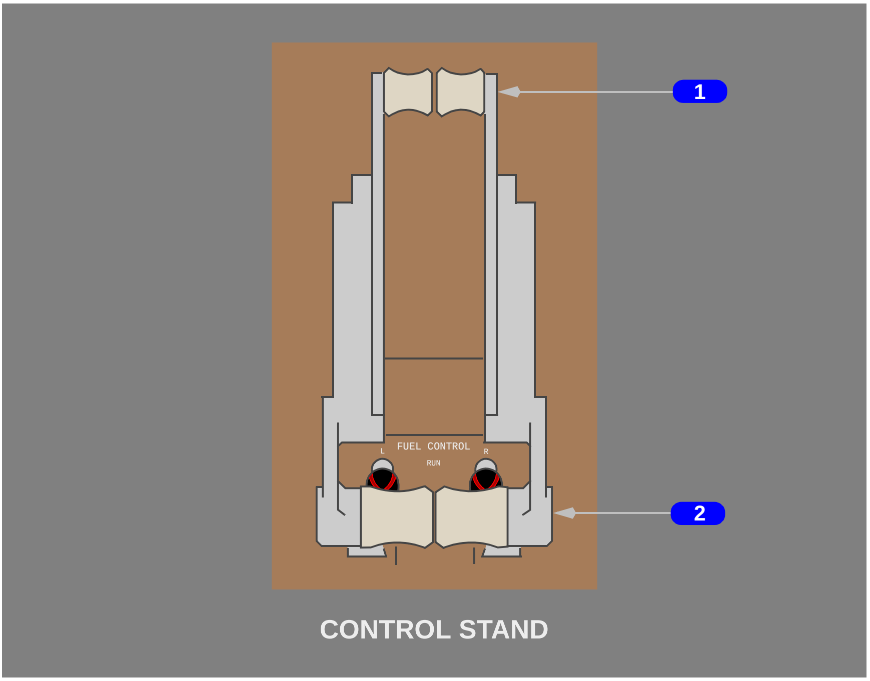
1 Compact Engine Indications

The following changes to EICAS and the normal secondary engine display occur:

- N2 changes from round dial display to digital display. The N2 digital display turns red if the limit is exceeded.
- FF, OIL PRESS and OIL TEMP are displayed as digital readouts only. The OIL PRESS and OIL TEMP digital displays turn amber or red if limits are exceeded.
- OIL QTY and VIB are displayed as digital readouts only. Low oil quantity and high vibrations are displayed the same as in the normal format.

Engine Controls

Thrust Levers



1 Reverse Thrust Levers

Controls engine reverse thrust

Reverse thrust can only be selected when the forward thrust levers are closed

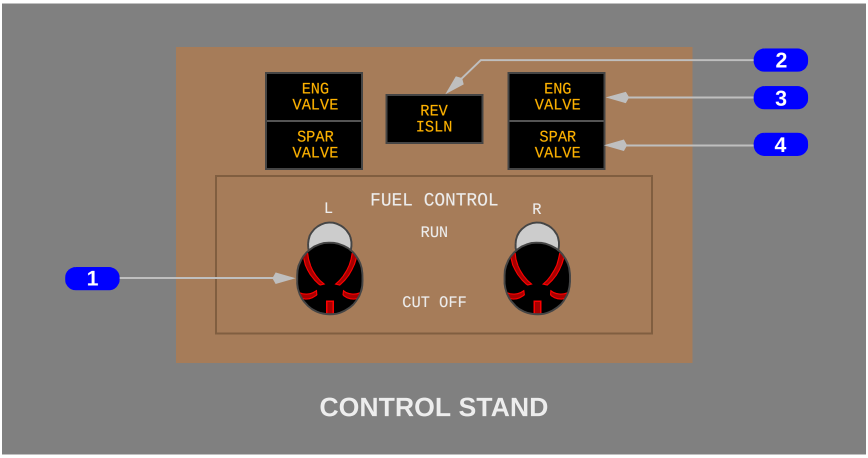
Actuates automatic speedbrakes (refer to Chapter 9, Flight Controls)

2 Forward Thrust Levers

Controls engine forward thrust

The thrust levers can only be advanced if the reverse thrust levers are down

Fuel Control Switches



1 FUEL CONTROL Switches

RUN –

- normal position for flight
- opens engine and spar fuel valves
- activates selected ignitor(s)

CUT OFF –

- closes engine and spar fuel valves
- terminates ignition

2 Reverser Isolation Valve (REV ISLN) Light

Illuminated (amber) – a fault has been detected in the thrust reverser system

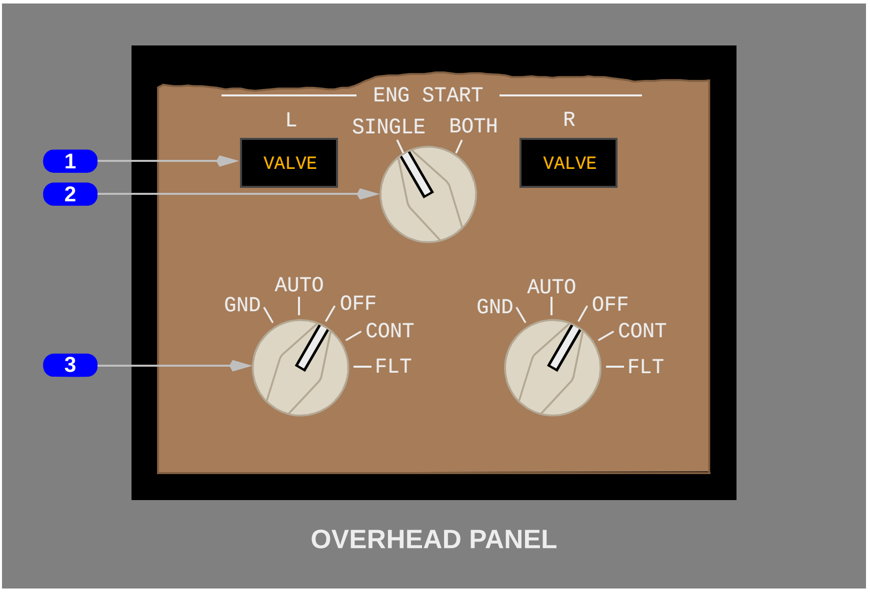
3 Engine Valve (ENG VALVE) Lights

Illuminated (amber) – engine fuel valve is not in commanded position

4 SPAR VALVE Lights

Illuminated (amber) – fuel spar valve is not in commanded position

Engine Control Panel



1 Engine Start Valve (VALVE) Lights

Illuminated (amber):

- valve is not in commanded position
- N2 RPM exceeds 50% and starter valve open

2 Ignition Selector

BOTH – both igniters in each engine operate when directed by Engine Start Selector

SINGLE – one igniter in each engine operates when directed by Engine Start Selector. The ignitor automatically alternates with each engine start.

Note: Auto relight is enabled regardless of engine start and ignition selector positions. Both ignitors operate when N2 drops below idle speed.

3 Engine Start Selectors

GND (push-in and rotate) –

- opens start valve to supply starter air
- arms selected igniter(s)
- selector magnetically held in GND position until 50% N2 RPM

AUTO –

- selector releases to AUTO at 50% N2 RPM
- closes start valve and terminates ignition
- selected igniter(s) operate continuously with L.E. slats extended or engine anti-ice on

OFF – no ignition

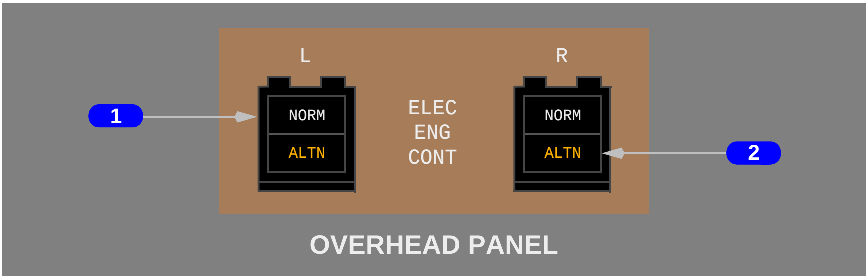
CONT –

- selected igniter(s) operate continuously
- no time limit
- engine operates at a minimum of approach idle

FLT –

- both igniters operate continuously regardless of ignition selector position
- no time limit

Electronic Engine Control (EEC)



1 EEC (ELEC ENG CONT) Switches

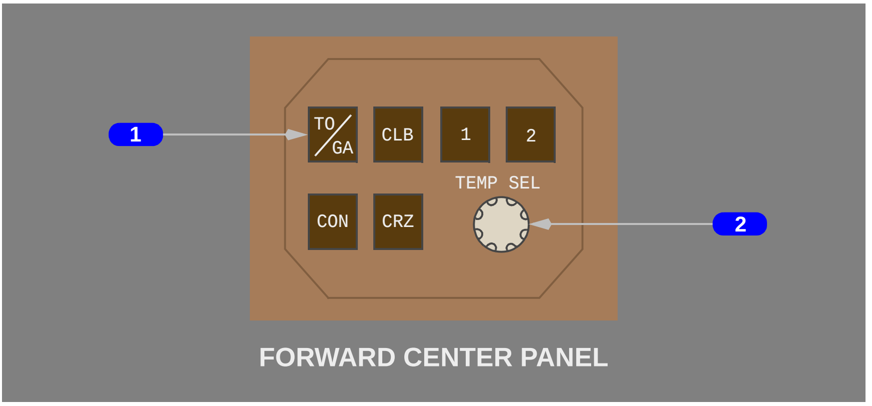
NORM – normal EEC mode is selected

ALTN (NORM not visible) – alternate EEC mode is selected

2 EEC Alternate Mode (ALTN) Lights

Illuminated (amber) – EEC is operating in alternate mode

Thrust Mode Select Panel (TMSP)



1 Thrust Reference Mode Select Switches

Push –

- manually selects desired thrust reference mode
- selected thrust reference mode and reference N1 are displayed

TO/GA –

- selects TO mode on the ground or GA mode inflight
- cancels preselected climb one or two
- cancels selected assumed temperature
- selecting 1 or 2 with TO or D-TO reference mode displayed:

  N422LA through N526LA
  - selects TO 1 or TO 2
  - preselects CLB 1 or CLB 2 on the ground if autothrottles not engaged
  - subsequent push cancels any preselected 1 or 2
  - cancels selected assumed temperature

CLB –

- selects CLB
- selects CLB 1 or CLB 2 if 1 or 2 is preselected

- selecting 1 or 2 with CLB Reference mode displayed:
  - selects CLB 1 or CLB 2
- with CLB 1 or CLB 2 reference mode displayed:
  - subsequent push of active mode switch cancels 1 or 2
- with CLB 2 reference mode displayed:
  - switch 1 selects CLB 1

CON –
- selects CON mode
- selecting 1 or 2 with CON reference mode displayed:
  - preselects CLB 1 or CLB 2

CRZ –
- selects CRZ mode
- selecting 1 or 2 with CRZ reference mode displayed:
  - preselects CLB 1 or CLB 2

2 Assumed Temperature Selector (TEMP SEL)

N422LA through N526LA
Functions only with TO, TO 1 or TO 2 mode displayed

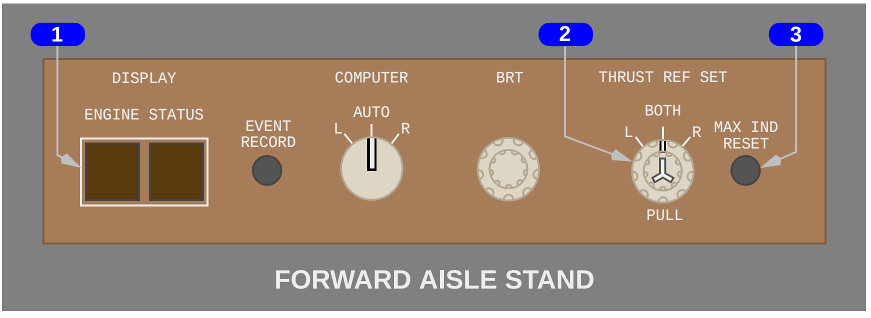
N316LA
Functions only with TO, TO 1* or TO 2* mode displayed

Sets assumed temperature

Rotate clockwise –
- assumed temperature appears on EICAS
- one click equals 1 degree centigrade

N316LA
Note: * WHITE NUMBER - indicates reduced climb thrust is preselected.

EICAS Control Panel



1 ENGINE Display Switch

Push – displays the secondary engine parameters on the lower EICAS CRT

N316LA
(SB Adds N422LA through N526LA when fuel flow displayed full time on EICAS installed.)
If secondary engine parameters are already displayed and no limits have been exceeded, the display reverts to fuel flow only

(SB Deletes N422LA through N526LA when fuel flow displayed full time on EICAS installed.)
If secondary engine parameters are already displayed and no limits have been exceeded, the display blanks

2 Manual Thrust Reference Set (THRUST REF SET) Controls

Outer Knob:

- BOTH – both N1 bugs may be set to the same value
- L or R – only the selected N1 bug may be set to the desired value. Bugs may be set at different values

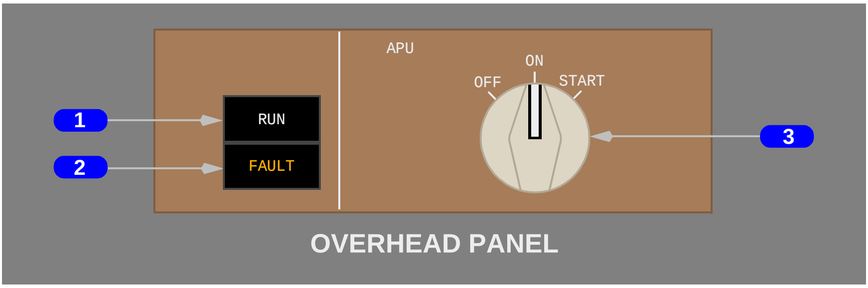
Inner Knob:

- Push – reference N1 is set automatically
- Pull – reference N1 is set manually. MAN appears in N1 thrust reference mode display and N1 bug moves to 104%
- Rotate – in manual mode, sets N1 bug and reference N1 to desired value

3 Maximum Indication Reset (MAX IND RESET) Switch

Push – resets and blanks all maximum exceedance values N1, EGT and N2

Auxiliary Power Unit (APU)
APU Controls



1 APU RUN Light

Illuminated (white) - APU is at operating speed

2 APU FAULT Light

Illuminated (amber):

- the APU has automatically shut down
- the APU fuel valve disagrees with the commanded position

3 APU Selector

OFF –

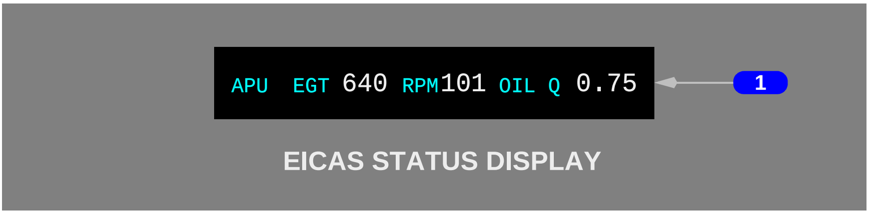
- closes the APU bleed air valve, if open
- initiates APU cooling cycle
- closes the APU fuel valve and inlet door shutting down APU when cooling cycle is complete
- resets auto shutdown fault logic

ON (APU operating position) –

- opens the APU fuel valve and inlet door
- activates AC or DC fuel pump
- powers the APU controller
- permits the APU bleed valve to open if the APU Bleed Switch is on when APU reaches operating speed

START (momentary position, spring–loaded to ON) – initiates automatic start sequence

APU Indications



1 APU Status Display

EGT – APU exhaust gas temperature displayed in degrees centigrade

RPM – APU rotation speed in percent

OIL Q – APU oil quantity displayed as FULL, 0.75, 0.50, 0.25 or ADD

Introduction

(SB Adds N316LA through N526LA when General Electric CF6-80C2B6F engines installed.)
The airplane is powered by two General Electric CF6-80C2B6F engines. The engines are rated at 60,200 pounds of takeoff thrust each.

N422LA through N526LA
(SB Deletes N316LA when General Electric CF6-80C2B7F engines removed.)
The airplane is powered by two General Electric CF6-80C2B7F engines. The engines are rated at 62,100 pounds of takeoff thrust each.

The engines are two–rotor axial flow turbofans of high compression and bypass ratio. The N1 rotor consists of the fan, a low pressure compressor and turbine section on a common shaft. The N2 rotor consists of a high pressure compressor and turbine section on a common shaft. The N1 and N2 rotors are mechanically independent. The N2 rotor drives the engine accessory gearbox.

Each engine has individual flight deck controls. Thrust is set by positioning the thrust levers. The thrust levers are positioned automatically by the autothrottle system or manually by the flight crew. See Chapter 11, Flight Management, Navigation, Section 40, for a description of FMC thrust management functions.

Each engine is controlled by an electronic engine controller (EEC). The EECs monitor autothrottle and flight crew inputs through the thrust levers to automatically control the engines.

Engine indications are displayed on the engine indication and crew alerting system (EICAS) display.

Engine Indications

Primary and secondary engine indications are provided. Engine indications are displayed on the EICAS display. In addition, annunciator lights and a liquid crystal standby engine indicator are provided to monitor engine operation.

Primary Engine Indications

N1 and EGT are the primary engine indications. The primary engine indications are always displayed on the upper EICAS display.

Secondary Engine Indications

N2, fuel flow, oil pressure, oil temperature, oil quantity, and engine vibration are secondary engine indications. Secondary engine indications are displayed on the lower EICAS display. The secondary engine indications can be displayed by pushing the Engine Display Switch (the ENGINE switch on the EICAS Control Panel).

The secondary engine indications are automatically displayed when:

- the displays initially receive electrical power, or
- a secondary engine parameter is exceeded.

Normal Display Format

Primary engine indications and the N2 and Fuel Flow indications are digital readouts and round dial/moving pointer indications. The digital readouts display numerical values while the moving pointers indicate relative value.

Oil pressure, oil temperature, oil quantity and vibration indications are both digital readouts and vertical indication/moving pointers. All digital readouts are enclosed by boxes. The dial and vertical indications display the normal operating range, caution range, and operating limits (as applicable).

Normal operating range is displayed on a dial or vertical indication in white.

The oil pressure and oil temperature vertical indications have caution ranges displayed by amber bands. If oil pressure or oil temperature reaches the caution range, the digital readout, digital readout box, and pointer all change color to amber.

N1, EGT, N2, oil pressure, and oil temperature indications have operating limits indicated by red lines. If one of these indications reaches the red line, the digital readout, box, and pointer change color to red for that indication.

The EGT indication has a maximum continuous limit represented by an amber band. If EGT reaches the maximum continuous limit, the digital indication, box, pointer, and dial all change color to amber.

The EGT indication is inhibited from changing to amber during takeoff or go–around for five minutes. The inhibit is extended to ten minutes for single–engine operation. The red line limits for these parameters are not inhibited.

The EGT indication has a maximum takeoff limit displayed by a red line. If EGT reaches the maximum takeoff limit, the digital indication, box, pointer and dial, all change color to red.

The maximum N1 limit is indicated by an amber line on the N1 dial. The N1 indication does not change color when maximum N1 is reached. The reference/target N1 indication displays the FMS reference or target N1.

Compact Display Format

In compact format, primary and secondary engine indications are combined on the same display. The N1 and EGT displays are the same as the normal displays. All other indications change to digital readouts only. If an amber or red line parameter for a digital indication is exceeded, the digital indication changes color to amber or red (as does the box that appears around an EGT indication).

Primary and secondary engine indications are displayed on EICAS in compact format whenever a CRT fails.

Engine Secondary Data Cue

A series of blue ‘v’s are visible on the lower left corner of the upper EICAS CRT any time engine data is displayed on the lower EICAS CRT. If for some reason the engine data is not visible, the Status Display Switch may be used to allow the engine data to come up partially compacted on the upper EICAS CRT display.

N1 RPM

N1 RPM is the primary thrust parameter. Annunciations associated with N1 are:

- Maximum N1
- Thrust Reference Mode
- Reference/Target N1 Indication
- Reference N1
- Assumed Temperature
- Thrust Reverser Indication
- Command Thrust Level
- Command Sector

The maximum N1 is the maximum certified thrust limit for all phases of flight and varies with existing ambient conditions. The maximum N1 is indicated by dual amber radials on the periphery of the N1 indicator. This value is acquired from the EEC or the TMC. With the EEC operating normally, the thrust levers can be moved to the forward stop and the engines will not exceed the displayed maximum N1.

N422LA through N526LA
(SB Deletes N316LA when General Electric CF6-80C2B7F engines removed.)
During a maximum thrust takeoff, full takeoff thrust will not be available until approximately 65 KIAS. The TO thrust limit will be displayed throughout the takeoff, but the command thrust level will be approximately 1% to 2% below this limit at airspeeds below 65 KIAS.

The command thrust level is a display of thrust lever position and appears as an extension of the N1 pointer when the engine is stabilized. A change in thrust lever position moves the command thrust level and displays the commanded thrust on the N1 indicator. This allows for precise thrust control.

The command sector is a display of the momentary difference between the command thrust level and actual N1 and appears as a white band on the N1 indicator. As the engine accelerates or decelerates to the command thrust level the command sector is erased. This allows for monitoring of engine acceleration and deceleration.

Thrust reverser indication (REV) is displayed above the N1 indicator when the reverser is activated. The annunciation is amber when the reverser is unlocked or in transit. When the reverser is fully deployed, the annunciation changes color to green and the forward thrust reference displays are inhibited.

Thrust Management Computer (TMC)

The thrust management computer calculates a reference N1 based on existing pressure altitude and ambient temperature data from the air data system for the following modes:

- TO – takeoff

N422LA through N526LA
- TO 1 – takeoff one

N422LA through N526LA
- TO 2 – takeoff two
- D-TO – assumed temperature takeoff
- CLB – climb
- CLB 1 – climb one
- CLB 2 – climb two
- CRZ – cruise
- CON – continuous
- GA – go–around

These modes can be selected with the thrust mode select panel (TMSP). The inner thrust reference set control on the EICAS control panel must be pushed in for the thrust reference modes to be displayed on EICAS. The selected thrust reference mode is displayed above the N1 indicators. The digital reference N1 is displayed adjacent to the mode display. When the N1 bug is green, it is positioned on the N1 scale at the same value as the digital reference N1.

The thrust mode select switches provide the capability of selecting different thrust modes for each phase of flight. The TO/GA switch is used to select takeoff thrust on the ground and go-around thrust inflight.

N422LA through N526LA
The 1 and 2 switches are used to select a reduced takeoff thrust rating or reduced climb thrust. When reduced takeoff thrust rating one or two is selected, this automatically preselects the associated reduced climb one or two. The CLB switch is used to select climb thrust inflight. If reduced climb thrust one or two was preselected, pushing the climb switch inflight selects CLB 1 or CLB 2.

The assumed temperature for a reduced thrust takeoff can be set by:

- using the assumed temperature selector on the TMSP
- entering the assumed temperature into the CDU TAKEOFF REF page

  N422LA through N526LA
- datalink

N316LA
The 1 and 2 switches are used to select reduced climb thrust. Reduced climb thrust one or two can be preselected in conjunction with takeoff or assumed temperature takeoff thrust prior to takeoff. The CLB switch is used to select climb thrust inflight. If reduced climb thrust one or two was preselected, pushing the climb switch inflight selects CLB 1 or CLB 2.

The CON switch is used to select maximum continuous thrust inflight. The CRZ switch is used to select cruise thrust inflight. The assumed temperature selector or the CDU is used to set assumed temperatures when reduced takeoff thrust is desired.

To manually set Reference N1 values the thrust reference set control is pulled out, MAN appears as the thrust mode annunciation and the N1 bug slews to 104%. Manual reference N1 values can then be set by rotating the inner control. The outer control of the thrust reference set control is used to select the desired N1 indicator(s) for manual N1 display. The autothrottles do not respond to manually set reference N1 values. When the inner control is pulled out, the autothrottles remain in the active TMC mode. The TMSP remains operable and the autothrottles respond to TMSP mode changes, but selected thrust reference mode displays are inhibited.

When the AFDS VNAV mode is engaged, the N1 bug may be magenta. When the N1 bug is magenta, it is positioned at a nominal target N1 by the FMC, which may not correlate with the digital reference N1. In VNAV, the FMC controls Thrust mode selection automatically to meet thrust requirements for the active vertical mode of operation. The FMC does not have the capability to select reduced climb thrust values, these values must be selected manually with the 1 or 2 TMSP switches.

The thrust reference mode, reference N1 and N1 bug are not displayed when the reversers are fully deployed.

Reduced Takeoff Thrust

N422LA through N526LA

Two levels of reduced takeoff thrust are available with the 1 and 2 mode switches on the Thrust Mode Select Panel. These are lower thrust ratings than takeoff thrust. Takeoff 1 is approximately 90% of takeoff thrust and takeoff 2 is approximately 80% of takeoff thrust. Assumed temperature reduced thrust can be used in conjunction with these lower thrust ratings.

Assumed Temperature Takeoff

The thrust management computer calculates the reference N1 for assumed temperature reduced thrust takeoff. The assumed temperature can be entered manually on the CDU TAKEOFF REF page or selected with the assumed temperature selector on the TMSP. The assumed temperature is displayed above the thrust reference mode.

When the assumed temperature selector on the TMSP is initially rotated clockwise, a reference temperature is displayed on EICAS. This temperature also appears on the CDU TAKEOFF REF page as THRUST.

N422LA through N526LA
The assumed temperature can be supplied to the FMC and CDU via datalink.

Further clockwise rotation of the selector increases the assumed temperature by 1 degree centigrade per click. The reduced thrust annunciation of D–TO appears when the assumed temperature selected is above ambient. If the ambient temperature is greater than the initially displayed reference temperature, D–TO and reduced thrust occur when the assumed temperature selected exceeds ambient.

Counterclockwise rotation of the selector reduces the assumed temperature by one degree centigrade per click.

Assumed temperature takeoff thrust is limited to a 25% reduction of takeoff thrust or selected climb thrust, whichever is the greater thrust value. When the limit is reached, further adjustment to the assumed temperature by rotating the assumed temperature selector on the TMSP or changing the value entered in the CDU TAKEOFF REF page does not change the displayed assumed temperature or reference thrust value.

Reduced Climb Thrust

N422LA through N526LA
Climb one or two is automatically preselected when takeoff one or takeoff two is selected.

Two levels of reduced climb thrust are available with the 1 and 2 mode switches on the thrust mode select panel. Climb 1 is approximately 90% of climb thrust and climb 2 is approximately 80% of climb thrust. Climb one or two can be preselected in conjunction with the TO, D–TO, CON and CRZ thrust reference modes.

N316LA
Above 10,000 feet, reduced climb thrust gradually changes to reach full climb thrust by 12,000 feet. The 1 or 2 annunciation disappears from the display by 12,500 feet.

N422LA through N526LA
Above 10,000 feet, reduced climb thrust gradually changes to reach full climb thrust by 30,000 feet. The 1 annunciation disappears from the display by 30,500 feet. The 2 annunciation will remain above 30,000 feet unless manually deselected by pressing the 2 switch on the TMSP. If not manually deselected, at cruise altitude the 2 will remain annunciated (white) until flaps are extended and the thrust reference mode changes to GA.

Electronic Engine Control (EEC)

Each EEC has full authority over engine operation. The EEC uses thrust lever inputs to automatically control forward thrust and reverse thrust. The EEC has two control modes: normal and alternate. In normal and alternate modes, the EEC uses N1 RPM as the parameter for setting thrust.

EEC Normal Control Mode

In the normal mode, the EEC sets thrust by controlling N1 based on thrust lever position. N1 is commanded by positioning the thrust levers either automatically with the autothrottles, or manually by the flight crew.

Maximum N1 represents the maximum rated thrust available from the engine. The EEC continuously computes maximum N1.

Maximum rated thrust is available in any phase of flight by moving the thrust levers to the full forward positions.

The EICAS advisory message L or R ENG CONTROL and ENGINE CONTROLS displays when faults are detected in the engine control systems.

EEC Alternate Mode

If the required signals are not available to operate in the normal mode, the EEC automatically uses the alternate mode. In the alternate mode, the EEC schedules N1 as a function of thrust lever position. The alternate mode provides soft and hard levels of control:

- Soft – When the EEC automatically switches an engine to the alternate mode and the EEC mode switch remains in NORM, the EEC is in the soft alternate mode (the switch position is NORM, the EEC mode is alternate). At a fixed thrust lever position, thrust does not change.
- Hard – When ALTN is manually selected on an EEC mode switch, that engine is switched to the hard alternate mode (the switch position is ALTN, the EEC mode is alternate). Reference and target N1, and maximum and commanded N1 values are displayed on the N1 indication during the hard alternate mode. Thrust may change to set the commanded N1 when ALTN is manually selected.

For the normal, soft alternate, and hard alternate modes, actual, command, reference/target, maximum, and red line N1 information is displayed.

Automatic reversion or manual selection to the alternate mode is indicated by the EICAS advisory message L or R ENG EEC MODE and illumination of the ALTN light on the associated EEC mode switch. Selecting the alternate mode on both engines eliminates thrust lever stagger at equal thrust settings, or asymmetric thrust when the thrust levers are operated together.

The autothrottles remain engaged whenever the EEC automatically switches to the alternate mode. The alternate mode N1 reference/target values are computed by the TMC.

Note: Autothrottles remains engaged in the soft or hard alternate mode.

The alternate mode schedule (N1 schedule) provides equal or greater thrust than the normal mode for the same thrust lever position.

Thrust protection is not provided in the alternate mode and maximum rated thrust is reached at a thrust lever position less than full forward. As a result, thrust overboost can occur at full forward thrust lever positions. The EICAS caution message L or R ENG LIM PROT is displayed if the thrust lever position commands an N1 greater than the maximum rated thrust (maximum N1). N1 and N2 red line protection is still available in the alternate control mode.

Overspeed Protection

The EEC also provides N1 and N2 red line overspeed protection. If N1 or N2 approaches overspeed, the EEC commands reduced fuel flow.

The EICAS advisory message L or R ENG RPM LIM is displayed when N1 or N2 is at the red line limit.

The EEC does not provide EGT overtemperature protection.

If engine limit protection is not available, advancing the thrust levers full forward should be considered only during emergency situations when all other available actions have been taken and terrain contact is imminent.

Idle Selection

There are two engine idle speeds: minimum idle and approach idle. Minimum idle is a lower thrust than approach idle and selected for ground operation and all phases of flight except approach and landing. Approach idle is selected whenever this higher idle setting is required for proper system operation. The EEC selects these idle speeds automatically.

Rotating the engine start selectors to continuous manually selects approach idle.

The EICAS advisory message L or R ENG LOW IDLE displays to indicate an engine failed to go to approach idle.

The EICAS advisory message IDLE DISAGREE displays to indicate the engines are at different idle settings. Either one engine has failed to go to approach idle when required or one engine has failed to return to minimum idle. Inflight, to ensure that approach idle is available if required, the thrust lever on the engine with the lower RPM should be advanced to match the engine with the higher RPM.

Engine Start and Ignition System

Air from the pneumatic duct is used to power the air driven starter, which is connected to the N2 rotor. The starter air source may be from a ground cart, APU or the other running engine.

The engine start selectors control the start valves. Ignition and fuel flow are controlled through the fuel control switches.

A maximum start limit line (red) is displayed on the EGT indication when the fuel control switch is moved to CUT OFF. It remains displayed after the fuel control switch is moved to RUN until the engine is stabilized at idle. The EGT indication changes color to red if the EGT start limit is reached during starting.

Engine Start

Pushing in and rotating the engine start selector to the GND position, opens the start valve, engages the air driven starter to the N2 rotor and closes the engine bleed air valve if it is open. The VALVE light illuminates and the EICAS advisory message L or R ENG STARTER displays to indicate the start valve failed to open. As N2 rotation accelerates to maximum motoring RPM or 20% N2, the fuel control switch is positioned to RUN. Maximum motoring speed is reached when acceleration is less than approximately 1% in 5 seconds. Minimum N2 for selecting RUN is indicated by a magenta fuel on command bug. The fuel control switch opens the spar and engine fuel valves allowing the fuel to flow to the fuel control unit and activates the selected ignition.

The ignition selector may be used to select SINGLE or BOTH ignitor(s). With the ignition selector in SINGLE, each EEC channel alternates between the two ignitors on each engine.

Normally, only one ignitor is used for ground start while both ignitors are used for inflight starts. At approximately 50% N2, the engine start selector automatically moves to the AUTO position. The starter automatically cuts out and the start valve closes stopping the flow of air to the starter. This allows the engine bleed valve to return to a position that agrees with the engine bleed air switch. If the start valve fails to close automatically, the corresponding valve light will illuminate and the EICAS caution message L or R STARTER CUTOUT will display. The engine start selector must be manually moved to the AUTO or OFF position to terminate starter operation.

Starter Operation

Continuous operation of the starter must be limited in accordance with the following starter duty cycles:

Normal Duty Cycle

Five minutes on, followed by one–half minute off per minute on.

Re–engagement Speed

- 0% N2 – recommended
- 0–20% N2 – normal

Re–engagement is not recommended above 20% N2 except in case of fire. Re–engagement above 30% N2 may result in starter or gearbox damages.

In–Flight Start

Inflight start envelope information is displayed on the EICAS primary display when an engine is not running in flight, the respective engine fire switch is not pulled and both EICAS primary and secondary displays are selected. The inflight start envelope indicates the airspeed range necessary to ensure an inflight start at the current flight level. If the current flight level is above the maximum start altitude, the maximum start altitude and respective airspeed range are displayed.

A crossbleed start indication (X–BLD) appears above the N2 indication and a fuel on command bug is displayed if airspeed is below that recommended for a windmilling start.

Auto Relight

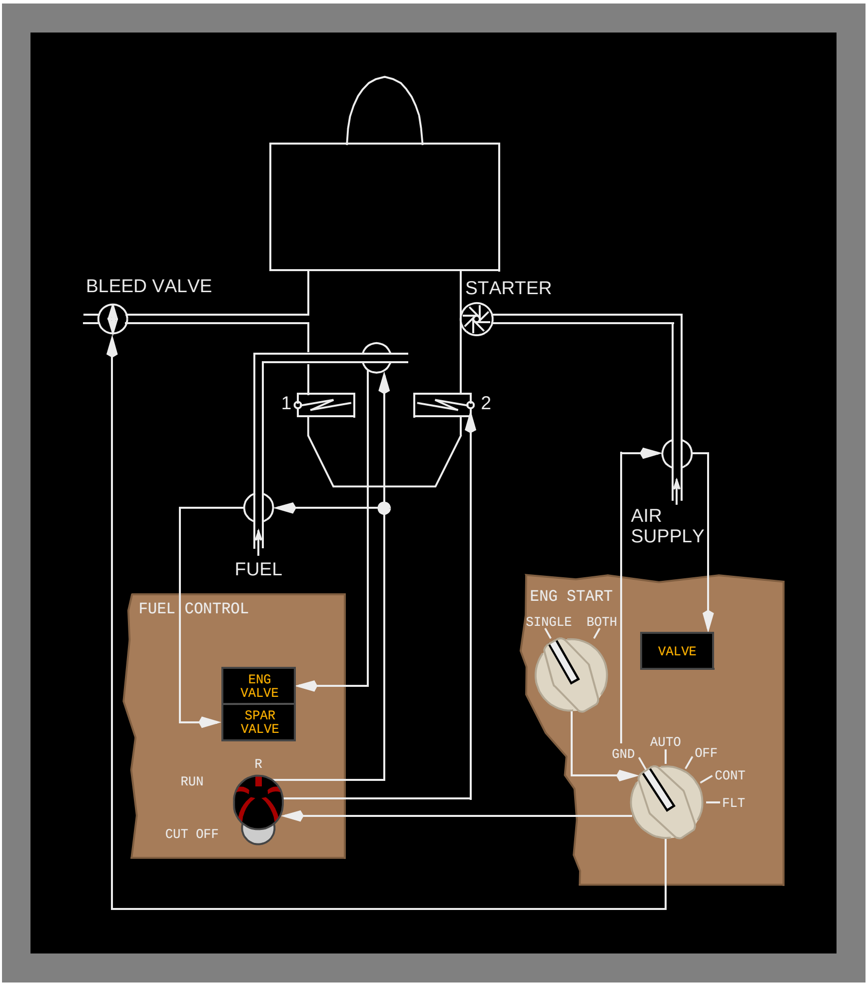
In the air or on the ground, an automatic relight feature is enabled if N2 drops below idle speed. If this occurs, the EEC will energize both ignition systems for the affected engine(s).

Engine Ignition

Each engine has two ignitors. Dual ignitors are always used for inflight starts.

Main AC power is the normal power source for ignition. Standby AC power provides a backup source.

Engine Start and Ignition System Schematic



Engine Fuel System

Fuel is supplied by fuel pumps located in the fuel tanks. The fuel flows through a spar fuel valve located in the main tank. It then passes through the first stage engine fuel pump where additional pressure is added. Final pressure is generated by a second stage fuel pump prior to entering a fuel/oil heat exchanger where it is preheated. A fuel filter removes contaminants. The fuel is then controlled to meet the existing thrust requirements. The fuel then flows through the engine fuel valve and fuel flow meter before entering the engine.

Fuel Metering Unit

The engine fuel control system incorporates a fuel metering unit which operates in conjunction with the EEC. The fuel control system schedules fuel flow to meet engine thrust requirements as dictated by the thrust lever position and the specific engine operating conditions. The EEC controls the metered fuel and prevents engine limits from being exceeded.

Engine and Spar Valves

The spar and engine fuel valves allow fuel flow to the engine when both valves are open. The valves open when the engine fire switch is IN and the fuel control switch is in the RUN position. Both valves close when either the fuel control switch is in CUT OFF or the engine fire switch is OUT.

The ENG VALVE and SPAR VALVE lights illuminate momentarily as the valves open or close. If the valves do not agree with the fuel control switch or the respective fire switch position after allowing for the normal operating time, the lights remain illuminated and the EICAS advisory message L or R FUEL SPAR VAL or L or R ENG FUEL VAL displays.

Fuel Filter

The fuel is filtered by a filter with bypass capabilities. If the filter becomes clogged with contaminates, fuel will bypass the filter allowing contaminated fuel to enter the fuel control unit.

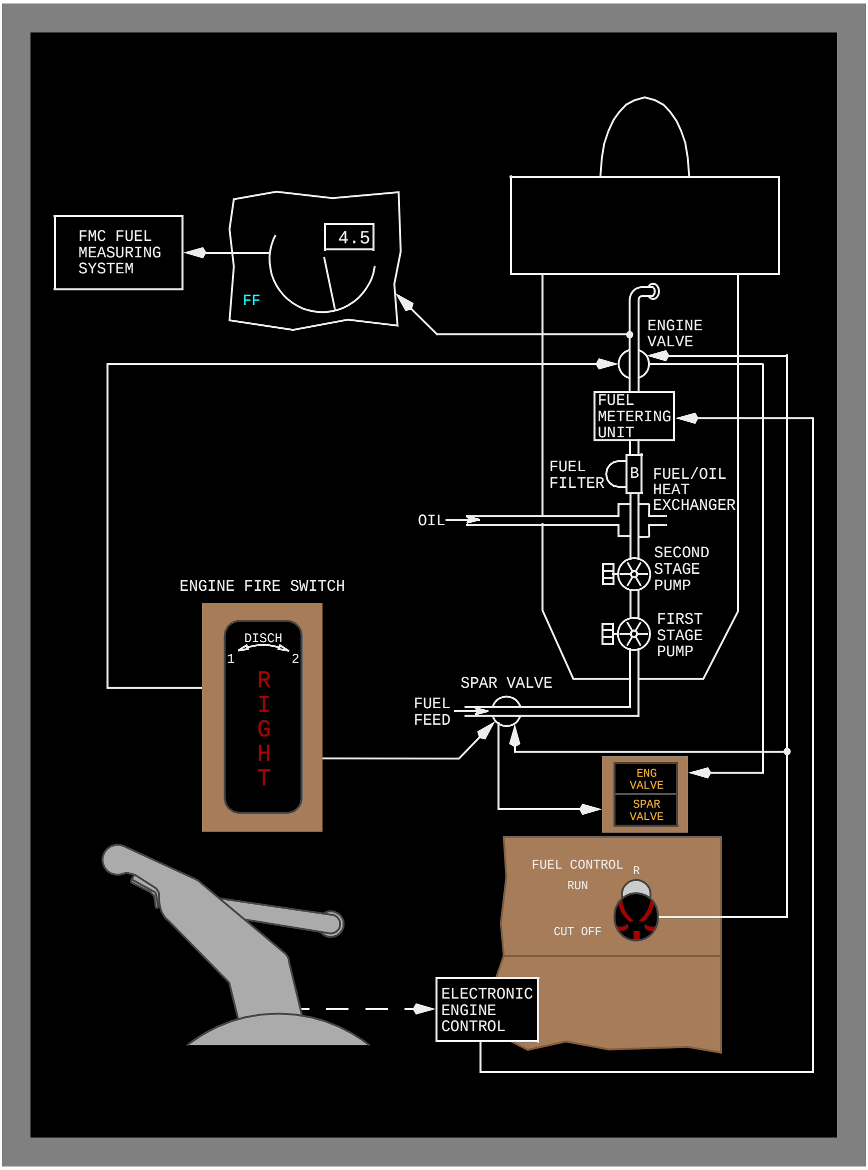
The EICAS advisory message L or R ENG FUEL FILT displays to indicate the affected engine filter is approaching a level sufficient to cause filter bypass.

Erratic engine operation and flameout may occur due to fuel contamination.

Fuel Flow Measurement

Fuel flow is measured after passing through the engine fuel valve. Fuel flow is displayed on the secondary engine display. Fuel flow information is also provided to the FMS.

Engine Fuel System Schematic



Engine Oil System

The oil system provides pressurized oil to lubricate and cool the engine main bearings, gears and accessory drives. The oil system also provides automatic fuel heating for fuel system icing protection.

Oil is pressurized by a main (engine–driven) oil pump. From the pump, the oil flows through the oil filter where contaminants are removed and then delivered to the engine main bearings, gears, and accessory drives. The oil is returned by means of a scavenge pump.

The oil enters the fuel/oil heat exchanger where fuel is used as the heat sink and then flows through a second filter before returning to the reservoir.

Should an oil filter become saturated with contaminants, oil will automatically bypass the filter. The EICAS advisory message L or R OIL FILTER displays indicating the oil filter is bypassed.

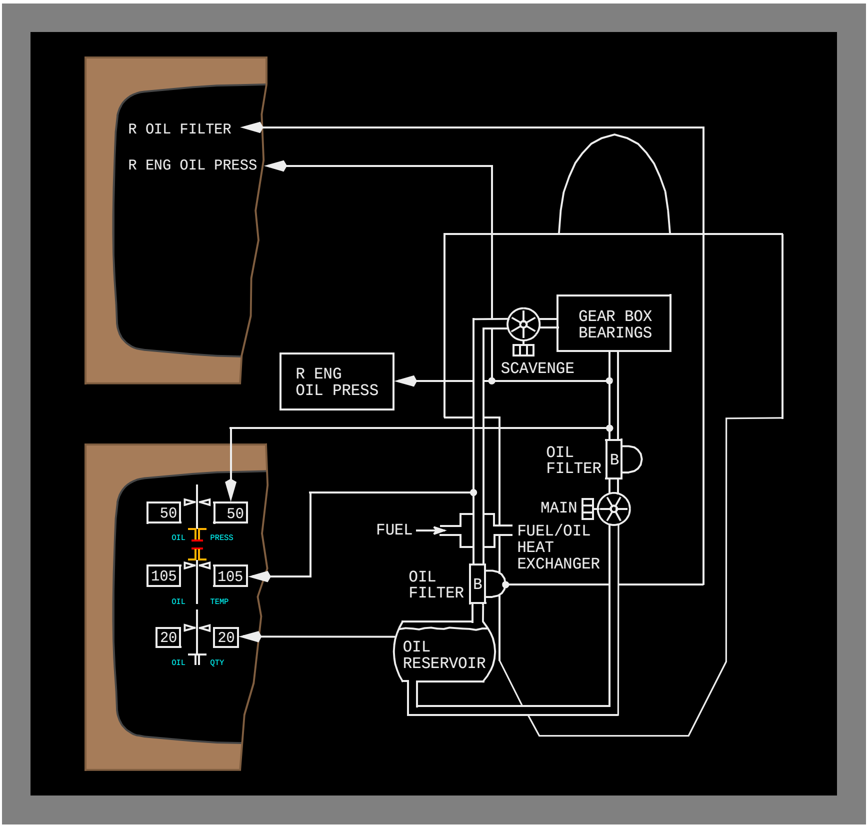
Oil pressure, temperature, and quantity are displayed on the secondary engine display.

Oil pressure is measured prior to entering the engine. The L or R ENG OIL PRESS light illuminates and the EICAS advisory message L or R ENG OIL PRESS displays to indicate the oil pressure is low. When the oil pressure is at or below the variable limits, the EICAS indication changes to amber.

Oil temperature is measured after leaving the scavenge pump, prior to entering the second filter.

There is no minimum oil quantity limit (no amber or red line limit). There are no operating limitations for the engine oil quantity; therefore, there are no flight crew procedures based solely on a response to low oil quantity.

Engine Oil System Schematic



Thrust Reverser System

Each engine has a pneumatically actuated fan air thrust reverser. Reverse thrust is available only on the ground.

The reverse thrust levers can be raised only when the forward thrust levers are in the idle position. An interlock stop limits thrust to idle reverse while the reverser is in transit.

The EECs control thrust limits during reverser operation.

When the reverse thrust levers are pulled aft to the interlock position:

- the autothrottle disengages
- the auto speedbrakes deploy

When the reverser system is activated:

- reverser isolation valve opens allowing the reverser translating sleeves to pneumatically move aft
- the fan flow blocker doors rotate into place to direct fan air through stationary cascade guide vanes
- the reverser indication (REV) is displayed above each digital N1 indication (REV is displayed in amber when the reverser is in transit)

When the interlock releases:

- the reverse thrust levers can be raised to the maximum reverse thrust position
- the REV indication changes to green when the reverser is fully deployed

Pushing the reverse thrust levers to the full down position retracts the reversers to the stowed and locked position. While the reverser is in transit, the REV annunciation changes color to amber. The thrust levers cannot be moved forward until the reverse thrust levers are fully down. When the reverser reaches the stowed position, the amber REV annunciation disappears.

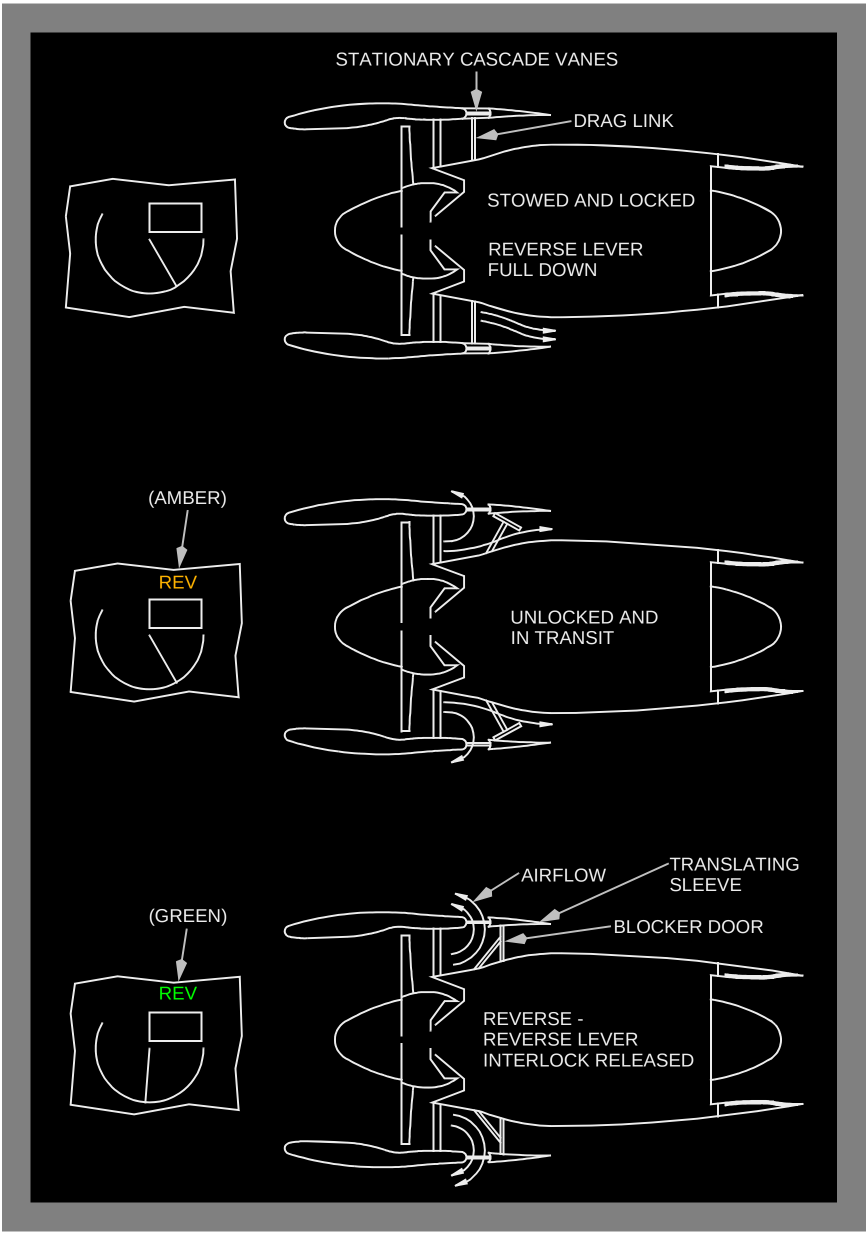
Each thrust reverser is automatically protected against unintentional reverse thrust. If an uncommanded thrust reverser movement is sensed, an autostow feature automatically applies pneumatic pressure to stow the reverser.

The EICAS advisory message L or R REV ISLN VAL is displayed and the REV ISLN light illuminates when a fault exists in the reverser system.

The light and message are inhibited in flight.

An electromechanical lock prevents uncommanded reverser deployment in the event of additional system failures.

Thrust Reverser Schematic



Airborne Vibration Monitoring System

The airborne vibration monitoring system monitors engine vibration levels. The vibration indications are displayed on the secondary engine display. The vibration source indication is also displayed. If the vibration monitoring system cannot determine the source (FAN, LPT or N2), broadband (BB) is displayed for the affected engine. Broadband vibration is the average vibration detected.

Thrust reduction at top of descent may cause momentary peak vibration increases. Minor throttle movements may improve, or remove, these momentary peak vibrations.

Certain engine malfunctions can result in airframe vibrations from the windmilling engine. As the airplane transitions from cruise to landing, there can be multiple, narrow regions of altitudes and airspeeds where the vibration level can become severe. In general, airframe vibrations can best be reduced by descending and reducing airspeed. However, if after descending and reducing airspeed, the existing vibration level is unacceptable, and if it is impractical to further reduce airspeed, the vibration level may be reduced to a previous, lower level by a slight increase in airspeed.

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Introduction

The auxiliary power unit (APU) is a self–contained gas turbine engine located in the airplane tail cone. The APU air inlet door is located between the horizontal and vertical stabilizers on the right side of the airplane.

While the primary purpose of the APU is to supply electrical power and bleed air on the ground before engine start, the APU can also be started inflight, and operated up to the airplane maximum certified altitude.

Electrical power has priority over bleed air. Electrical power is available throughout the airplane operating envelope. Inflight, APU bleed air is available up to approximately 17,000 feet.

Refer to the following chapters for additional information:

- Chapter 2, Air Systems, for a description of APU bleed air operation
- Chapter 6, Electrical, for a description of APU electrical operation
- Chapter 8, Fire Protection, for a description of the APU fire protection system
- Chapter 12, Fuel, for a description of the APU fuel system

APU Operation

APU Start

APU start requires both the APU battery and the aircraft main battery.

Fuel for the APU is supplied from the left manifold. A dedicated DC fuel pump is energized when the APU Selector is placed in the ON position if no AC power is available. When AC power is available, the left forward AC fuel pump is signaled to operate regardless of its switch position, and the DC fuel pump is signaled off.

Rotating the APU selector to START begins the automatic start sequence. The APU fuel valve opens and at the same time the APU inlet door begins to open. A fuel pump also begins to operate.

When the inlet door is open, the electric starter engages. After the APU reaches the proper speed, ignition and fuel are provided, and the APU accelerates to its normal operating speed.

The starter duty cycle is a maximum of three consecutive starts or attempts within a sixty minute period.

APU Run

When the APU RUN light illuminates, the APU may be used to supply electrical power and bleed air.

APU Shutdown

To protect the unit from thermal shock, the APU control system incorporates a time-delay feature permitting APU cooling before shutdown. If the APU is supplying pneumatic power, rotating the APU selector to OFF begins the shutdown cycle by closing the APU bleed air valve. If the APU bleed valve has been closed for a sufficient length of time when the selector is moved to OFF, the APU fuel valve and inlet door closes and the APU shuts down without delay.

If the selector is inadvertently moved to OFF, but the RUN light is still illuminated, momentarily moving the selector to START cancels the shutdown signal.

Protection System

On the ground, placing the Battery Switch OFF also results in an APU shutdown. This is not a recommended procedure however, because while the APU will go through a cooldown cycle, APU fire detection may not be available. In flight, Battery Switch position does not affect APU operation.

An amber FAULT light on the APU control panel illuminates whenever a fault is sensed. In addition, an EICAS advisory message APU FAULT is displayed, and the APU shuts down immediately. Fault detection circuitry is reset by positioning the APU Selector to OFF.

The FAULT light also comes on when the APU fuel valve is not in the commanded position. Therefore, during APU start and shutdown, the light illuminates momentarily. The EICAS advisory APU FUEL VAL appears if the valve fails to reach the commanded position.

With the APU Selector positioned to OFF, both the APU FAULT light and the associated APU FAULT EICAS message are inhibited. Only a failure of the APU fuel valve to close causes the APU FAULT light and the associated APU FUEL VAL message.

Engines, APU EICAS Messages

The following EICAS messages can be displayed.

APU

Message	Level	Light	Aural	Condition
APU FAULT	Advisory	FAULT		The APU has automatically shut down
APU FUEL VAL	Advisory	FAULT		The APU fuel valve position disagrees with the commanded position

Engine

Control

Message	Level	Light	Aural	Condition
ENGINE CONTROLS	Advisory			Faults are detected in the engine control system
L ENG CONTROL R ENG CONTROL	Advisory			Faults are detected in the engine control system
L ENG EEC MODE R ENG EEC MODE	Advisory	ALTN		The electronic engine control is not receiving adequate inputs and an alternate N1 control mode is being used by the EEC to control thrust
L ENG LIM PROT R ENG LIM PROT	Caution	ALTN	Beeper	The electronic engine control is operating in the ALTN control mode and the throttles are advanced into the overboost range

Message	Level	Light	Aural	Condition
L ENG LOW IDLE R ENG LOW IDLE	Advisory			An engine has failed to go to approach idle
L ENG RPM LIM R ENG RPM LIM	Advisory			N1 or N2 RPM is at the red line limit
L ENG SHUTDOWN R ENG SHUTDOWN	Caution			Engine was shutdown by the fuel control switch or fire switch
IDLE DISAGREE	Advisory			The engines are at different idle settings

Fuel

Message	Level	Light	Aural	Condition
L ENG FUEL FILT R ENG FUEL FILT	Advisory			An impending fuel filter bypass condition exists on the affected engine
L ENG FUEL VAL R ENG FUEL VAL	Advisory	ENG VALVE		The engine fuel valve position disagrees with commanded position
L FUEL SPAR VAL R FUEL SPAR VAL	Advisory	SPAR VALVE		The fuel spar valve position disagrees with commanded position

Oil

Message	Level	Light	Aural	Condition
L ENG OIL PRESS R ENG OIL PRESS	Advisory	L ENG OIL PRESS R ENG OIL PRESS		Engine oil pressure is low
L OIL FILTER R OIL FILTER	Advisory			Affected engine oil filter contamination has been detected

Start

Message	Level	Light	Aural	Condition
L ENG STARTER R ENG STARTER	Advisory	VALVE		Engine starter valve is not in the commanded position
L STARTER CUTOUT R STARTER CUTOUT	Caution	VALVE	Beeper	The engine start valve is open when commanded closed

Thrust Reverser

Message	Level	Light	Aural	Condition
L REV ISLN VAL R REV ISLN VAL	Advisory	REV ISLN		Fault is detected in the affected engine reverser system

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Fire Protection — Chapter 8

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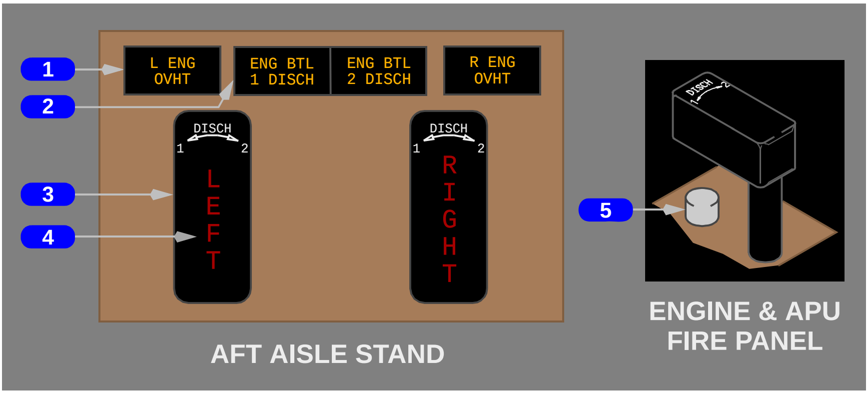
Engine Fire Protection
Engine Fire Panel



1 Engine Overheat (L/R ENG OVHT) Lights

Illuminated (amber) – engine overheat is detected

2 Engine Bottle Discharged (ENG BTL DISCH) Lights

Illuminated (amber) – the extinguisher bottle is discharged or has low pressure

3 Engine Fire Switches

In – normal position, mechanically locked; unlocks automatically for fire warning

Out – closes the associated engine and spar fuel valves, and

- closes the associated engine bleed air valves
- trips the associated engine generator off
- shuts off hydraulic fluid to the associated engine–driven hydraulic pump
- arms both engine fire extinguisher bottles

Rotate to position 1 or 2 – discharges the selected fire extinguisher into the engine nacelle

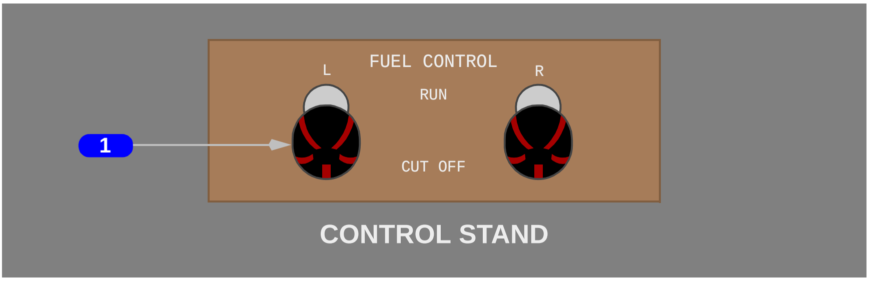
4 Engine Fire Warning Lights

Illuminated (red) – an engine fire is detected

5 Engine and APU Fire Override Switches

Push – unlocks the respective engine or APU fire switch

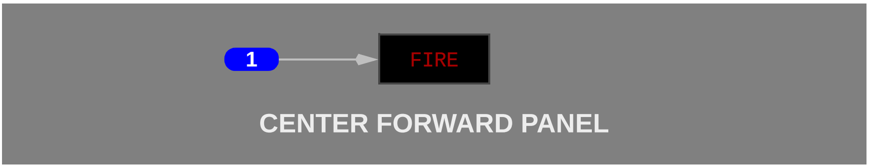
Fuel Control Switches



1 FUEL CONTROL Switch Fire Warning Lights

Illuminated (red) – an associated engine fire is detected

Fire Warning Light

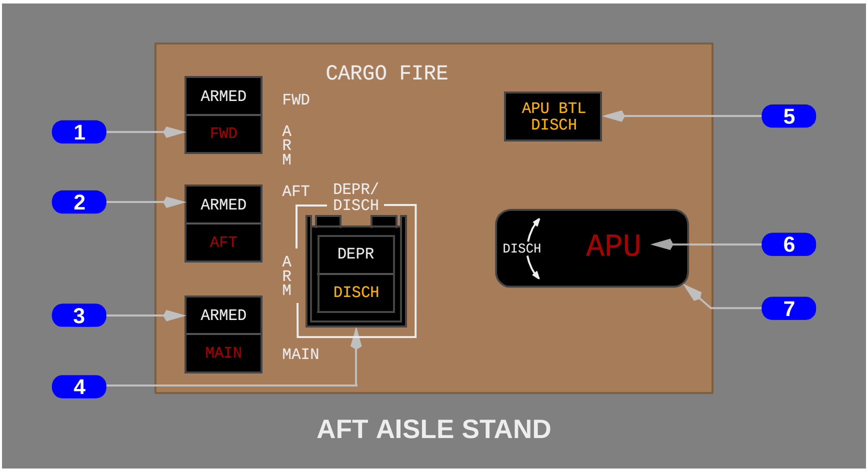


1 FIRE Warning Light

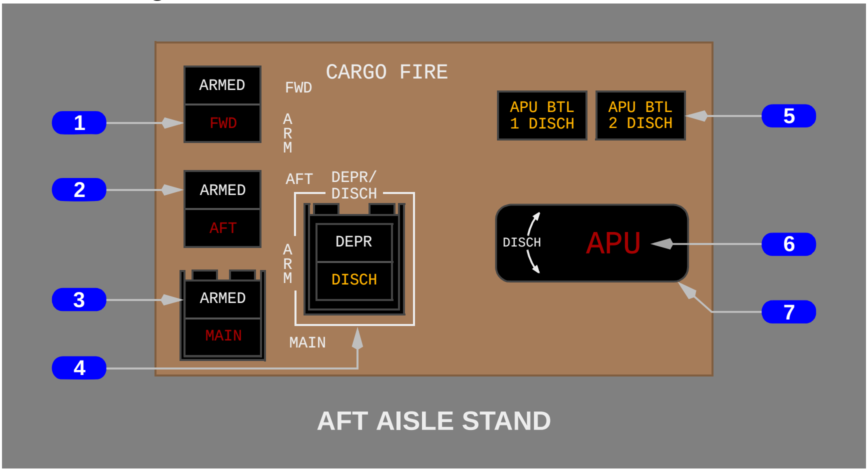
Illuminated (red) – an engine, APU, wheel well, or cargo fire is detected

Cargo and APU Fire Protection
Cargo and APU Fire Panel

N316LA



N422LA through N526LA



1 CARGO FIRE Warning Lights (FWD, AFT or MAIN)

Illuminated (red) – smoke is detected in the respective cargo compartment

2 FWD/AFT Cargo Compartment ARMED Switches and Lights

Push FWD ARMED – Light Illuminates

- arms all cargo fire extinguisher bottles
- closes the associated cargo compartment heat valves
- arms the DEPR/DISCH switch for discharge
- turns off the forward overboard exhaust fans
- shuts down the forward cargo air conditioning system

Push AFT ARMED – Light Illuminates

- arms all cargo fire extinguisher bottles
- closes the associated cargo compartment heat valves
- arms the DEPR/DISCH switch for discharge

Off – normal position

3 MAIN Cargo Compartment ARMED Switch/Light

Push MAIN ARMED – Light Illuminates

- shuts down one pack
- commands the remaining pack to low flow
- closes the valves supplying air to the main deck cargo area
- closes the forward and aft trim air valves and cargo heat valves
- shuts down the forward cargo air conditioning system
- arms the DEPR/DISCH switch for depressurization

N316LA

- inhibits the siren and master warning light for cabin altitude

Off – normal position

4 CARGO FIRE Depressurization/Discharge (DEPR/DISCH) Switch

FWD or AFT ARMED:

Push – begins discharge of the cargo fire extinguishers into the armed cargo compartment and illuminates the discharge (DISCH) light

MAIN ARMED:

Push – opens the E/E cooling override/smoke valve to depressurize the airplane main cargo compartment and illuminates the depressurization (DEPR) light

DISCH Light:

Illuminated (amber) – a cargo fire extinguisher bottle has discharged or has low pressure

N316LA

5 APU Fire Bottle Discharged (APU BTL DISCH) Light

Illuminated (amber) – the extinguisher bottle is discharged or has low pressure

N422LA through N526LA

5 APU Fire Bottle Discharged (APU BTL 1 DISCH or APU BTL 2 DISCH) Lights

Illuminated (amber) – the respective extinguisher bottle is discharged or has low pressure

6 APU Fire Warning Light

Illuminated (red) – an APU fire is detected

7 APU Fire Switch

In – normal position, mechanically locked; unlocks automatically if fire warning occurs

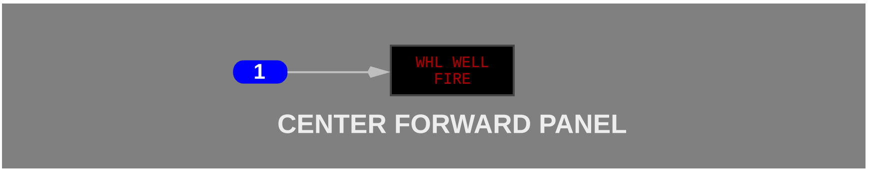
Out – closes the APU fuel valve, and:

- trips the APU generator off
- closes the APU air supply valve
- shuts down the APU
- arms the APU fire extinguisher bottle

N316LA
Rotate – either direction discharges the APU fire extinguisher into the APU compartment

N422LA through N526LA
Rotate – either direction discharges one of the APU fire extinguishers into the APU compartment. Rotating in the other direction will discharge the second bottle.

Wheel Well Fire Light

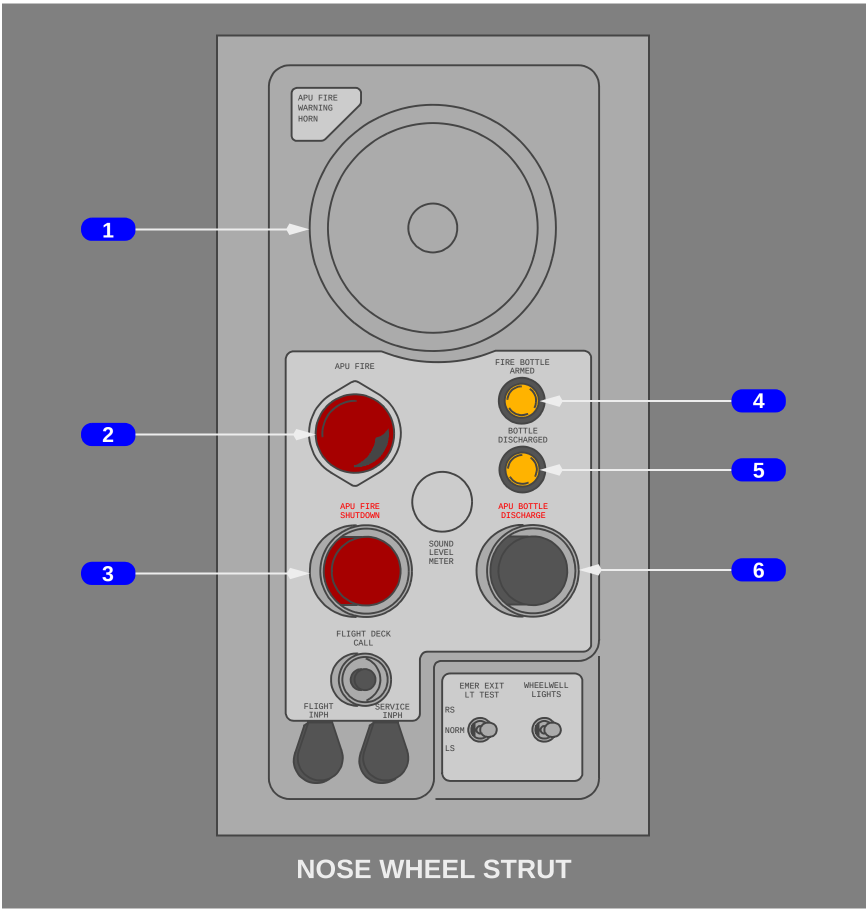


1 Wheel (WHL) WELL FIRE Warning Light

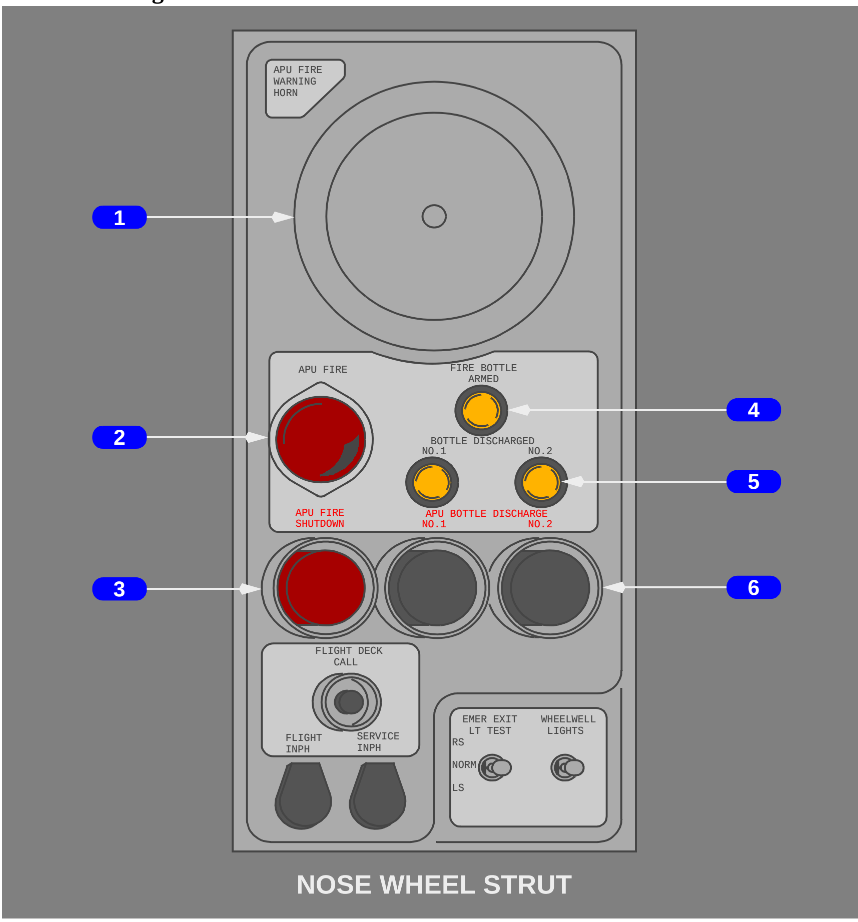
Illuminated (red) – a fire is detected in one or both of the main gear wheel wells

APU Ground Control Fire Protection Panel

N316LA



N422LA through N526LA



1 APU Fire Warning Horn

Sounds intermittently during ground operation for an APU fire

2 APU FIRE Light

Illuminated (red) – an APU fire is detected

The APU automatically shuts down for a detected fire

N316LA

3 APU FIRE SHUTDOWN Switch

Push –

- closes the APU fuel valve and trips the APU generator off
- closes the APU air supply valve and shuts down the APU
- arms the APU fire extinguisher bottle

N422LA through N526LA

3 APU FIRE SHUTDOWN Switch

Push –

- closes the APU fuel valve and trips the APU generator off
- closes the APU air supply valve and shuts down the APU
- arms the APU fire extinguisher bottles

4 APU FIRE BOTTLE ARMED Light

Illuminated (amber) - the APU fire extinguisher is armed

N316LA

5 APU Fire BOTTLE DISCHARGED Light

Illuminated (amber) - the APU fire extinguisher bottle is discharged or has low pressure

N422LA through N526LA

5 APU Fire BOTTLE DISCHARGED Lights

Illuminated (amber) - an APU fire extinguisher bottle is discharged or has low pressure

N316LA

6 APU BOTTLE DISCHARGE Switch

Push – discharges the APU fire extinguisher bottle into the APU compartment

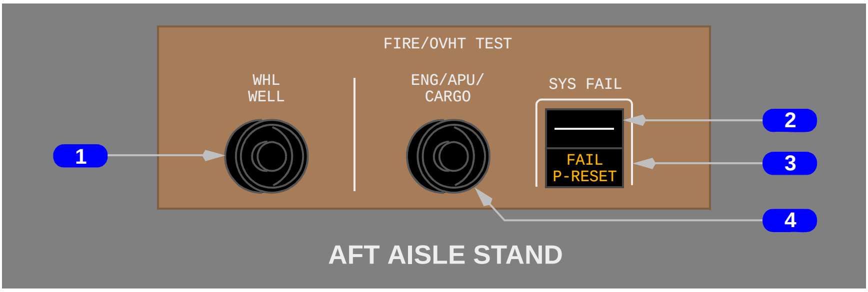
N422LA through N526LA

6 APU BOTTLE DISCHARGE Switches

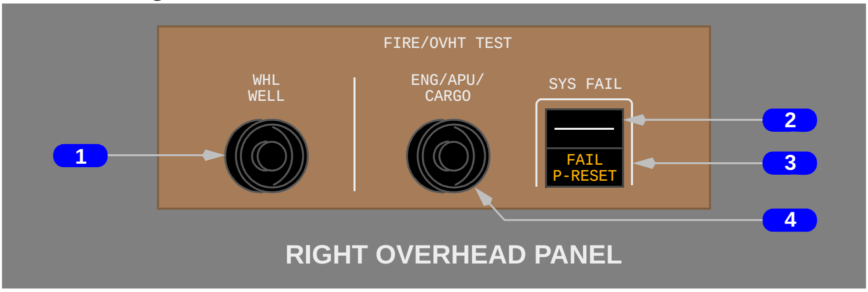
Push – discharges one of the APU fire extinguisher bottles into the APU compartment

Fire/Overheat Test Panel

N316LA



N422LA through N526LA



1 Wheel (WHL) WELL Fire Test Switch

Push and hold – initiates a wheel well fire test

2 System Fail (FAIL P – RESET) Light

Illuminated (amber) – indicates the failure of the detectors in one of the following systems:

- engine fire
- engine overheat
- APU fire
- cargo fire

3 System Fail (SYS FAIL) Reset Switch (FAIL P – RESET)

Push – extinguishes the FAIL light and resets the monitor for other systems

4 ENG/APU/CARGO Test Switch

Push and hold – initiates an engine, APU, and cargo fire/overheat test

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Introduction

There are fire detection and extinguishing systems for the:

- engines
- APU
- forward and aft cargo compartments
- lavatory

The main deck cargo compartment has fire detection and warning, but no active fire extinguishing system. Fire suppression on the main deck is accomplished by depressurizing the airplane.

The main gear wheel wells have a fire detection system, but no fire extinguishing system. The system will not detect hot brakes alone, without an associated fire.

Overheat detection systems are installed for both engines, struts, and pneumatic ducts in the wing and body areas.

Refer to Chapter 2, Air Systems, for a description of equipment smoke evacuation, equipment overheat detection and bleed air duct leak.

Engine Fire Protection

Engine fire protection consists of these systems:

- engine fire and overheat detection
- engine fire warning
- engine overheat caution
- engine fire extinguishing

Engine Fire and Overheat Detection

There are detector loops in each engine nacelle to provide both fire and overheat detection. The SYS FAIL light illuminates and the EICAS advisory message FIRE/OVHT SYS displays to indicate failure of the fire/overheat detection system. The SYS FAIL light and advisory message can be reset to allow monitoring of the remaining systems.

Engine Fire Warning

The indications of an engine fire warning are:

- the fire bell sounds
- the master WARNING lights illuminate
- the engine fire switch LEFT or RIGHT fire warning light illuminates
- the discrete FIRE warning light illuminates

- the engine FUEL CONTROL switch fire warning light illuminates
- the EICAS warning message L or R ENGINE FIRE displays
- the engine fire switch unlocks

The fire warning lights remain illuminated as long as the fire signal exists. The fire bell may be silenced by any of the following actions:

- extinguishing the fire
- pushing either master warning/caution reset switch
- pulling the appropriate fire switch

Engine Overheat Caution

The indications of an engine overheat caution are:

- the caution beeper sounds
- the master CAUTION lights illuminate
- the L or R ENG OVHT light illuminates
- the EICAS caution message L or R ENG OVHT displays

The overheat lights remain illuminated as long as the overheat condition exists.

Engine Fire Extinguishing

There are two engine fire extinguisher bottles. Either or both bottles can be discharged into either engine.

When an engine fire switch is pulled out, the associated engine:

- fuel is shut off
- bleed valves are closed
- generator is tripped off
- hydraulic fluid is shut off to the engine-driven hydraulic pump
- fire extinguishing bottles are armed

Rotating the fire switch in either direction discharges a single extinguisher bottle into the associated engine. Rotating the engine fire switch in the other direction discharges the second extinguisher bottle into the same engine.

If an extinguisher bottle is discharged or has low pressure:

- the ENG BTL 1 or 2 DISCH light illuminates
- the EICAS advisory message ENG BTL 1 or 2 displays

Engine/APU Fire and Override Switches

The engine and APU fire switches are mechanically locked in the down position to avoid inadvertent activation. When a fire is detected, the respective switch is electrically unlocked and may then be pulled out. Manual unlocking of the switch is accomplished by pushing the fire override switch located beneath the fire switch.

APU Fire Protection

APU fire protection consists of these systems:

- APU fire detection
- APU fire warning
- APU fire extinguishing

APU Fire Detection

There are fire detector loops in the APU compartment. There is no APU overheat detection. The SYS FAIL light illuminates and the EICAS advisory message FIRE/OVHT SYS displays to indicate failure of the APU fire detection system. The SYS FAIL light and advisory message can be reset to allow monitoring of the remaining systems.

APU Fire Warning

The indications of an APU fire warning are:

- the fire bell sounds
- the master WARNING lights illuminate
- the APU fire warning light illuminates
- the discrete FIRE warning light illuminates
- the EICAS warning message APU FIRE displays
- the APU automatically shuts down
- the APU fire switch unlocks

In addition to the above APU fire warnings, if the airplane is on the ground the horn on the nose gear strut sounds and the fire warning light on the APU ground control panel illuminates.

The fire warning lights remain illuminated as long as the fire signal exists. The fire bell (and horn if APU fire on the ground) may be silenced by any of the following actions:

- extinguishing the fire
- pushing either master warning/caution reset switch
- pulling the APU fire switch
- pushing the APU fire shutdown switch if on the ground

APU Fire Extinguishing

N316LA

There is one APU fire extinguisher bottle. When the APU fire switch is pulled out, the APU:

- fuel is shut off
- bleed air valve is closed

- generator is tripped off
- fire extinguishing bottle is armed

Rotating the switch in either direction discharges the extinguisher bottle into the APU compartment. When the bottle is discharged or has low pressure:

- the APU BTL DISCH light illuminates
- the EICAS advisory message APU BTL displays

APU Fire Extinguishing

N422LA through N526LA

There are two APU fire extinguisher bottles. When the APU fire switch is pulled out, the APU:

- fuel is shut off
- bleed air valve is closed
- generator is tripped off
- fire extinguisher bottles are armed

Rotating the switch in the opposite direction will discharge the other bottle into the APU compartment. When one of the bottles is discharged or has low pressure

- the APU BTL 1 or 2 DISCH light illuminates
- the EICAS advisory message APU BTL 1 or 2 displays

Main Gear Wheel Well Fire Protection

The main gear wheel well has fire detection and warning only. There is no fire extinguishing system. The nose gear wheel well does not have a fire detection system.

Main Gear Wheel Well Fire Detection

The main wheel well fire detection system consists of a single fire detection loop.

Main Gear Wheel Well Fire Warning

The indications for a main wheel well fire are:

- the fire bell sounds
- the master WARNING lights illuminate
- the WHL WELL FIRE warning light illuminates
- the discrete FIRE warning light illuminates
- the EICAS warning message WHEEL WELL FIRE displays

The fire warning lights remain illuminated as long as the fire signal exists. The fire bell may be silenced by any of the following actions:

- extinguishing the fire
- pushing either master warning/caution reset switch

Cargo Compartment Fire Protection

Cargo compartment fire protection consists of these systems:

- cargo compartment smoke detection
- cargo compartment fire warning
- cargo compartment fire extinguishing

Cargo Compartment Smoke Detection

The main, forward, and aft cargo compartments each have smoke detectors installed

The SYS FAIL light illuminates and the EICAS advisory message FIRE/OVHT SYS displays to indicate failure of the cargo compartment smoke detection system. The SYS FAIL light can be reset to allow monitoring of the remaining systems.

Cargo Compartment Fire Warning

The indications of a cargo compartment fire are:

- the fire bell sounds
- the master WARNING lights illuminate
- the MAIN, FWD, or AFT cargo fire warning light illuminates
- the discrete FIRE warning light illuminates
- the EICAS warning message MAIN, FWD, or AFT CARGO FIRE displays

The fire warning lights remain illuminated as long as the fire signal exists. The fire bell may be silenced by any of the following actions:

- extinguishing the fire and clearing the smoke
- pushing either master warning/caution reset switch
- pushing the illuminated cargo compartment ARMED switch

Forward and Aft Cargo Compartment Fire Extinguishing

Fire extinguisher bottles are installed for cargo compartment fire extinguishing. Pushing the FWD or AFT cargo compartment ARMED switch arms the extinguishers for the respective compartment.

Pushing the cargo fire bottle DEPR/DISCH switch initiates discharge of the fire bottles. The first bottle discharges immediately into the selected compartment. The CARGO BTL 1 advisory message is displayed on EICAS within a few seconds after pressing the cargo fire bottle DEPR/DISCH switch. The second fire bottle discharges at a later time or at a reduced flow rate into the selected compartment. The CARGO BTL 2 advisory messages is displayed on EICAS within a few seconds after the bottle starts to discharge. The DISCH light illuminates when either bottle discharges.

MAIN Deck Cargo Compartment Fire Suppression

Fire suppression in the main deck cargo compartment is accomplished by shutting off the supply of air to the compartment. As a result, the airplane gradually depressurizes and the oxygen required for combustion is eliminated. When a fire is detected in the main deck cargo compartment, the MAIN cargo fire warning light illuminates. Pushing the MAIN ARMED switch will arm the Depressurization/Discharge (DEPR/DISCH) switch for depressurization of the main deck. Pushing the Cargo Fire DEPR/DISCH switch results in a gradual depressurization of the aircraft to the approximate flight altitude.

Lavatory Fire Protection

Lavatory fire protection consists of these systems:

- lavatory fire detection and annunciation
- automatic fire extinguishing in the lavatory waste container cabinet

Lavatory Smoke Detection and Annunciation

The lavatory has a single smoke detector. An aural annunciation consisting of a horn, sounds in the lavatory and is audible in the immediate vicinity.

There is no cockpit annunciation of smoke detected in a lavatory.

Lavatory Fire Extinguishing

The lavatory has a fire extinguisher located in the waste container cabinet, with:

- automatic fire extinguisher actuation
- no cockpit annunciation of lavatory fire extinguisher operation

Fire and Overheat Detection System Fault Test

Automatic testing of the engine fire and overheat detectors, APU fire detectors and cargo compartment smoke detectors occurs when electrical power is initially applied. The FIRE/OVHT test panel permits manual testing of the various fire and overheat sensors.

Fire Protection EICAS Messages

The following EICAS messages can be displayed.

Message	Level	Light	Aural	Condition

N316LA

Message	Level	Light	Aural	Condition
APU BTL	Advisory	APU BTL DISCH		APU fire extinguisher bottle pressure is low

N422LA through N526LA

Message	Level	Light	Aural	Condition
APU BTL 1 APU BTL 2	Advisory	APU BTL 1 DISCH APU BTL 2 DISCH		APU fire extinguisher bottle 1 or bottle 2 pressure is low

Message	Level	Light	Aural	Condition
APU FIRE	Warning	APU	Fire Bell	Fire is detected in the APU

N316LA

Message	Level	Light	Aural	Condition
CARGO BTL 1 CARGO BTL 2	Advisory	DISCH		Cargo fire extinguisher bottle 1 or bottle 2 pressure is low

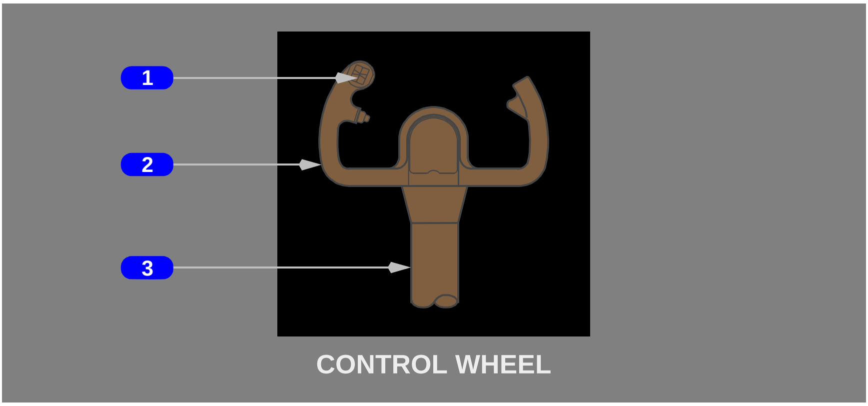
Message	Level	Light	Aural	Condition
AFT CARGO FIRE FWD CARGO FIRE MAIN CARGO FIRE	Warning	AFT FWD MAIN	Fire Bell	Smoke is detected in the affected cargo compartment
ENG BTL 1 ENG BTL 2	Advisory	ENG BTL 1 DISCH ENG BTL 2 DISCH		Engine fire extinguisher bottle 1 or bottle 2 pressure is low
L ENGINE FIRE R ENGINE FIRE	Warning	LEFT RIGHT	Fire Bell	Fire is detected in the engine

Message	Level	Light	Aural	Condition
L ENG OVHT R ENG OVHT	Caution	L ENG OVHT R ENG OVHT	Beeper	An overheat is detected in the engine
FIRE/OVHT SYS	Advisory	FAIL P-RESET		Fire or overheat detection is inoperative for loops as shown on the status page
WHEEL WELL FIRE	Warning	WHL WELL FIRE	Fire Bell	Fire is detected in a main wheel well

Flight Controls Chapter 9
Table of Contents Section TOC

Pitch and Stabilizer Trim System

Control Wheel and Column



1 Pitch Trim Switches

Spring–loaded to neutral.

Push (both switches) – electrically signals stabilizer movement.

2 Control Wheel

Rotate – deflects the ailerons and spoilers in the desired direction.

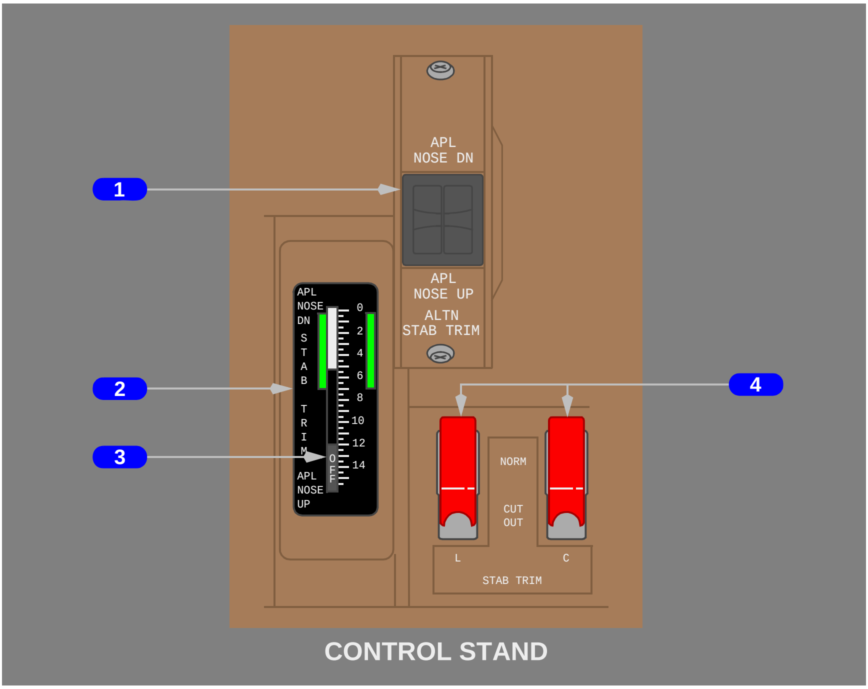
Moves and remains displaced with aileron trim.

3 Control Column

Push/Pull –

- deflects the elevator
- movement opposing stabilizer trim stops trimming

Stabilizer Trim System



1 Alternate Stabilizer Trim (ALTN STAB TRIM) Switches

Spring–loaded to neutral.

Push (both switches) –

- electrically signals stabilizer movement
- neutralizes conflicting trim commands

2 Stabilizer Trim (STAB TRIM) Indicator

- indicates stabilizer position in units of trim
- the green bands indicate the allowable takeoff trim range

3 Stabilizer Trim OFF Flag

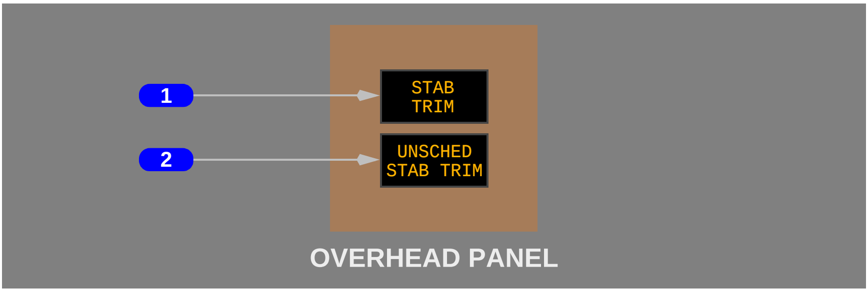
Trim indicator inoperative.

4 Stabilizer (STAB) Cutout Switches

NORM – hydraulic power is supplied to the related stabilizer trim control module.

CUTOUT – shuts off the respective left or center hydraulic system power to the related stabilizer trim control module.

Stabilizer Trim Lights



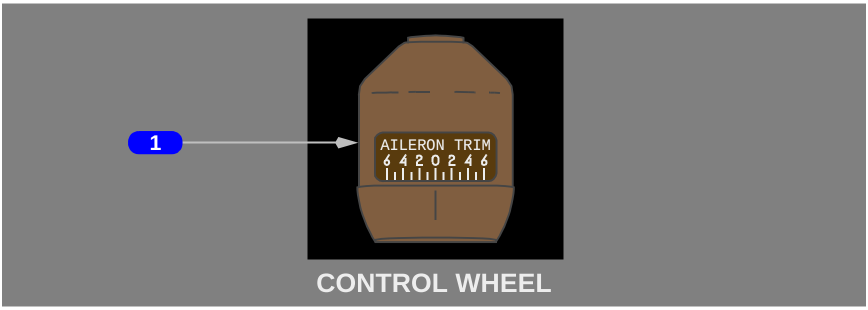
1 Stabilizer Trim (STAB TRIM) Light

Illuminated (amber) – stabilizer trim rate is one–half the normal control wheel stabilizer trim switch rate.

2 Unscheduled Stabilizer Trim (UNSCHED STAB TRIM) Light

Illuminated (amber) – uncommanded stabilizer motion detected.

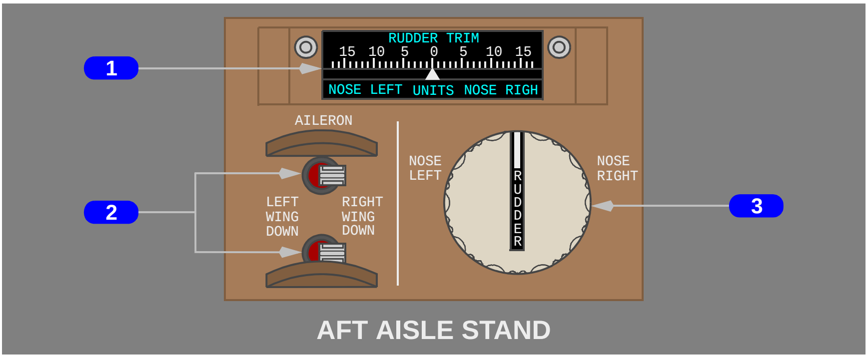
Aileron and Rudder Trim Controls
Aileron Trim Indicator



1 AILERON TRIM Indicator

Indicates units of aileron trim.

Aileron and Rudder Trim



1 RUDDER TRIM Indicator

Indicates units of rudder trim.

2 AILERON Trim Switches

Spring–loaded to neutral.

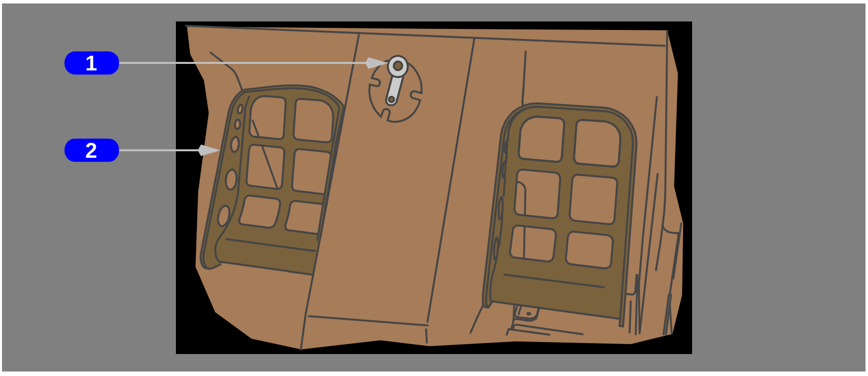
Push (both switches) – moves the control wheel, ailerons, and spoilers in the desired direction.

3 RUDDER Trim Control

Spring–loaded to neutral.

Rotate – moves the rudder pedals and rudder in the desired direction.

Rudder System
Rudder/Brake Pedals



1 Rudder Pedals Adjustment Crank

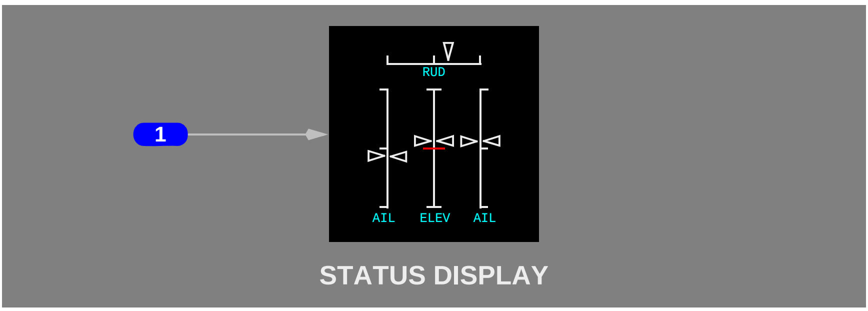
Pull and Rotate – adjusts rudder pedals forward or aft.

2 Rudder Pedals

Push – deflects the rudder in the desired direction.

Refer to Chapter 14, Landing Gear, for brakes and nosewheel steering description.

EICAS Status Display

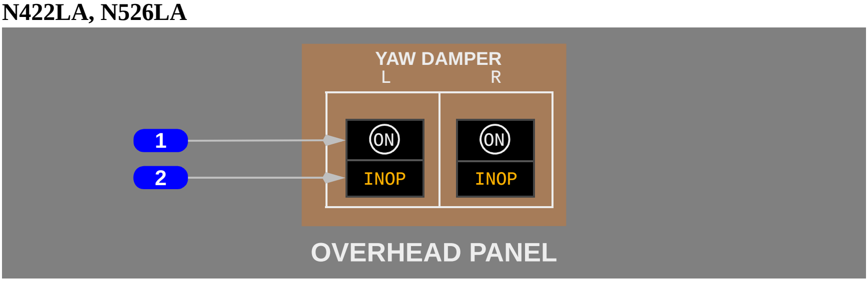


1 Rudder, Aileron, and Elevator (RUD, AIL, ELEV) Position

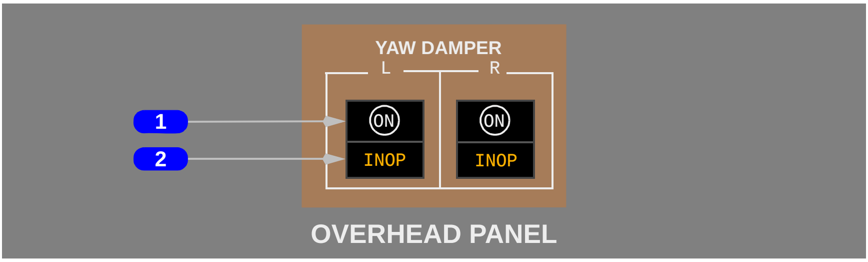
Indicates rudder, aileron, and elevator flight control surface deflection.

Yaw Damper Switches

N422LA, N526LA



N316LA, N524LA



1 YAW DAMPER Switches

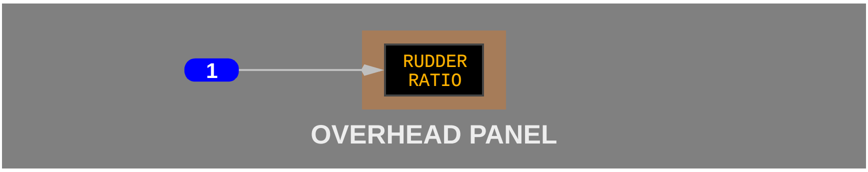
ON – yaw damper is commanded on.

Off (ON not visible) – the yaw damper is commanded off.

2 Yaw Damper Inoperative (INOP) Lights

Illuminated (amber) – the yaw damper is off or inoperative.

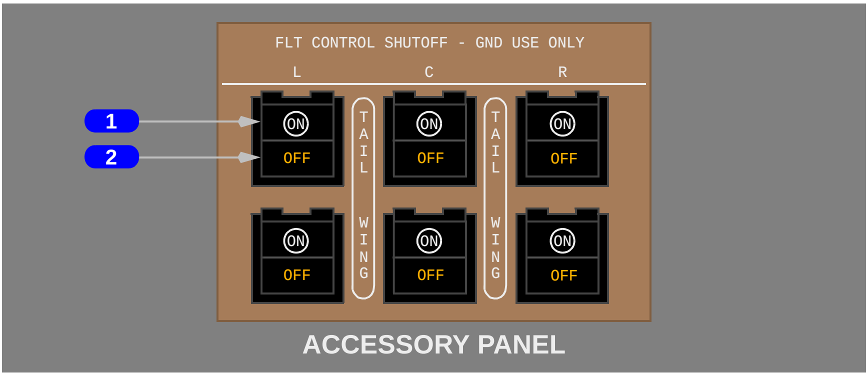
Rudder System Light



1 RUDDER RATIO Light

Illuminated (amber) – the rudder ratio system is failed.

Flight Control Shutoff Switches



1 Flight (FLT) CONTROL SHUTOFF Switches

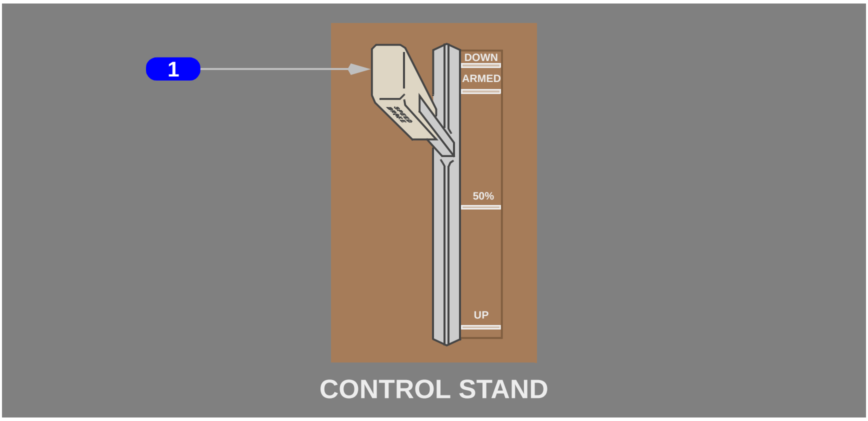
ON – the flight control valve is commanded open.

Off (ON not visible) – the flight control valve is commanded closed.

2 Flight Control Shutoff OFF Lights

Illuminated (amber) – the flight control valve is closed.

Speedbrakes
Speedbrake Lever



1 SPEEDBRAKE LEVER

DOWN (detent) – all spoiler panels are retracted.

ARMED –

- the auto speedbrake system is armed
- after landing, the speedbrake lever automatically moves to UP and the spoiler panels extend

50% – If the speedbrakes are deployed beyond the 50% position and the speedbrake load alleviation feature is activated:

- the speedbrake lever moves to this position
- all flight spoilers retract to one-half of their maximum position for inflight use

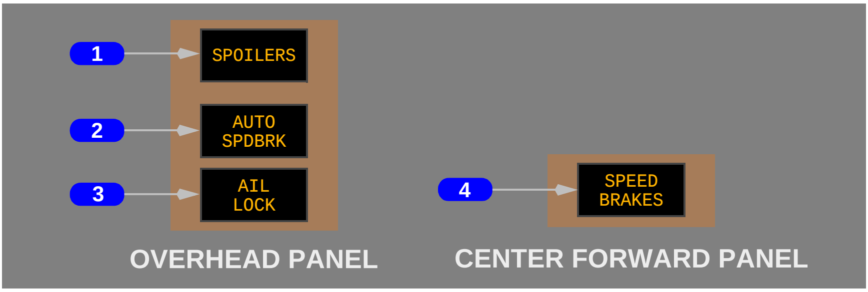
Note: Winglet modifications may include installation of the load alleviation system. If installed, the 50% speedbrake position is utilized to limit speedbrake extension under certain condtions.

UP – the required spoiler panels extend to their maximum in–flight or on–ground positions (intermediate positions can be selected).

On the ground:

- speedbrake lever moves to DOWN and all spoiler panels retract if either thrust lever is advanced to the takeoff thrust position
- the speedbrake lever moves to UP and all spoiler panels extend if either reverse thrust lever is raised to the reverse idle detent

Speedbrake and Aileron Lights



1 SPOILERS Light

Illuminated (amber) – one or more spoiler pairs are inoperative.

2 Auto Speedbrake (AUTO SPDBRK) Light

Illuminated (amber) – a fault is detected in the automatic speedbrake system. Do not exceed 320 knots and do not arm the automatic speedbrakes for landing. Use manual speedbrake deployment as required. Increased force may be required to move the speedbrake lever into the UP position.

3 Aileron Lockout (AIL LOCK) Light

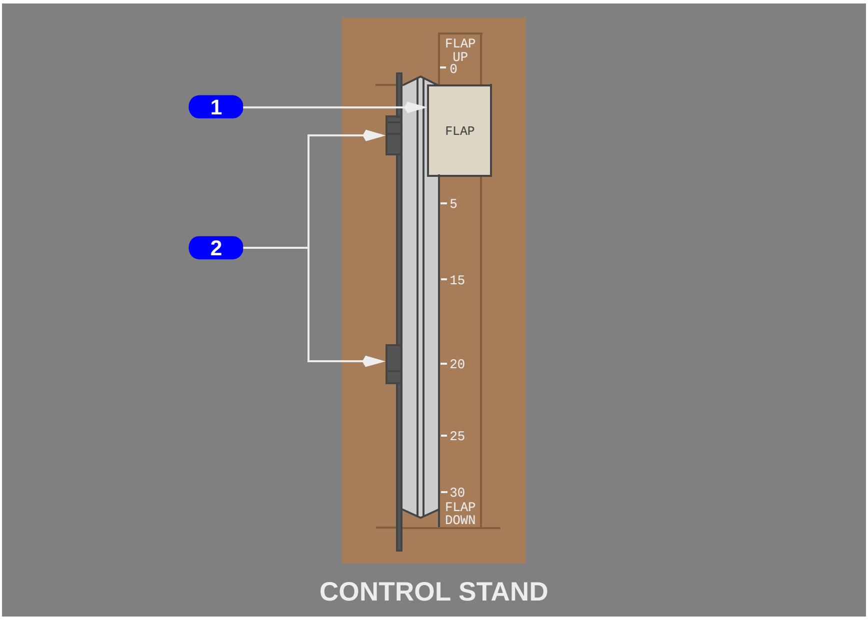
Illuminated (amber) – aileron lockout actuator disagrees with the commanded position.

4 SPEED BRAKES Light

Illuminated (amber) – the speedbrakes are extended when:

- radio altitude is 800 feet or below, or
- flaps are in a landing position

Flap System
Flap Controls



1 FLAP Lever

Positions the slats and flaps hydraulically.

Up – the slats and flaps are retracted.

1 –

- the slats extend to the midrange position
- the flaps remain retracted

5, 15, and 20 –

- the slats remain in the midrange position
- the flaps extend to the commanded position
- the inboard ailerons droop in conjunction with flap extension from 5 to 15 degrees
- the flap load relief system arms at flaps 20

25 –

- the slats extend to the fully extended position
- the flaps extend to 25

30 –

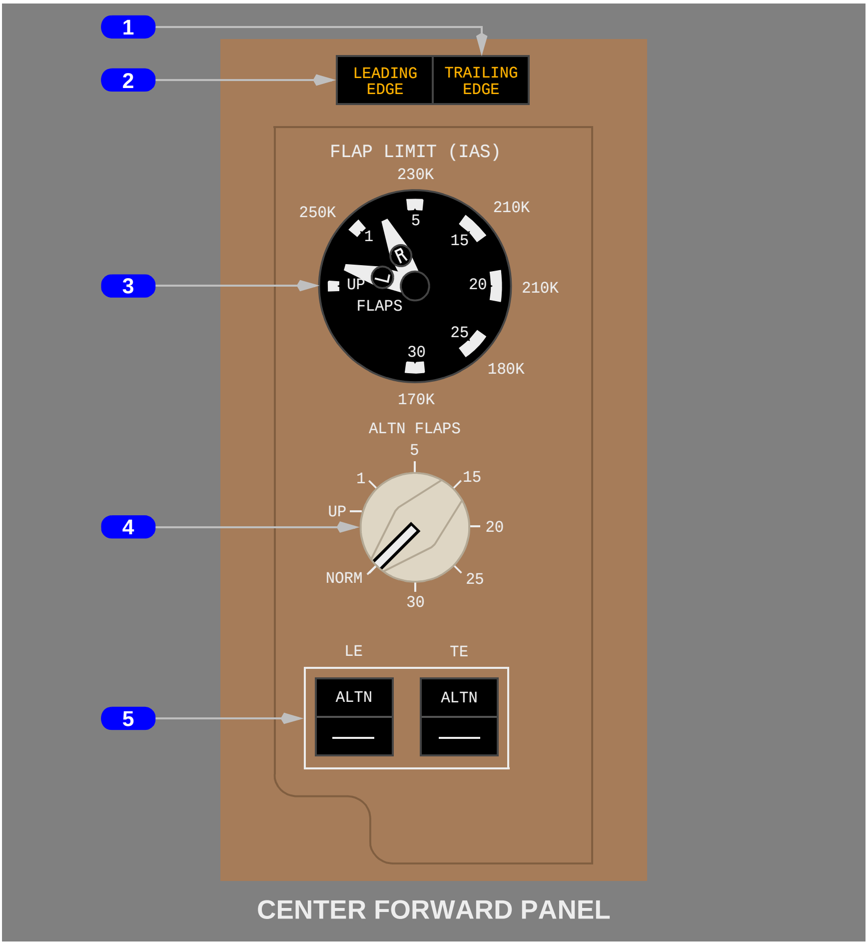
- the slats remain in the fully extended position
- the flaps extend to 30

2 Flap Gates

1 – prevents inadvertent retraction of the slats.

20 – prevents inadvertent retraction of the flaps past the go–around position.

Flap Position Indicator/Alternate Flaps Selector



1 TRAILING EDGE Light

Illuminated (amber) –

- a flap disagree exists
- a flap asymmetry exists
- the flap load relief system is not operating when required

2 LEADING EDGE Light

Illuminated (amber) –

- a slat disagree exists
- a slat asymmetry exists

3 Flap Position Indicator

Indicates flap position.

UP – the slats and flaps are retracted.

Between UP and 1 – the slats are between the retracted and midrange position.

1 to 30 – the flaps are in the indicated position.

4 Alternate (ALTN FLAPS) Flaps Selector

NORM – normal flap operation, alternate system not in use.

UP – the slats and flaps are retracted.

1 –

- the slats extend to the midrange position
- the flaps remain retracted

5 to 20 –

- the slats remain in the midrange position
- the flaps extend to the commanded position

Alternate flaps switches must be in ALTN for the slats and flaps to move.

5 Alternate (ALTN) Flaps Arm Switches

ALTN –

- arms the selected LE slat or TE flap alternate drive unit
- shuts off hydraulic power to the selected LE slat or TE flap drive system.

Off (ALTN not visible) – alternate flaps and slats command inactive.

Intentionally
Blank

Introduction

The primary flight controls are elevators, ailerons, and rudders. The control column, control wheel, and rudder pedals control these flight control surfaces. The primary flight controls are powered by redundant hydraulic systems; there is no manual reversion.

Secondary flight controls include a moveable horizontal stabilizer, spoilers, and leading and trailing edge flaps. Spoilers operate differentially to assist ailerons for roll control and symmetrically as speedbrakes.

There are six guarded flight control shutoff switches that control hydraulic power to the ailerons, spoilers, elevators and rudder. The flight control shutoff OFF light illuminates and the EICAS advisory message L, C, or R WING HYD VAL or L, C, or R TAIL HYD VAL displays when a flight control valve is closed. If two or more OFF lights illuminate the EICAS advisory message FLT CONT VALS displays.

Pilot Controls

The pilot controls consist of:

- two control columns
- two control wheels
- two pairs of rudder pedals
- control wheel stabilizer trim switches
- the speedbrake lever
- the flap lever
- aileron trim switches
- rudder trim switch
- alternate stabilizer trim switches

The columns and wheels are connected through jam override mechanisms. If a jam occurs in a column or wheel, the pilots can maintain control by applying force to the other column or wheel to overcome the jam. When a restricted portion of the flight controls are bypassed, some control effectiveness may be lost.

The rudder pedals are rigidly connected between the two sides.

The speedbrake lever allows manual or automatic symmetric actuation of the spoilers.

Flight Control Surfaces

Pitch control is provided by:

- two elevators
- a movable horizontal stabilizer

Roll control is provided by:

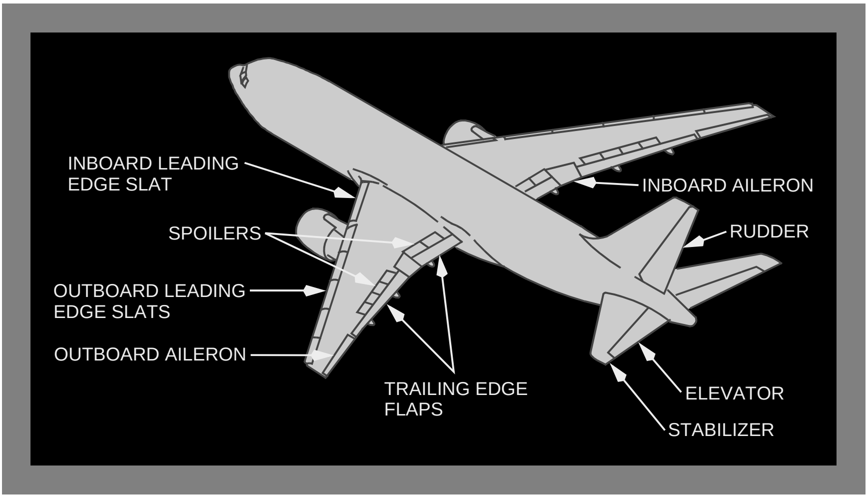
- four ailerons
- twelve spoilers

Yaw control is provided by a single rudder.

Flaps and slats provide high lift for takeoff, approach, and landing.

Symmetric spoilers are used as speedbrakes.

Flight Control Surface Locations



Pitch Control

The pitch control surfaces consist of two elevators and a stabilizer.

Elevator

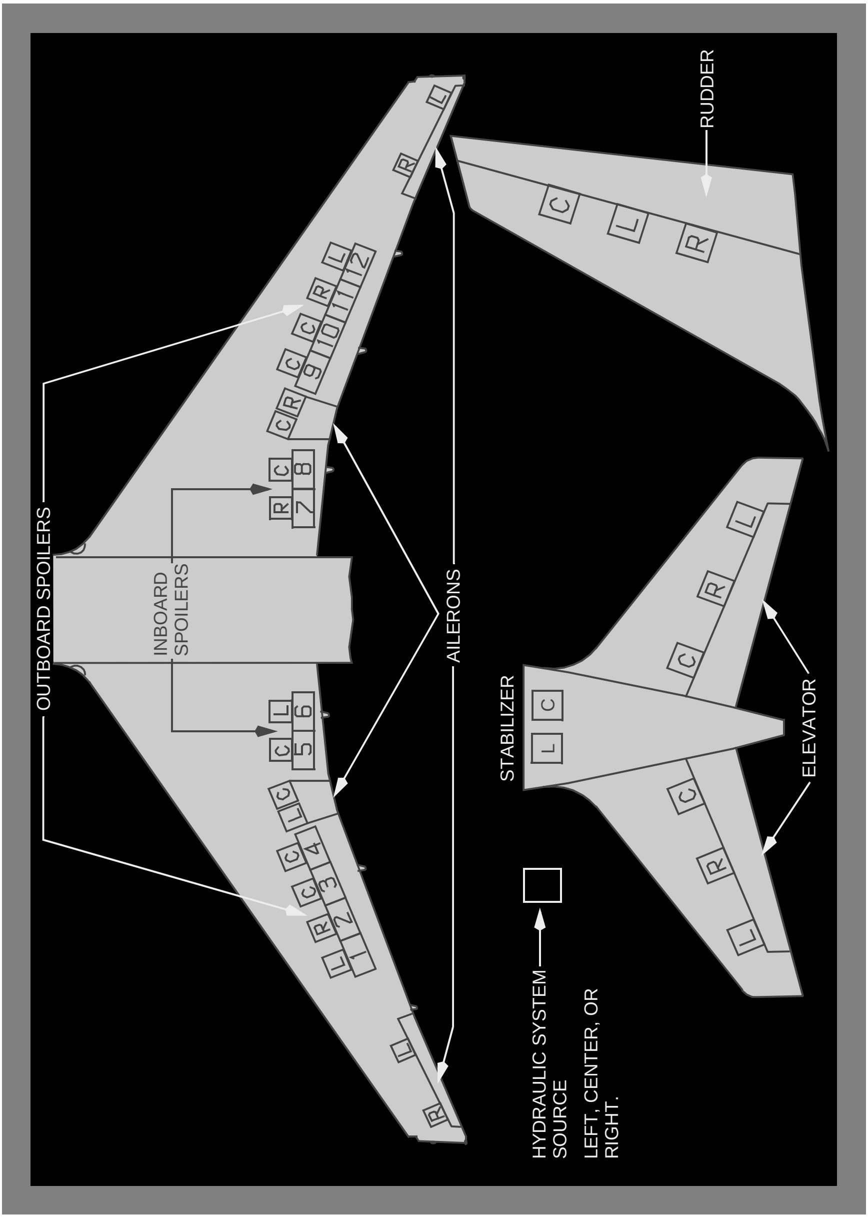
Moving the control column signals hydraulic actuators to move the elevators.

Elevator positions are shown on the EICAS status display. Separate pointers indicate the left and right elevator deflection. A full–scale indication corresponds to the maximum elevator deflection.

If one control column should jam, applying significant forward or aft force to the other causes the two columns to override. Pitch control is then available using the free control column path.

Two elevator feel systems provide artificial feel forces to the pilots control columns. Mechanical springs provide feel following a loss of the left and center hydraulic systems.

Actuator Control Hydraulic Power Distribution



Stabilizer Trim Control

The stabilizer is powered by the left and center hydraulic systems. Stabilizer position commands are sent to the stabilizer trim control modules, which control hydraulic power to the stabilizer. There are two modules, one for each stabilizer hydraulic source.

Stabilizer position is displayed on two stabilizer position indicators located on the control stand. Green bands indicate the normal trim settings for takeoff.

There are three modes of stabilizer trim control:

- electric
- alternate
- automatic

Electric Trim

Dual electric pitch trim switches located on the control wheel must be pushed simultaneously to command trim changes.

The alternate trim system must be used to set the stabilizer trim to less than 1.5 units with the flaps up.

Alternate Trim

Alternate trim control is provided by the alternate stabilizer trim switches on the control stand. Pushing both switches simultaneously commands trim changes and provides an increased range of stabilizer travel. The signals neutralize any other conflicting trim inputs.

Automatic Trim

The stabilizer is controlled automatically by the autopilot.

Automatic stabilizer trim uses only one trim control module and trims at one–half the electric or alternate trim rate.

Non–normal Operation

If a single autopilot is engaged, electric trimming causes the autopilot to disengage. If multiple autopilots are engaged, the electric trim switches are inhibited. Alternate trimming does not cause autopilot disengagement.

The UNSCHED STAB TRIM light illuminates and the EICAS caution message UNSCHD STAB TRIM displays when uncommanded stabilizer motion is detected.

The light and message also occur if alternate trim is used with an autopilot engaged.

The left and center stabilizer cutout switches control hydraulic power to the respective stabilizer trim control module. Placing both switches in the CUTOUT position removes all hydraulic power from the stabilizer.

The control column can be used to interrupt stabilizer trim commands. This feature allows the pilot to quickly stop uncommanded trim changes. The stabilizer trim commands are interrupted if the control column is displaced in the opposing direction.

The STAB TRIM light illuminates and the EICAS advisory message STAB TRIM displays when the electric stabilizer trim rate is one–half the normal control wheel stabilizer trim switch rate.

If the malfunction is unique to the electric trim control, full trim rate is available by using alternate trim.

Pitch Enhancement System (PES)

The Pitch Enhancement System (PES) consists of a hydraulic motor in the right system driving a pump which uses trapped left trim system fluid to operate the stabilizer. It will automatically activate if both the left and center hydraulic systems are lost in flight. Only electric trim is available at approximately 1/4 the normal rate. Alternate and automatic trim will be inoperative.

Roll Control

Two ailerons are located on each wing on either side of the outboard trailing edge flap. Aileron surface deflections are proportional to control wheel displacement. Spoilers begin to extend to augment roll control after several degrees of control wheel rotation. Control wheel forces increase as control displacement increases.

The control wheels are connected so that, if one control wheel jams, using significant force causes the control wheels to override. Roll control is then available using the free control wheel.

The inboard ailerons droop in conjunction with trailing edge flap extension.

Ailerons

Aileron positions are shown on the EICAS status display. A full–scale indication corresponds to maximum aileron deflection.

Dual aileron trim switches located on the aft aisle stand must be pushed simultaneously to command trim changes. Hydraulic power from one of the three hydraulic systems is necessary to accurately set aileron trim.

The amount of aileron trim is indicated on a scale on the top of each control column.

Note: If the flight crew inadvertently activates aileron trim while an autopilot is engaged, the repositioning of the aileron neutral point is not apparent to the crew. When the autopilot is disengaged, the control wheels and ailerons move to the new (possibly undesired) neutral point and the airplane will roll proportional to the amount of trim input.

The aileron lockout control system permits full travel of the outboard ailerons at low speeds and locks out the outboard ailerons at high speeds. This provides the required roll authority at low airspeeds and prevents over controlling at high airspeeds.

The AIL LOCK light illuminates and the EICAS advisory message AILERON LOCKOUT displays to indicate aileron lockout actuator disagrees with the commanded position. At high airspeeds it may indicate that one or both of the outboard ailerons failed to lockout. When the message and light appear at low airspeeds it may indicate that one or both of the outboard ailerons failed to unlock.

Yaw Control

Yaw control is provided by a single rudder. Two yaw dampers operate through the rudder control system to improve directional stability.

Rudder

Rudder position is shown on the EICAS status display. On the ground, a full scale indication corresponds to the maximum rudder deflection.

The rudder trim control can be used to command trim changes. The rudder trim indicator shows the units of rudder trim that are commanded.

Rudder Ratio

The control commands from the rudder pedals and trim control are modified by a rudder ratio changer. As airspeed increases the ratio changer desensitizes these inputs from the pilot to reduce the rudder deflection.

The ratio changer receives air data computer airspeed inputs and provides control commands to an actuator powered by the left hydraulic system. The actuator then dampens the pilots inputs to the rudder.

The RUDDER RATIO light illuminates and the EICAS advisory message RUDDER RATIO displays to indicate the rudder ratio system is failed. Rudder structural protection is provided by automatic depressurization of the left hydraulic system actuator which limits rudder displacement at high airspeeds. However, abrupt rudder pedal input should be avoided at high airspeeds. At low airspeeds the two remaining rudder actuators provide sufficient control for full rudder displacement.

If the left hydraulic system is providing normal pressure to the ratio changer, a fault may result in limited displacement of the rudder at all airspeeds. This requires that crosswind and auto land limitations be observed.

Yaw Damping

The yaw damper systems improve turn coordination and dutchroll damping.

The yaw damper INOP light illuminates and the EICAS advisory message L or R YAW DAMPER displays, when a yaw damper is inoperative.

Spoilers

There are six spoiler panels located on the upper wing surface of each wing. Spoilers on opposing wings are symmetrically paired.

Spoiler panels are used as speedbrakes to increase drag and reduce lift, both in flight and on the ground. The spoilers also supplement roll control in response to control wheel commands.

Speedbrake Load Alleviation System

The speedbrake load alleviation system may be installed on aircraft with winglets. It can be identified by the addition of a 50% position on the speedbrake lever.

The speedbrake load alleviation system operates in flight when these conditions occur at the same time:

- Flaps are UP
- Gross weight is greater than 154,221 kgs
- Indicated airspeed is greater than 320 knots

If the speedbrake lever is beyond the 50% position, it will automatically move to the 50% position. If the speedbrake lever is DOWN, an attempt to move it past the 50% position will be restricted. In either case, the pilot may override the speedbrake lever restriction by applying additional force to the speedbrake lever.

When gross weight decreases to less than 153,768 kgs or airspeed is reduced to less than 315 knots, the load alleviation system deactivates and speedbrake lever movement is unrestricted.

Spoiler Speedbrake Operation

The speedbrakes are controlled by the speedbrake lever located on the control stand. The speedbrake lever has four marked positions:

- DOWN
- ARMED
- 50%
- UP

On airplanes equipped with the speedbrake load alleviation system, the speedbrake lever can be placed in intermediate positions between ARMED and UP; however, the load alleviation system may limit lever placement to 50% or less.

In the ARMED position, when the landing gear is fully on the ground (not tilted) and the thrust levers are at idle, the speedbrake lever is driven aft to the UP position and the spoiler panels are fully extended.

On the ground, when either reverse thrust lever is moved to the reverse idle detent, the speedbrake lever is driven to the up position and the spoiler panels are fully extended. The speedbrake lever does not need to be in the ARMED position.

The SPEEDBRAKES light illuminates if speedbrakes are extended when radio altitude is 800 feet or below or the flaps are in landing position.

The EICAS caution message SPEEDBRAKES EXT displays and the master caution lights and beeper activate when the SPEEDBRAKES light illuminates.

The AUTO SPDBRK light illuminates and the EICAS advisory message AUTO SPEEDBRAKE displays to indicate a fault is detected in the automatic speedbrake system which may result in the loss of automatic speedbrake extension.

If the speedbrake lever is armed, the message and light indicate a fault which may result in an inadvertent speedbrake extension in flight. The speedbrake lever should be returned to the DOWN position. The speedbrakes can still be operated manually.

If the AUTO SPDBRK light illuminates on airplanes equipped with the load alleviation system, do not exceed 320 knots. Increased force may be required to move the speedbrake lever into the UP postion during manual operation due to actuation of the load alleviation system.

The SPOILERS light illuminates and the EICAS advisory message SPOILERS displays to indicated that one or more spoiler pairs are inoperative.

Flaps and Slats

The trailing edge flaps and leading edge slats are high lift devices that increase wing lift and decrease stall speed during takeoff, approach, and landing.

Flap and slat positions are indicated by two pointers in the flap position indicator. There are L and R pointers for the left and right wing flaps and slats. The right pointer is normally hidden from view by the left pointer.

In the flaps 1 position, only the slats move. Flaps 5, 15, 20 are takeoff flap positions. Flaps 25 and 30 are landing flaps positions. Flaps 20 is used for some non-normal landing conditions.

Flap and Slat Sequencing

When the flap lever is in the UP detent, all flaps and slats are commanded retracted and the flap position indicator points to UP. Moving the flap lever aft allows selection of flap detent positions 1, 5, 15, 20, 25, and 30.

Starting from flaps UP, selection of flaps 1 commands the slats to move to the midrange position. The flaps remain retracted. The position indicator pointers move mid–way between UP and 1 when the slats are in transit. The pointers move to the 1 indication when all slats are in the midrange position.

Selection of the flaps 5, 15, or 20 positions commands the flaps to move to the position selected. The inboard ailerons droop in conjunction with flap extension. The slats remain in the midrange position. The position indicator provides only trailing edge flap position indications for all flap settings greater than 1.

Selection of flaps 25 commands both the flaps and slats to move to landing positions.

Selection of flaps 30 commands the flaps to extend to the primary landing position.

During retraction flap and slat sequencing is reversed.

The flap gate at the flaps 20 detent prevents inadvertent retraction of the flaps past the go–around position. The flap gate at flaps 1 prevents inadvertent retraction of the slats.

Flap Load Relief

The flap load relief system protects the flaps from excessive airloads.

If the flap airspeed placard limit is exceeded with the flaps in the 25 or 30 position, the flaps automatically retract to position 20.

When airspeed is reduced, the flaps automatically re–extend.

Flap/Slat Non–Normal Operation
Alternate Flap Operation

The alternate mode allows direct manual operation of either the flaps and/or slats through electric motors. The alternate flaps switches:

- allow independent selection of either flaps or slats
- disable normal control
- arm the alternate mode
- engage the electric motors
- the flap lever no longer controls the selected flaps and/or slats

The alternate flaps selector extends and retracts the flaps and slats. Alternate mode flap and slat extension is limited procedurally to flaps 20. Flap load relief is not available in the alternate mode.

Trailing edge flap asymmetry protection is not available in the alternate mode.

Slat and flap operation time in the alternate mode is greatly increased.

Leading Edge Disagreement

The LEADING EDGE light illuminates and the EICAS caution message LE SLAT DISAGREE displays when the leading edge slat positions disagree with commanded position.

The disagree indicates that the slats are not driving toward their new commanded position.

A LE SLAT DISAGREE may also occur if the flap lever is not in a detent for an extended period of time. In this case, the light and message can be removed by moving the flap lever to the desired detent.

Leading Edge Asymmetry

The LEADING EDGE light illuminates and the EICAS caution message LE SLAT ASYM displays when the leading edge slats are not symmetrically extended. Hydraulic power to the slats is automatically shut off.

Trailing edge flaps extension is inhibited until the slats extend to position 1. Therefore, if a slat asymmetry occurs between the UP and 1 positions, the flap indicator may not move until flaps 5 or greater is selected.

Trailing Edge Disagreement

The TRAILING EDGE light illuminates and the EICAS caution message TE FLAP DISAGREE displays when the trailing edge flap positions disagree with commanded position.

The disagree indicates that the flaps are not driving toward their new commanded position.

A TE FLAP DISAGREE may also occur if the flap lever is not in a detent for an extended period of time. In this case, the light and message can be removed by moving the flap lever to the desired detent.

Trailing Edge Asymmetry

The TRAILING EDGE light illuminates and the EICAS caution message TE FLAP ASYM displays when the trailing edge flaps are not symmetrically extended. Hydraulic power to the flaps is automatically shut off.

Load Relief Inoperative

The TRAILING EDGE light illuminates and the EICAS advisory message FLAP LD RELIEF is displayed when the flap load relief system fails to operate when required.

Hydraulic Driven Generator

When the hydraulic driven generator is supplying electrical power, hydraulic flow to the slats and flaps is reduced, resulting in increased slat and flap operating time.

Flight Controls EICAS Messages

The following EICAS messages can be displayed.

Message	Level	Light	Aural	Condition
AILERON LOCKOUT	Advisory	AIL LOCK		An aileron lockout actuator disagrees with the commanded position.
AUTO SPEEDBRAKE	Advisory	AUTO SPDBRK		A fault is detected in the automatic speedbrake system.
FLAP LD RELIEF	Advisory	TRAILING EDGE		The flap load relief system fails to operate when required.
FLT CONT VALS	Advisory	OFF		Two or more flight control valves are closed.
LE SLAT ASYM	Caution	LEADING EDGE	Beeper	The leading edge slats are not symmetrically extended.
LE SLAT DISAGREE	Caution	LEADING EDGE	Beeper	The leading edge slat positions disagree with the commanded position.
RUDDER RATIO	Advisory	RUDDER RATIO		The rudder ratio system is failed.
SPEEDBRAKE S EXT	Caution	SPEED BRAKES	Beeper	The speedbrakes are extended when the flaps are in a landing position, or when radio altitude is 800 feet or below.
SPOILERS	Advisory	SPOILERS		One or more spoiler pairs are inoperative.

Message	Level	Light	Aural	Condition
STAB TRIM	Advisory	STAB TRIM		The stabilizer trim rate is one–half of the normal control wheel stabilizer trim switch rate.
C TAIL HYD VAL L TAIL HYD VAL R TAIL HYD VAL	Advisory	OFF		A tail flight control valve is closed.
TE FLAP ASYM	Caution	TRAILING EDGE	Beeper	The trailing edge flaps are not symmetrically extended.
TE FLAP DISAGREE	Caution	TRAILING EDGE	Beeper	The trailing edge flap positions disagree with the commanded position.
UNSCHD STAB TRIM	Caution	UNSCHED STAB TRIM	Beeper	Uncommanded stabilizer motion is detected.
C WING HYD VAL L WING HYD VAL R WING HYD VAL	Advisory	OFF		A wing flight control valve is closed.
L YAW DAMPER R YAW DAMPER	Advisory	INOP		The yaw damper is inoperative.

Flight Instruments, Displays — Chapter 10
Table of Contents — Section TOC

Intentionally
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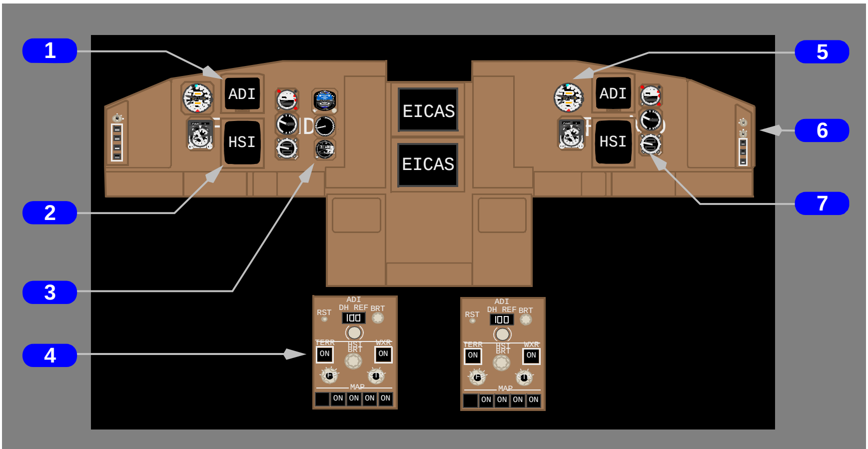
Flight Instruments, Displays — Chapter 10
EFIS Controls and Indicators — Section 10

Flight Instrument Display System - Overview



LEFT AND RIGHT FORWARD PANELS

1 Attitude Director Indicator (ADI)

Displays flight management modes, airspeed, attitude, and radio altitude.

2 Horizontal Situation Indicator (HSI)

Displays map, approach, VOR or plan modes as selected on EFIS CPs.

3 Standby Flight Instruments

4 EFIS Control Panels

Displays controlled via their respective EFIS CP

5 Primary Airspeed Indicator (Conventional)

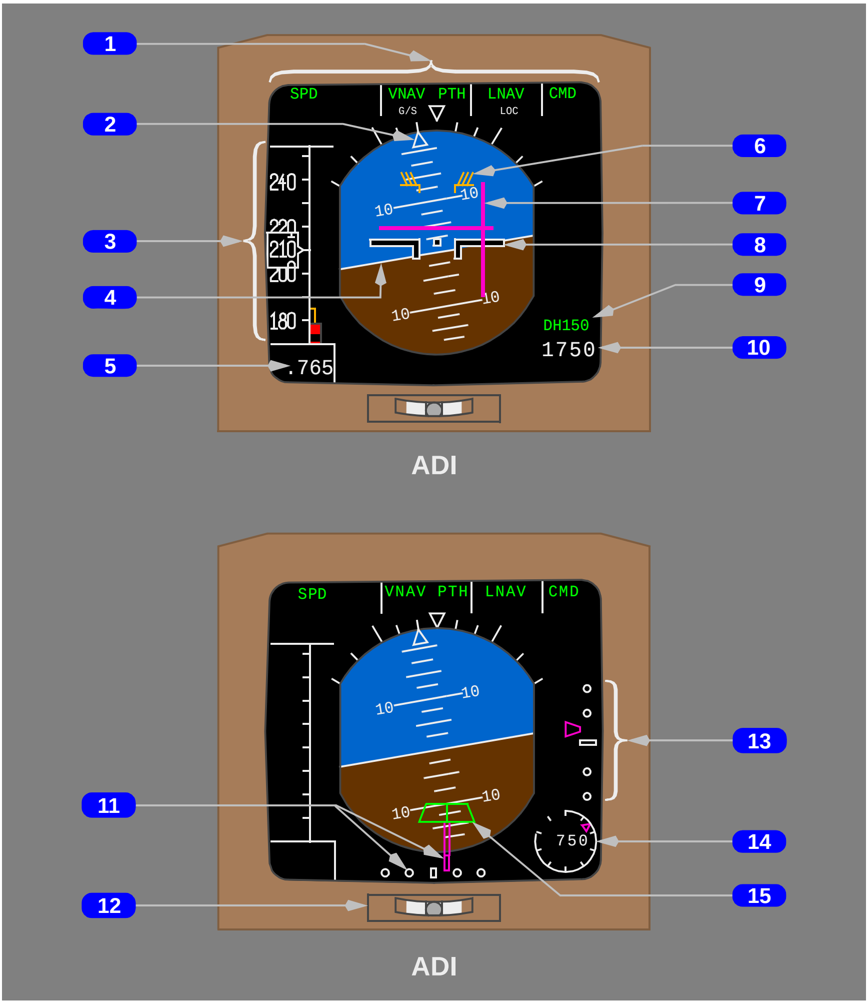
6 Source Selector Panel

Selects sources for respective flight instruments.

7 Primary Flight Instruments (Conventional)

Attitude Director Indicator (ADI) Display

N422LA through N526LA



1 **Flight Mode Annunciations**

Displays Autopilot Flight Director System (AFDS) mode status. Refer to Automatic Flight, Chapter 4 for description.

2 **Bank Pointer and Scale**

Indicates IRS bank in reference to the bank scale.

3 **Speed Tape Airspeed Indicator**

4 **Horizon Line and Pitch Angle Scale**

Indicates the IRS horizon relative to the airplane symbol. Pitch scale is in 2.5 degree increments.

5 **Mach Number**

6 **Pitch Limit Indicator**

7 **Flight Director Command Bars**

8 **Airplane Symbol**

9 **Decision Height**

10 **Radio Altitude**

11 **Localizer Pointer and Deviation Scale**

12 **Slip Indicator**

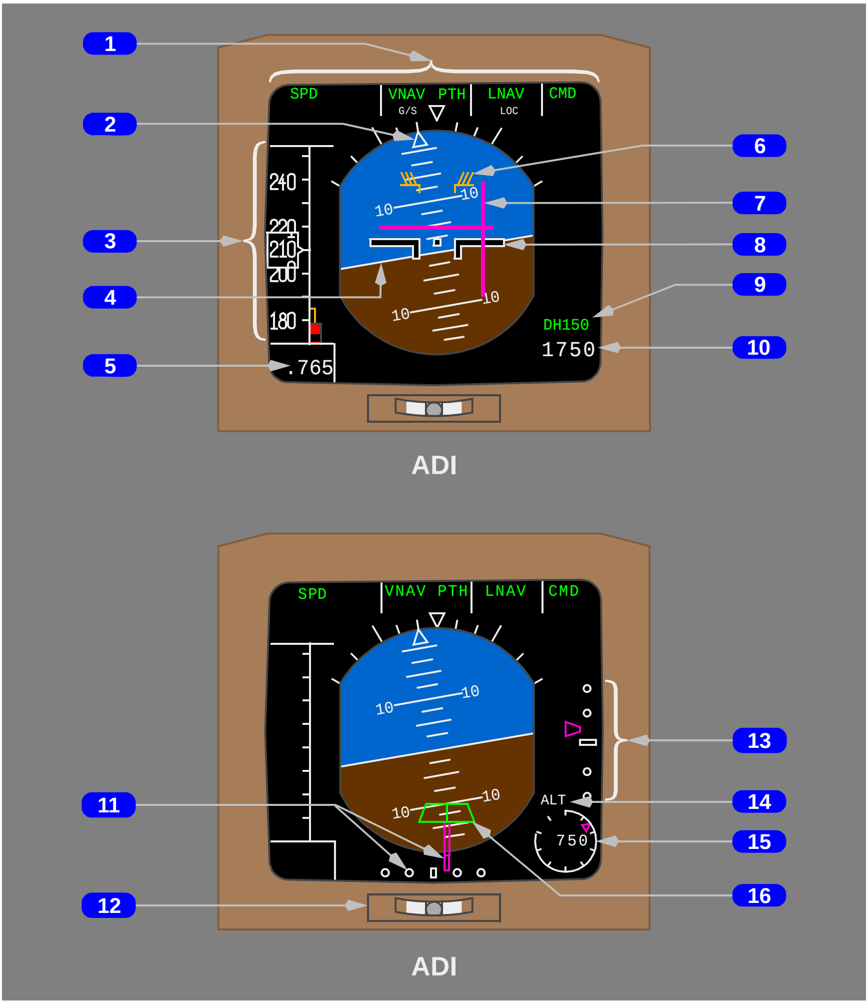
Indicates coordinated flight.

13 **Glideslope Pointer and Deviation Scale**

14 **Radio Altitude Dial**

15 **Rising Runway**

N316LA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ADI

1 Flight Mode Annunciations

Displays Autopilot Flight Director System (AFDS) mode status. Refer to Automatic Flight, Chapter 4 for description.

2 Bank Pointer and Scale

Indicates IRS bank in reference to the bank scale.

3 Speed Tape Airspeed Indicator

4 Horizon Line and Pitch Angle Scale

Indicates the IRS horizon relative to the airplane symbol. Pitch scale is in 2.5 degree increments.

5 Mach Number

6 Pitch Limit Indicator

7 Flight Director Command Bars

8 Airplane Symbol

9 Decision Height

10 Radio Altitude

11 Localizer Pointer and Deviation Scale

12 Slip Indicator

Indicates coordinated flight.

13 Glideslope Pointer and Deviation Scale

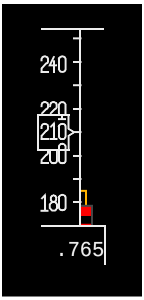
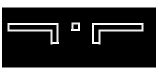
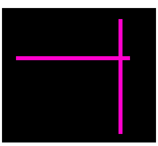
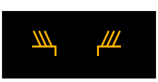
14 Height Alert

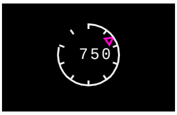
15 Radio Altitude Dial

16 Rising Runway

ADI Symbology

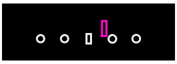
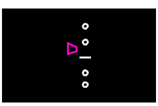
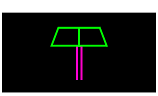
The following symbols can be displayed.

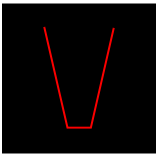
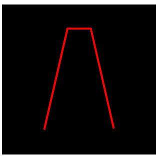
Symbol	Name	Remarks
	Speed tape airspeed indicator with rolling digits (white).	Displays airspeed information. Refer to "ADI Speed Tape" in this section for description.
	Airplane symbol (black)	Indicates airplane attitude with reference to the IRS horizon.
	Flight director command bars (magenta)	Indicates flight director pitch and roll steering commands. • displays when the respective F/D switch is ON and valid command steering is available • blanks when the respective F/D switch is OFF or when command steering becomes invalid.
	PLI - Pitch Limit Indicator (amber)	Indicates pitch limit (stick shaker activation point for the existing flight conditions). • displays when flaps are not up, or at slow speeds with the flaps up.
	Decision height (green/amber)	Displays selected decision height. • blanks when negative decision height is selected • replaced by dial display below 1,000 feet AGL.
	Radio altitude (white/amber)	Displays radio altitude. • blank above 2500 feet AGL • changes to dial display below 1,000 feet AGL.

Symbol	Name	Remarks
	Radio altitude dial (white) and pointer (magenta)	Displays when radio altitude is 1,000 feet AGL or below. • when dial displayed, pointer replaces digital decision height display • dial displays in 100 foot increments • during descent, segments of the dial erase, with remaining dial indicating radio altitude • display changes from white to amber and flashes momentarily when airplane descends below decision height (decision height alerting) • decision height alert is reset automatically – if airplane climbs 75 feet or more above the selected decision height, or after the airplane lands • decision height alert is reset manually – if the RST switch is pushed.

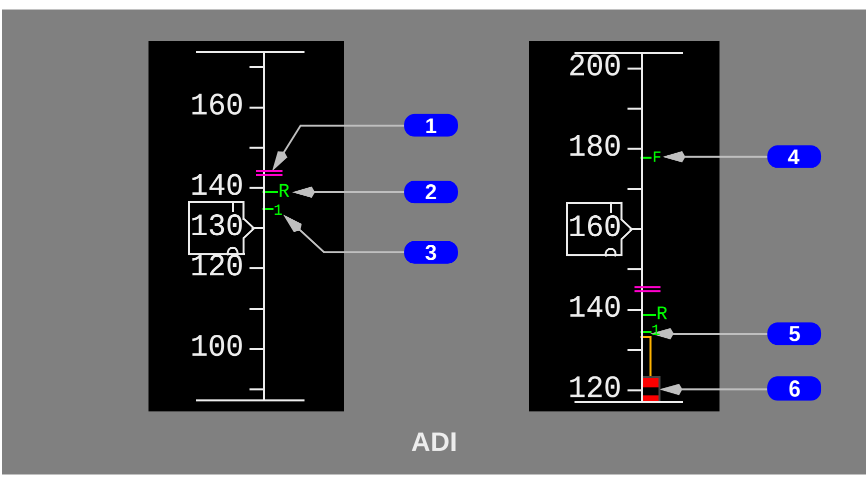
N316LA

	Height alerting (white)	Indicates airplane has descended through a specified altitude. • blanks if the RST switch is pushed. • displays during descent from 2,500 feet to 500 feet AGL

Symbol	Name	Remarks
	Localizer deviation scale (white) and pointer (magenta)	The localizer pointer indicates position relative to the airplane. • scale indicates deviation • pointer not displayed when localizer is unusable • scale and pointer not displayed when an ILS frequency is not selected • scale and pointer can display an ILS Deviation Alert. • a two dot expanded localizer scale (not shown here) displays when LOC is engaged and deviation is slightly more than one half dot on the four dot scale. • expanded scale is more sensitive, with one dot deviation equal to one half dot deviation on the four dot scale
	Glideslope deviation scale (white) and pointer (magenta)	The glideslope pointer indicates glideslope position relative to the airplane. • scale indicates deviation • pointer not displayed when glideslope unusable or when track and the front course on the ILS panel differ by more than 90° • scale and pointer not displayed when an ILS frequency is not selected • scale and pointer can display an ILS deviation alert.
	Rising runway (green)	Displays when the localizer pointer is displayed and radio altitude is below 2500 feet. • rises towards airplane symbol when radio altitude is below 200 feet AGL • stem can display an ILS deviation alert.

Symbol	Name	Remarks
	Vertical guidance (down advisory) (red)	Displayed whenever a TCAS RA is active. Indicates pitch altitude region to be avoided for traffic avoidance maneuver. Refer to Chapter 15, Warning Systems. **Note:** Both of the TCAS RA pitch commands (above and below) may be displayed at the same time. **Note:** The area inside the red lines indicates the pitch region to avoid in order to resolve the traffic conflict. The center of the airplane symbol must be outside the red RA pitch command area to ensure traffic avoidance.
	Vertical guidance (up advisory) (red)	
WINDSHEAR	Windshear annunciation (Red)	Windshear warning active. Refer to Chapter 15, Warning Systems.

ADI Speed Tape



1 FMC/MCP Command Airspeed Bug

Displays when the FMC/MCP command airspeed as selected by the FMC or the IAS/MACH selector is in the displayed range.

2 VR (Rotation Speed) Bug

Indicates rotation speed.

- displays after manual entry on the TAKEOFF REF page
- blanks 2 minutes after takeoff.

3 V1 (Decision Speed) Bug

Indicates Decision Speed

- displays after manual entry on the TAKEOFF REF page
- replaces digital V1 display when V1 speed is within the displayed range
- blanks 2 minutes after takeoff.

4 VF (Maneuvering Speed) Bug

- displays maneuvering speed for existing flap setting
- displays 10 seconds after takeoff
- if VF is within 4 knots of VR, both VR and V1 bugs are blanked
- blanks above 20,000 feet.

5 Minimum Maneuvering Speed

Top of amber bar indicates minimum maneuvering speed. This airspeed provides:

- 1.3g maneuver capability to stick shaker below approximately 20,000 feet
- 1.3g maneuver capability to low speed buffet (or an alternative approved maneuver capability as preset by maintenance) above approximately 20,000 feet.

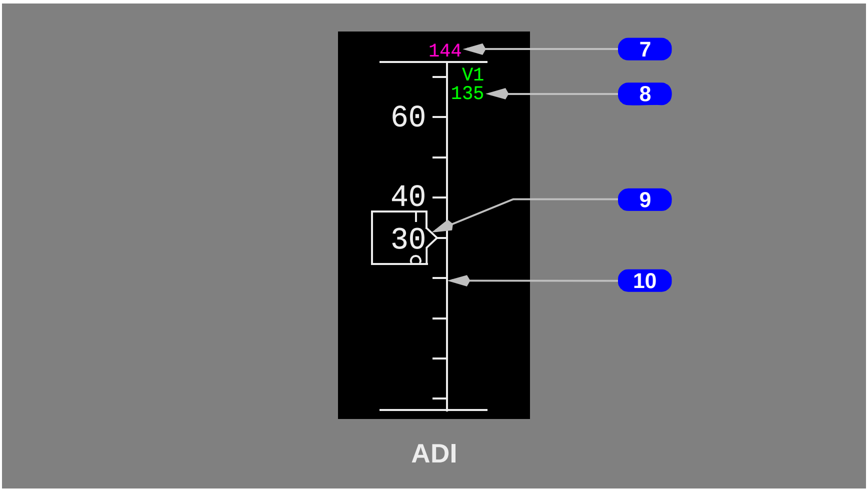
Displayed shortly after takeoff.

Note: 1.3g maneuver capability occurs at 40 degrees of bank in level flight.

6 Minimum Operating Speed

Indicates the minimum operating speed

- below 20,000 feet - airspeed where stick shaker activates
- above 20,000 feet - airspeed where stick shaker or low speed buffet occurs, whichever is higher.



7 **FMC/MCP Command Airspeed**

Displays in this location when the FMC/MCP command airspeed bug as selected by the FMC or IAS/MACH selector is above the displayed range.

8 **V1 (Decision Speed)**

Indicates decision speed.

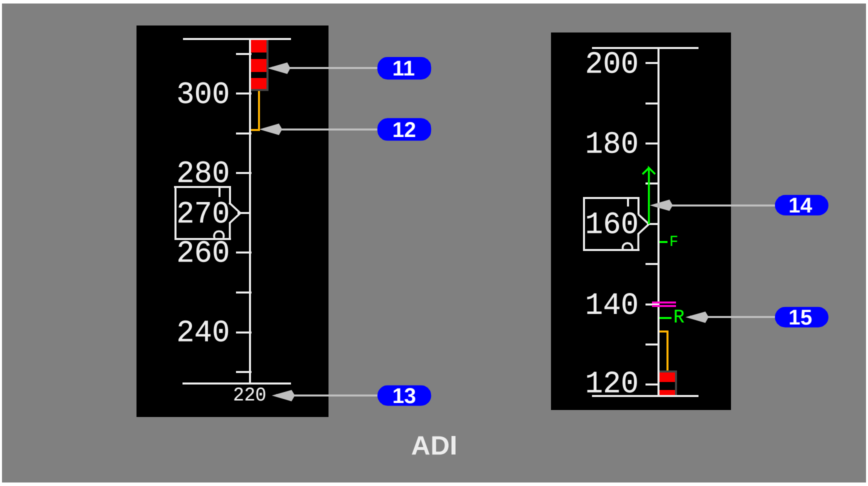
- displays after manual entry on the TAKEOFF REF page
- displays during initial takeoff roll when V1 is above the displayed range.

9 **Airspeed Pointer and Digital Display**

- indicates current airspeed when above 30 knots

10 **Speed Tape Scale**

Scrolls up or down in response to airspeed changes.



11 Maximum Speed

Indicates maximum permissible airspeed as limited by the lowest of the following:

- Vmo/Mmo
- landing gear placard speed
- flap placard speed.

12 Maximum Maneuvering Speed

Bottom of the amber bar indicates the maximum maneuvering speed. This airspeed provides 1.3g maneuver capability to high speed buffet (or an alternative approved maneuver capability set by maintenance). May be displayed when operating at high altitude at relatively high gross weights.

Note: 1.3g maneuver capability occurs at 40 degrees of bank in level flight.

13 FMC/MCP Command Airspeed

Displayed in this location when the FMC/MCP command airspeed bug as selected by the FMC or IAS/MACH selector is below the displayed range.

14 Speed Trend Vector

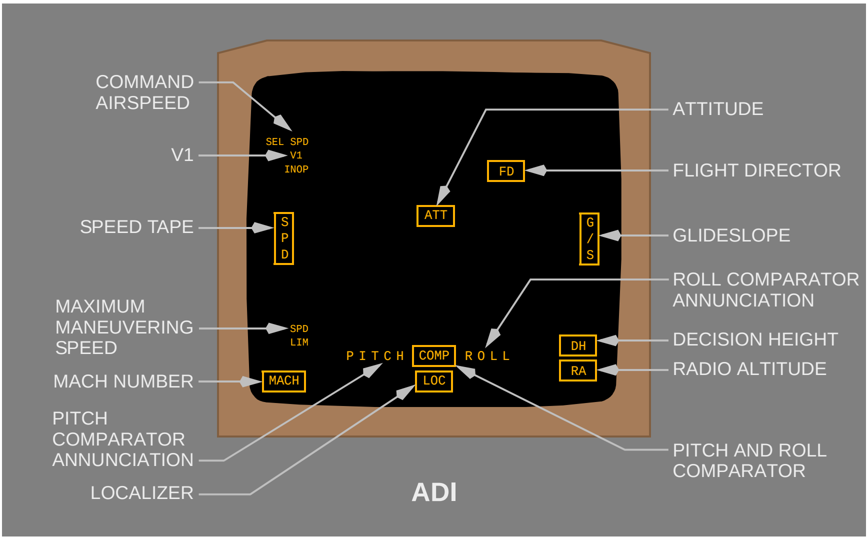
Indicates predicted airspeed in 10 seconds based on current acceleration or deceleration.

15 Landing Reference Bug

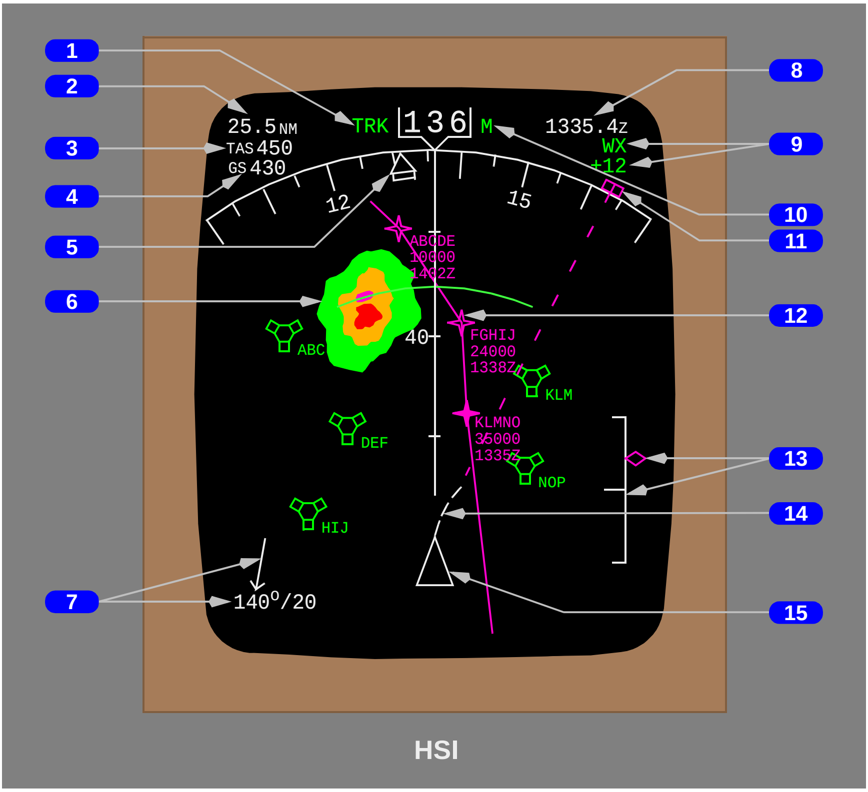
Displays the VREF speed as selected on the APPROACH REF page.

ADI Failure Flags and Annunciations

Note: ADI failure flags replace the appropriate display to indicate source system failure, or lack of computed information.



Horizontal Situation Indicator (HSI) Display Modes
MAP Mode



1 **Current Track**

2 **Distance to the Active Waypoint**

3 **True Airspeed**

4 **Groundspeed**

5 **Heading Pointer**

6 **Weather Radar Returns**

7 **Wind Direction and Speed**

8 **Estimated Time of Arrival at the Active Waypoint**

9 **Weather Radar Annunciations**

10 **Magnetic/True Reference**

11 **Selected Heading Bug**

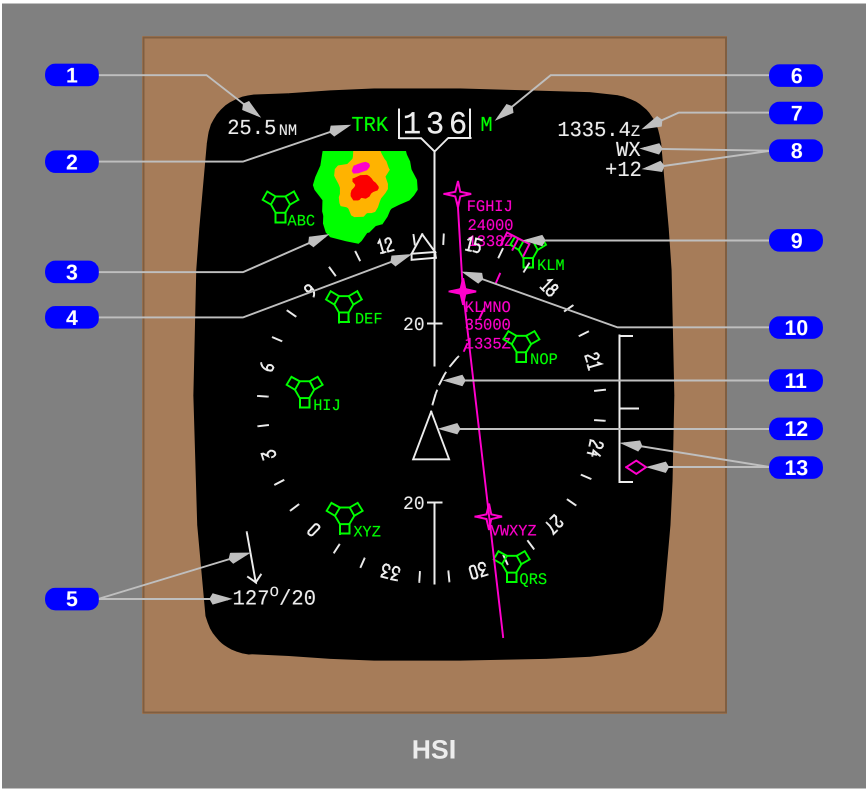
12 **Active LNAV Route**

13 **Vertical Pointer and Deviation Scale**

14 **Position Trend Vector**

15 **Airplane Symbol**

CTR MAP Mode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VWXYZ
QRS
127°/20
HSI

1 **Distance to the Active Waypoint**

2 **Current Track**

3 **Weather Radar Returns**

4 **Heading Pointer**

5 **Wind Direction and Speed**

6 **Magnetic/True Reference**

7 **Estimated Time of Arrival at the Active Waypoint**

8 **Weather Radar Annunciations**

9 **Selected Heading Bug**

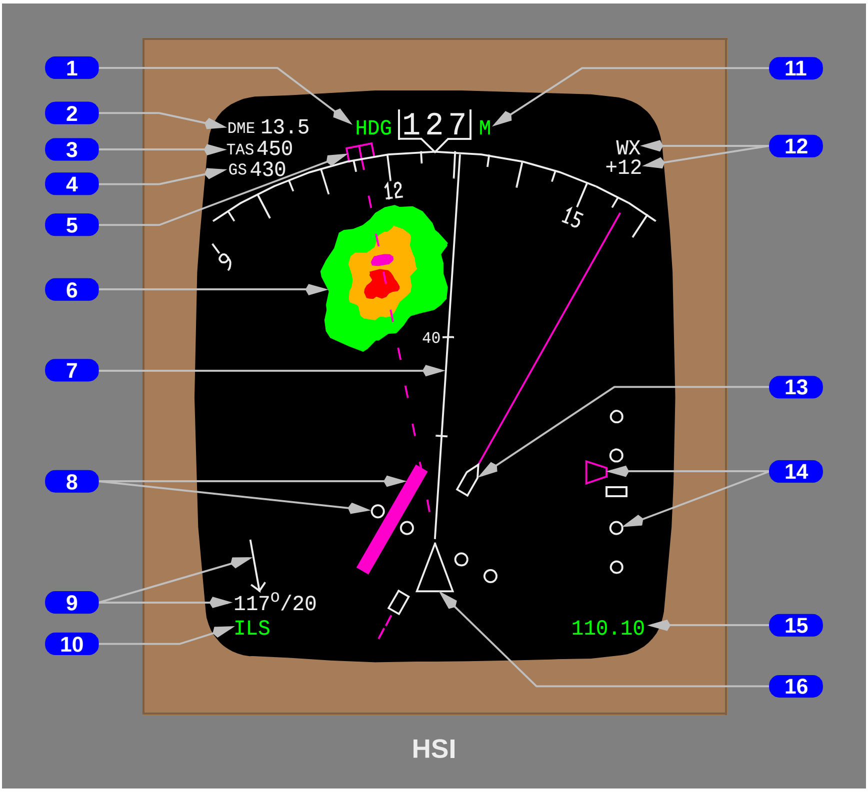
10 **Active LNAV Route**

11 **Position Trend Vector**

12 **Airplane Symbol**

13 **Vertical Pointer and Deviation Scale**

APP Mode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HDG 127 M
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117°/20
ILS
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HSI

1 **Current Heading**

2 **Reference ILS DME**

3 **True Airspeed**

4 **Groundspeed**

5 **Selected Heading Bug**

6 **Weather Radar Returns**

7 **Track Line**

8 **Course Deviation Indicator and Deviation Scale**

9 **Wind Direction and Speed**

10 **Reference ILS Receiver**

11 **Magnetic/True Reference**

12 **Weather Radar Annunciations**

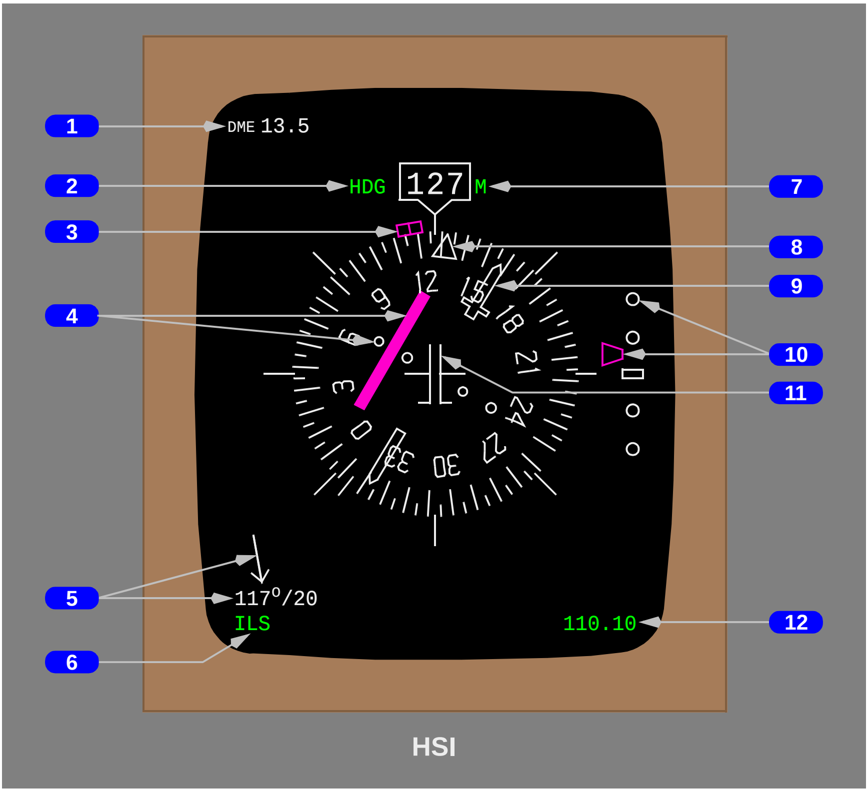
13 **Selected Course Pointer**

14 **Glideslope Pointer and Deviation Scale**

15 **Reference ILS Frequency**

16 **Airplane Symbol**

CTR APP Mode



1 **Reference ILS DME**

2 **Current Heading**

3 **Selected Heading Bug**

4 **Course Deviation Indicator and Deviation Scale**

5 **Wind Direction and Speed**

6 **Reference ILS Receiver**

7 **Magnetic/True Reference**

8 **Drift Angle Pointer**

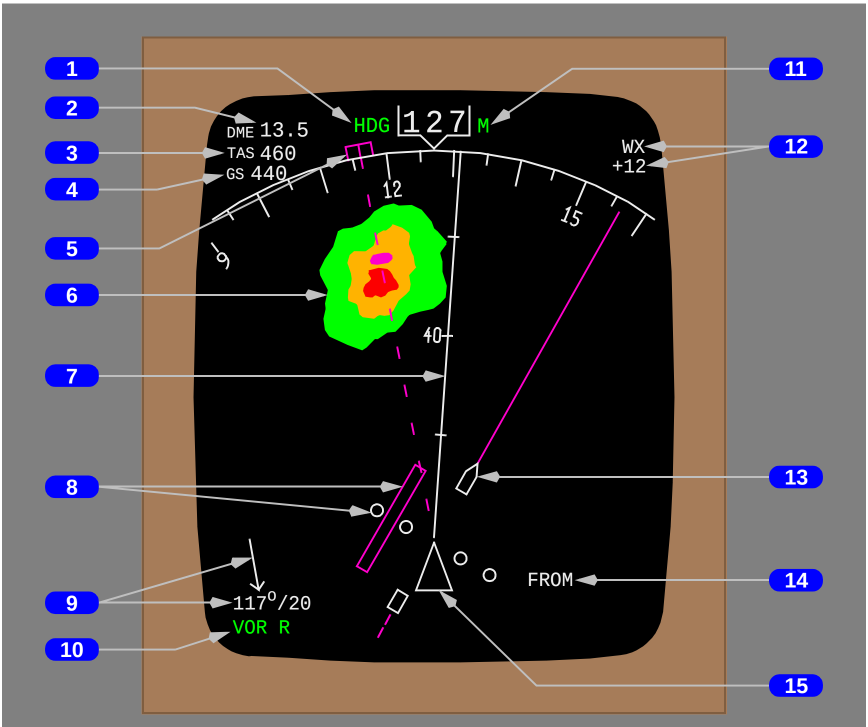
9 **Selected Course Pointer**

10 **Glideslope Pointer and Deviation Scale**

11 **Airplane Symbol**

12 **Reference ILS Frequency**

VOR Mode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GS 440
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VOR R
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HSI

1 **Current Heading**

2 **Reference VOR DME**

3 **True Airspeed**

4 **Groundspeed**

5 **Selected Heading Bug**

6 **Weather Radar Returns**

7 **Track Line**

8 **Course Deviation Indicator and Deviation Scale**

9 **Wind Direction and Speed**

10 **Reference VOR Receiver**

11 **Magnetic/True Reference**

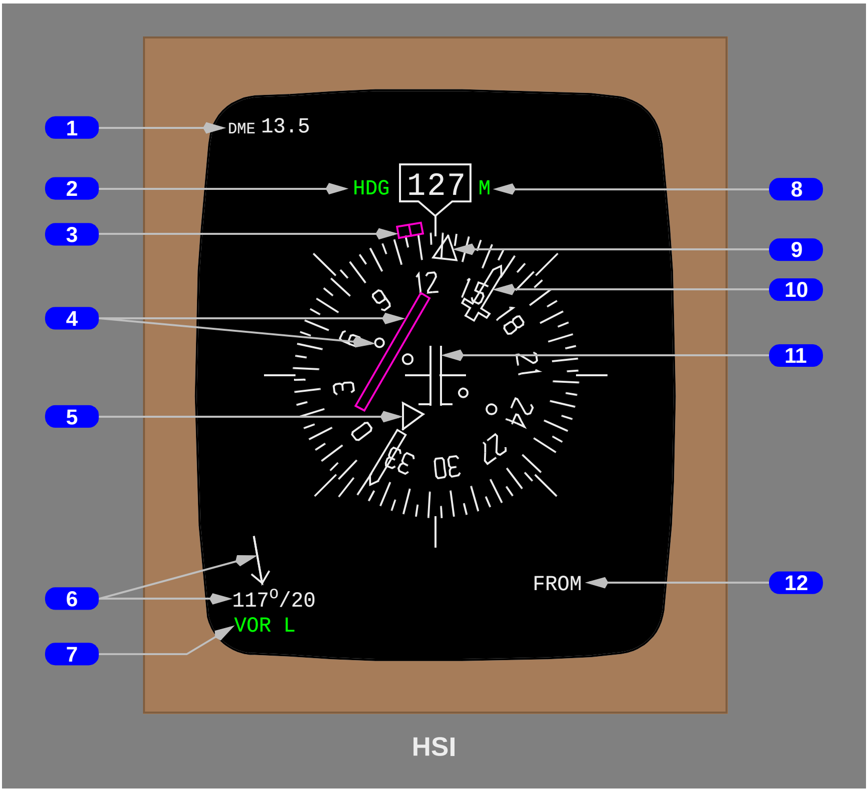
12 **Weather Radar Annunciations**

13 **Selected Course Pointer**

14 **TO/FROM Indication**

15 **Airplane Symbol**

CTR VOR Mode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1 **Reference VOR DME**

2 **Current Heading**

3 **Selected Heading Bug**

4 **Course Deviation Indicator and Deviation Scale**

5 **To/From Pointer**

6 **Wind Direction and Speed**

7 **Reference VOR Receiver**

8 **Magnetic/True Reference**

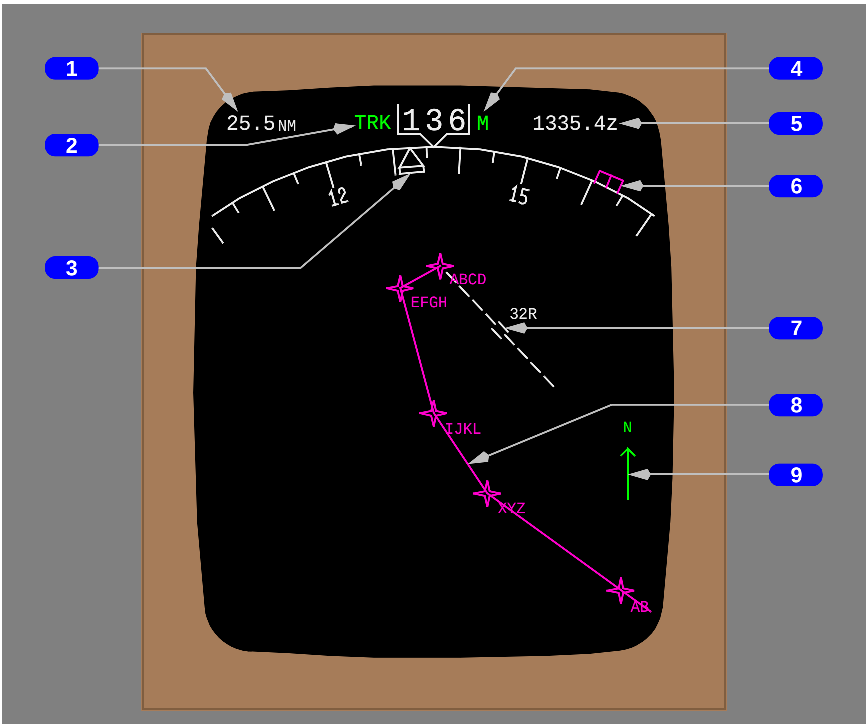
9 **Drift Angle Pointer**

10 **Selected Course Pointer**

11 **Airplane Symbol**

12 **TO/FROM Indication**

PLAN Mode



HSI

1 **Distance to the Active Waypoint**

2 **Current Track**

3 **Heading Pointer**

4 **Magnetic/True Reference**

5 **Estimated Time of Arrival at the Active Waypoint**

6 **Selected Heading Bug**

7 **Airport and Runway**

8 **Active LNAV Route**

9 **True North Pointer**

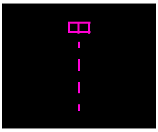
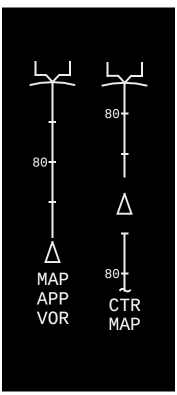
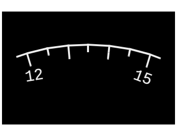
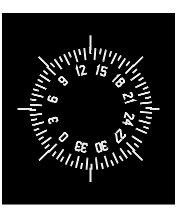
HSI Symbology

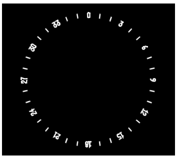
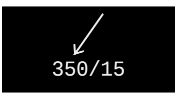
The following symbols can be displayed, depending on EFIS control panel switch selections. Colors indicate the following:

- W (white) – present status, range scales
- G (green) – active or selected mode and/or dynamic conditions
- M (magenta) – command information, pointers, symbols, fly–to condition, weather radar turbulence
- C (cyan) – nonactive or background information
- A (amber) – cautions, faults, flags
- R (red) – warnings
- B (black) – blank area, off condition.

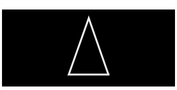
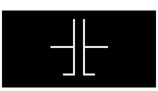
Heading, Track, and Wind

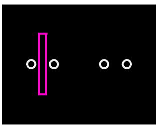
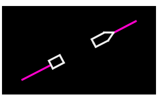
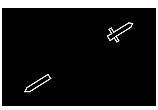
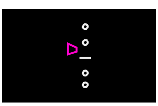
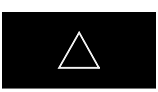
Symbol	Name	Applicable Mode(s)	Remarks
	Track orientation (G), current track (W), and track reference (G)	MAP PLAN CTR MAP	Displays track as the display orientation, the current track, and M or TRU as the reference, and points to the heading on the compass rose.
	HDG – Heading orientation (G), current heading and pointer (W), heading reference (G)	VOR CTR VOR APP CTR APP	HDG – Displays heading as the display orientation, current heading, M or TRU as the heading reference, and points to the heading on the compass rose.
	Heading reference (G), box (W) in TRU, box (A) if TRU displayed in descents of 2,000 feet at more than 800 feet per minute.	All	Indicates heading/track is referenced to magnetic north or true north. On transition from TRU to M, a highlight box is displayed around M for 10 seconds. When TRU is the reference, the highlight box is displayed full time (W).

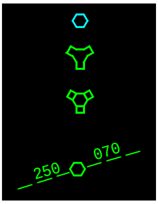
Symbol	Name	Applicable Mode(s)	Remarks
	Selected heading bug (M) and reference line (M)	MAP, CTR MAP VOR, APP Bug only CTR VOR CTR APP PLAN	Displays the heading set in the MCP. A dashed line (M) extends from the bug to the airplane symbol in the MAP and expanded modes.
	Current heading pointer (W)	MAP PLAN	Points to current heading on the compass rose.
	Track line and range scale (W)	MAP CTR MAP APP VOR	Displays present ground track based on airplane heading and wind. The displayed range numeric values are one-half and one–fourth (CTR MAP) the actual selected range. With heading-up orientation (VOR/APP mode), the track line will be rotated left or right at an angle equal to the drift angle.
	Expanded compass rose (W)	MAP PLAN VOR APP	Displays 70 degrees of compass rose.
	Full compass rose (W) Fixed reference marks (W)	CTR VOR CTR APP	The compass rose rotates through 360 degrees as a function of airplane heading. Fixed reference marks are evenly spaced at 45 degree intervals.

Symbol	Name	Applicable Mode(s)	Remarks
	Center Map full compass rose (W)	CTR MAP	The compass rose rotates through 360 degrees as a function of airplane heading.
TAS230	True airspeed. (W)	All	Indicates true airspeed in knots.
GS245	Ground speed. (W)	All	Indicates ground speed in knots.
	Wind speed and direction. (W)	All except PLAN	Indicates wind speed and direction, with respect to display orientation and heading reference.

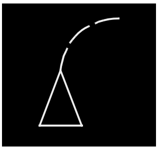
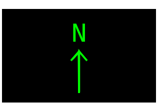
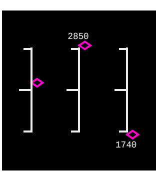
Radio Navigation

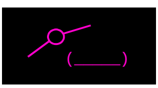
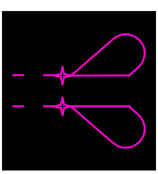
Symbol	Name	Applicable Mode(s)	Remarks
	Airplane symbol (W)	VOR APP	Current airplane position is at the apex of the triangle.
	Airplane symbol (W)	CTR VOR CTR APP	Current airplane position is at the center of the symbol.
VOR L,R ILS	Reference VOR receiver (G) Reference ILS receiver (G)	VOR CTR VOR APP CTR APP	Indicates the source of the displayed navigation data. In the VOR or APP mode the displayed data source is a function of the tuned frequency (VOR or LOC).
110.10	Reference ILS frequency (G)	APP CTR APP	Displays frequency of manually tuned navaid.

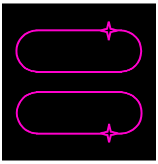
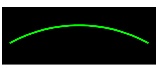
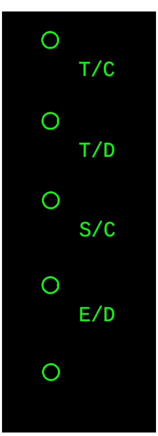
Symbol	Name	Applicable Mode(s)	Remarks
	Reference VOR or ILS DME (W)	VOR CTR VOR APP CTR APP	Indicates DME distance to the reference navaid.
	Course deviation indicator (M) and deviation scale (W)	VOR CTR VOR APP CTR APP	Displays ILS or VOR course deviation.
	Selected course pointer (W) and line (M)	VOR APP	Displays selected course as set by the related VOR or ILS course selector.
	Selected course pointer (W)	CTR VOR CTR APP	Displays selected course as set by the related VOR or ILS course selector.
	Glideslope pointer (M) and deviation scale (W)	APP CTR APP	Displays glideslope position and deviation. Pointer not displayed when track and front course differ by more than 90°.
	To/from indication (W)	VOR CTR VOR	Displays VOR TO/FROM indication.
	To/from pointer (W)	CTR VOR	Displays VOR to/from direction.

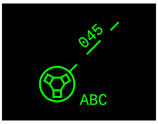
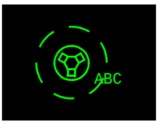
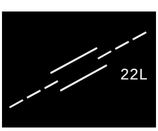
Symbol	Name	Applicable Mode(s)	Remarks
	VOR (C, G), DME/TACAN (C, G), VORTAC (C, G) Manually tuned VOR radials (G)	MAP CTR MAP	When the EFIS control panel NAV AID switch is OFF, tuned navaids, excluding NDBs, are displayed (G). When the EFIS control panel NAV AID switch is selected ON, appropriate navaids are displayed. All navaids contained in the FMC data base and within the MAP area are displayed when the selected range is 10, 20 or 40 NM. Only high altitude navaids are displayed when the selected range is 80, 160, 320 NM. Navaids not being used are displayed in cyan. Tuned VHF navaids are displayed in green, regardless of switch selection. When a navaid is manually tuned, the selected course and reciprocal are displayed.

Map

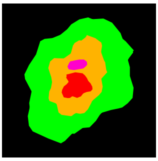
Symbol	Name	Applicable Mode(s)	Remarks
	Position trend vector (W) (dashed line) and airplane symbol (W).	MAP CTR MAP	Predicts position at the end of 30, 60, and 90 second intervals, based on bank angle and ground speed. Each segment represents 30 seconds. Selected range determines the number of segments displayed: • Range > 20 NM, 3 segments • Range = 20 NM, 2 segments • Range = 10 NM, 1 segment
	North Pointer (G)	PLAN	Indicates orientation of map background to true north.
	Vertical pointer (M), deviation scale (W), numeric display (W)	MAP CTR MAP	Displays vertical deviation from selected VNAV PATH during descent only. Scale indicates +/– 400 feet deviation. Digital display is provided when the pointer indicates more than +/– 400 feet.

Symbol	Name	Applicable Mode(s)	Remarks
	Off route waypoint (C)	MAP PLAN CTR MAP	When the EFIS control panel WPT switch is selected on, waypoints not on the selected route are displayed, for ranges of 10, 20, or 40 NM. When a range greater than 40NM is selected, only those waypoints associated with NDBs that are within 80NM of the airplane are displayed.
	Conditional Waypoint: active (M), inactive (W)	MAP PLAN	Active – represents the waypoint the airplane is currently navigating to. Inactive – represents the waypoints on the active route. Data with parentheses for conditional waypoints indicates type of conditional waypoint (ALTITUDE etc.)
	Procedure turn: active (M), modified (W), inactive (C)	MAP PLAN CTR MAP	A fixed size procedure turn appears when it is part of the displayed FMC route. When the procedure turn waypoint is active and the HSI range is 40 nm or less, the procedure turn changes to the correct scale size. Also used for procedure hold course reversal.

Symbol	Name	Applicable Mode(s)	Remarks
	Holding pattern: active route (M), modified route (W), inactive route (C)	MAP PLAN CTR MAP	A fixed size holding pattern appears when it is part of the displayed FMC route. When the holding waypoint is active and the HSI range is 80 nm or less, the holding pattern changes to the correct scale size. Depicts entry path until entry is completed.
	Altitude range arc (G)	MAP CTR MAP	Based on present vertical speed and ground speed, indicates the approximate map position where the MCP altitude is reached.
	Energy management circles: clean (C), speedbrake (W)	MAP CTR MAP	Indicates clean and speedbrake energy management circles as defined on OFFPATH DES page.
	Altitude profile point and identifier (G)	MAP PLAN CTR MAP	Indicates the approximate map position of the FMC–calculated T/C (top–of–climb), T/D (top– of–descent), S/C (step climb), and E/D (end of descent) points. Deceleration points have no identifier.

Symbol	Name	Applicable Mode(s)	Remarks
	Selected reference point and bearing information (G)	MAP PLAN CTR MAP	Displays the reference point selected on the CDU FIX page. Bearing from the fix is displayed with dashes (G).
	Selected reference point and distance information (G)	MAP PLAN CTR MAP	Displays the reference point selected on the CDU FIX page. Distance from the fix is displayed with dashes (G).
	Airport (C)	MAP PLAN CTR MAP	Displayed if the EFIS control panel ARPT switch is selected ON. Origin and destination airports are always displayed, regardless of switch selection.
	Airport and runway (W)		Displayed when selected as the origin or destination and selected range is 80, 160, or 320 NM.
	Airport and runway (W)		Displayed when selected as the origin or destination and selected range is 10, 20, or 40 NM. Dashed runway centerlines extend 14.2 NM.
CDU L,R	MAP source annunciation (G)	MAP	Displays HSI source if CDU is selected on respective NAV Source Select Switch.

Radar

Symbol	Name	Applicable Mode(s)	Remarks
	Weather radar (WXR) returns (R, A, G, M)	MAP CTR MAP VOR APP	The most intense areas are displayed in red, lesser intensity in amber, and lowest intensity green. Turbulence is displayed in magenta.
WX+T	WXR and turbulence mode (G)	MAP CTR MAP VOR APP	Weather radar system is selected on the EFIS control panel. Weather radar mode, gain and tilt is controlled on the weather radar panel(s) (refer to Chapter 11, Flight Management, Navigation).
VAR	WXR receiver gain (G)	MAP CTR MAP VOR APP	Weather radar system is selected on the EFIS control panel. Weather radar mode, gain and tilt is controlled on the weather radar panel(s) (refer to Chapter 11, Flight Management, Navigation).

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MAP	Mode used with down–tilt when ground mapping (G)	MAP CTR MAP VOR APP	Weather radar system is selected on the EFIS control panel. Weather radar mode, gain and tilt is controlled on the weather radar panel(s) (refer to Chapter 11, Flight Management, Navigation).

Symbol	Name	Applicable Mode(s)	Remarks

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Symbol	Name	Applicable Mode(s)	Remarks
+15 to -15	WXR antenna tilt (G)	MAP CTR MAP VOR APP	Weather radar system is selected on the EFIS control panel. Weather radar mode, gain and tilt is controlled on the weather radar panel(s) (refer to Chapter 11, Flight Management, Navigation).

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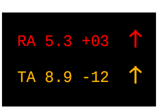
Symbol	Name	Applicable Mode(s)	Remarks
+15 (M or A) to -15 (M or A) *M=Manual A=Auto	WXR antenna tilt (G)	MAP CTR MAP VOR APP	Weather radar system is selected on the EFIS control panel. Weather radar mode, gain and tilt is controlled on the weather radar panel(s) (refer to Chapter 11, Flight Management, Navigation).
AUTOTILT FAIL	WXR detects loss of EGPWS input with AUTO TILT mode selected (A)		

Symbol	Name	Applicable Mode(s)	Remarks
TEST	WXR test mode (C) (G)	MAP CTR MAP VOR APP	Weather radar mode, gain and tilt is controlled on the weather radar panel(s) (refer to Chapter 11, Flight Management, Navigation).

Symbol	Name	Applicable Mode(s)	Remarks
WXR WEAK	WXR calibration fault (A)	MAP CTR MAP VOR APP	When a degraded condition is present the EFIS will continue to display weather radar information. If any two or all degraded conditions occur simultaneously, the system will display only the highest priority condition as follows: • WEAK • ATT • STAB
WXR ATT	WXR attitude input fault (A)		
WXR STAB	WXR stabilization off (A)		
WXR DSPY	WXR display fault (A)	MAP CTR MAP VOR APP	HSI overheat or loss of digital unit cooling air when WXR is selected. Overheat annunciation has display priority over all other degraded conditions. Weather radar information removed after 30 seconds.
WXR FAIL	WXR system failure (A)	MAP CTR MAP VOR APP	Weather radar system failure is annunciated under any of the following conditions: • receiver transmitter failure • antenna failure • control panel failure

Symbol	Name	Applicable Mode(s)	Remarks
WXR RANGE DISAGREE	WXR range status annunciations (A)	MAP CTR MAP VOR APP	Weather output range disagrees with the range selected by the EFIS control panel.
MAP/WXR RANGE DISAGREE	WXR range status annunciations (A)	MAP CTR MAP	Weather output range and map display output range disagree with selected EFIS control panel range.

TCAS

Symbol	Name	Applicable Mode(s)	Remarks
	TCAS resolution advisory (RA), relative altitude (R)	MAP CTR MAP APP VOR	These symbols are displayed only when the EFIS control panel traffic (TFC) switch is selected on. Refer to Chapter 15, Warning Systems. The arrow indicates traffic climbing or descending at a rate greater than or equal to 500 fpm. At rates less than 500 fpm, the arrow is not displayed. The number and associated signs indicate altitude of traffic in hundreds of feet relative to the airplane. The number is below the traffic symbol when the traffic is below, and above the traffic symbol when the traffic is above the airplane. Absence of the number implies altitude unknown.
	TCAS traffic advisory (TA), relative altitude (A)		
	TCAS proximate traffic, relative altitude (W)		
	TCAS other traffic, relative altitude (W)		
	TCAS no bearing message (RA–R, TA–A)	MAP CTR MAP APP VOR	Message provides traffic type, range in NM, altitude and vertical direction.

Symbol	Name	Applicable Mode(s)	Remarks
TRAFFIC	TCAS traffic alert message (RA–R, TA–A)	All	Displayed whenever a TCAS RA or TA is active. EFIS control panel TFC switch does not have to be selected on.
OFFSCALE	TCAS off scale message (RA–R, TA–A)	MAP CTR MAP APP VOR	Displayed whenever RA or TA traffic is outside the traffic area covered by the HSI range. Displayed only if the EFIS control panel TFC switch is selected on.
TFC	TCAS mode (G)	MAP CTR MAP APP VOR	Indicates the HSI TCAS display is active; the EFIS control panel TFC switch is selected on.
TA ONLY	TCAS mode (G)	All	Indicates TCAS computer is not computing RAs. Displayed whether the EFIS control panel TFC switch is selected on or off.
TCAS TEST	TCAS mode (W)	All	Indicates TCAS is operating in the test mode. Displayed whether EFIS control panel TFC switch is selected on or off.
TCAS OFF	TCAS off message (W)	MAP CTR MAP APP VOR	Displayed when the TCAS/ATC mode switch is not in TA ONLY or TA/RA. Not displayed if TCAS is failed.

Symbol	Name	Applicable Mode(s)	Remarks
TCAS FAIL	TCAS fail message (A)	MAP CTR MAP APP VOR	Indicates TCAS failure.

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Symbol	Name	Applicable Mode(s)	Remarks
050	Absolute altitude (R,A,W)	MAP CTR MAP APP VOR	Displays absolute traffic altitude (referenced to QNH or QNE). First two digits indicate thousands of feet, and third digit indicates hundreds of feet.

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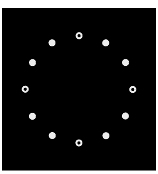
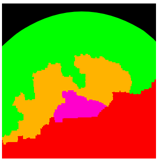
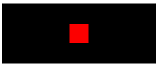
Symbol	Name	Applicable Mode(s)	Remarks
	3 NM Range Ring (W)	MAP CTR MAP APP VOR	Displayed when TFC is selected on the EFIS control panel and range is 80 NM or less. Ring is centered around the airplane symbol.

Look–Ahead Terrain

Symbol	Name	Applicable Mode(s)	Remarks

N422LA through N526LA

	Terrain display (R, A, G, M)	MAP CTR MAP VOR APP	Displays terrain data from the GPWS terrain data base. When the airplane is higher than 2,000 feet above the terrain, peaks contours are displayed in three densities (G). Highest peaks are displayed as solid, intermediate height terrain peaks are displayed as high density, and lowest terrain peaks are displayed as low density. When the airplane is lower than 2,000 feet above the terrain, the terrain displays as follows: 2,000 feet below to 500 feet (250 feet with gear down) below the airplane's current altitude (G), 500 feet (250 feet with gear down) below to 2000 feet above the airplane's current altitude (A), more than 2,000 feet above the airplane's current altitude (R), no terrain data available (M).

Symbol	Name	Applicable Mode(s)	Remarks
N422LA through N526LA			
	Obstacle display (R, A, G)	MAP CTR MAP VOR APP	Displays obstacle data from the GPWS obstacle data base. Color displays using the same rules as terrain display.
N422LA through N526LA			
	Highest and lowest terrain or obstacle altitudes (R, A, G)	MAP CTR MAP VOR APP	Terrain display enabled (manual or automatic display). Numbers displayed are altitudes, in hundreds of feet, of highest and lowest contours displayed on the HSI. Color corresponds to colors of highest and lowest terrain or obstacle displayed. Altitudes not displayed when terrain data unavailable.

Symbol	Name	Applicable Mode(s)	Remarks

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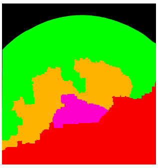	Terrain display (R, A, G, M)	MAP CTR MAP VOR APP	Displays terrain data from the GPWS terrain data base. The terrain displays as follows: 2,000 feet below to 500 feet (250 feet with gear down) below the airplane's current altitude (G), 500 feet (250 feet with gear down) below to 2000 feet above the airplane's current altitude (A), more than 2,000 feet above the airplane's current altitude (R), no terrain data available (M). Color and density vary based on terrain height vs. airplane altitude.

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OBSTACLE	Obstacle alert annunciation (R, A)	All	Look-ahead obstacle caution alert active (A), Look-ahead obstacle warning alert active (R).

TERRAIN	Terrain alert annunciation (R, A)	All	Look–ahead terrain caution alert active (A), look–ahead terrain warning alert active (R).
TERR	Terrain mode annunciation (C)	MAP CTR MAP VOR APP	Terrain display enabled (manual or automatic display).

Symbol	Name	Applicable Mode(s)	Remarks
TERR FAIL	Terrain status annunciations (A)	MAP CTR MAP VOR APP	Look–ahead terrain alerting and display have failed.
TERR POS			Look–ahead terrain alerting and display unavailable due to position uncertainty.
TERR OVRD			GPWS terrain override switch in OVRD position.
TERR TEST	Terrain test mode annunciation (C)		GPWS operating in self–test mode. This status annunciation is also available in plan mode.

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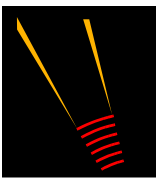
TERR DSPY	TERR display fault (A)	MAP CTR MAP VOR APP	HSI overheat or loss of digital unit cooling air when TERR is selected. Overheat annunciation has display priority over all other degraded conditions. Look-ahead terrain information removed after 30 seconds.

TERR RANGE DISAGREE	Terrain range status annunciations (A)	MAP CTR MAP VOR APP	Terrain output range disagrees with selected EFIS control panel range.

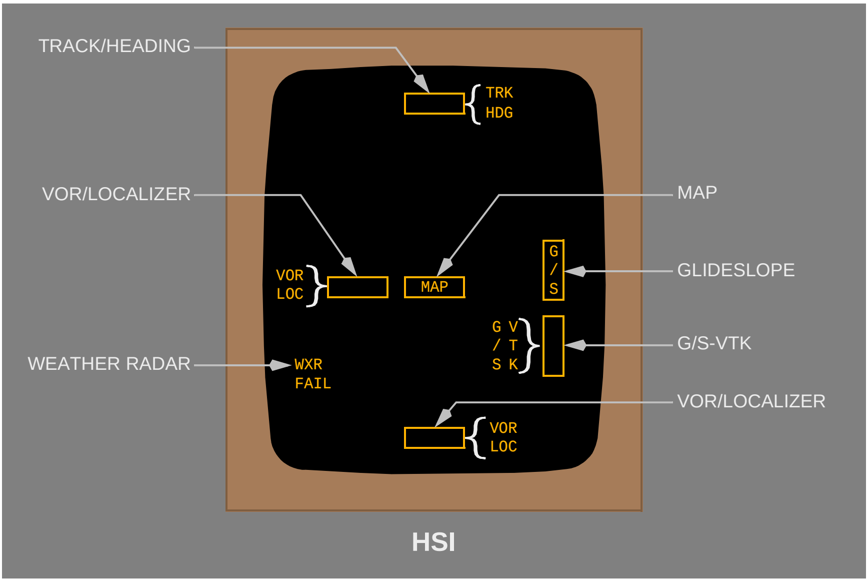
Symbol	Name	Applicable Mode(s)	Remarks
MAP/TERR RANGE DISAGREE	Terrain range status annunciations (A)	MAP CTR MAP	Terrain output range and map display output range disagree with selected EFIS control panel range.

Predictive Windshear

Symbol	Name	Applicable Mode(s)	Remarks
	Predictive windshear symbol (R, B, A)	MAP CTR MAP APP VOR	Displays windshear location and approximate geometric size (width and depth). Amber radials extend from predictive windshear symbol to help identify location of windshear event.
WINDSHEAR	Windshear annunciation (R, A)	All	Predictive windshear caution active (A). Predictive windshear warning active (R).

HSI Failure Flags and Annunciations

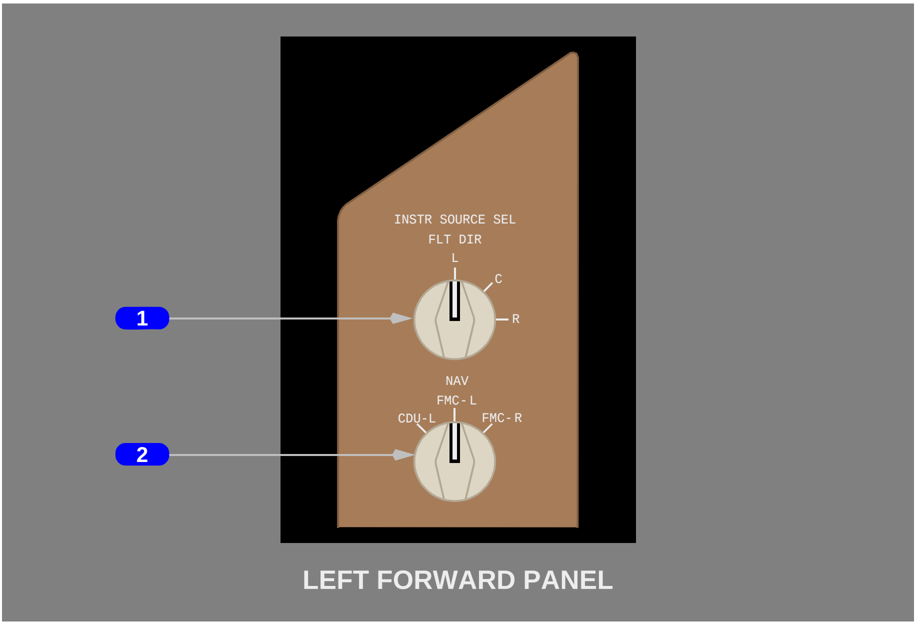
Note: HSI failure flags replace the appropriate display to indicate source system failure, or lack of computed information.



Instrument Switching

Various source selections are available for instrument displays. For other related instrument transfer switching, refer to Chapter 11, Flight Management, Navigation

Left Instrument Source Selector Panel (Upper)



1 Flight Director (FLT DIR) Source Selector

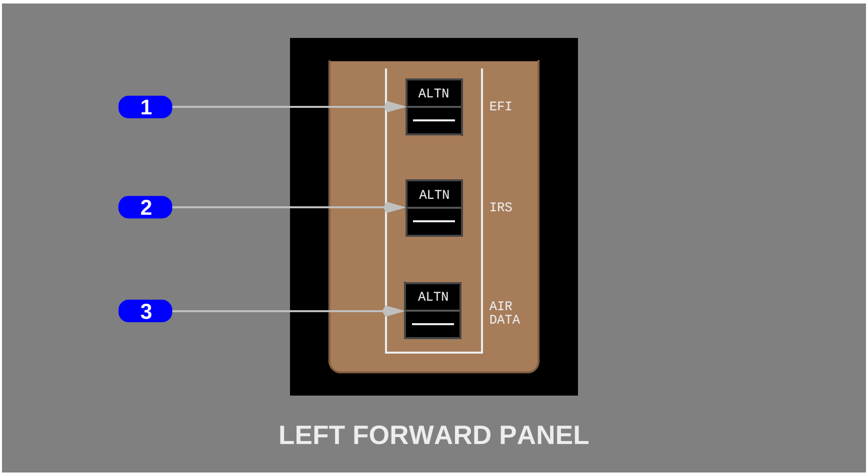
Selects the flight control computer (left, center, or right) used as the source of commands for the captain's flight director display.

2 Navigation (NAV) Source Selector

Selects the source of FMC information used by the left and center EFIS symbol generators and the left and center flight control computers (FCCs).

- FMC L – normal position. Provides information to the left and center symbol generators, and to the left and center FCCs
- FMC R – alternate position. Provides information to the left and center symbol generators, and to the left and center FCCs
- CDU L – provides information to the left and center symbol generators. Used for operation of the Alternate Navigation System (refer to Chapter 11, Flight Management, Navigation)

Left Instrument Source Selector Panel (Lower)



1 Electronic Flight Instruments (EFI) Switch

Selects the EFIS symbol generator, ILS receiver, and radio altimeter used as the sources of information for the captains's ADI and HSI displays.

- Blank – normal position. The captains's displays use the left symbol generator, left ILS receiver, and left radio altimeter
- ALTN – alternate position. The captains's displays use the center symbol generator, center ILS receiver, and center radio altimeter

If both pilots select ALTN (both using center sources):

- both pilots' ADI and HSI displays are controlled by the left EFIS control panel
- the EICAS message INSTR SWITCH displays

2 Inertial Reference System (IRS) Switch

Selects the IRS used as the source of information for the left and center symbol generators, the captain's VSI, and the first officers RDMI. Information provided by the IRS includes attitude, heading, and vertical speed

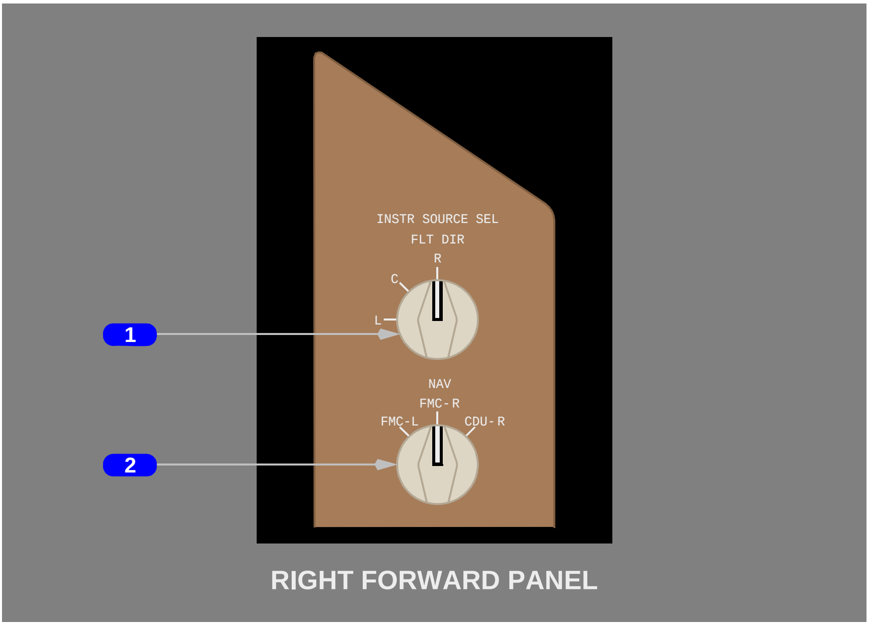
- Blank – normal position. The left IRS is the source for the left and center symbol generators, the captain's VSI, and the first officer's RDMI
- ALTN – alternate position. The center IRS is the source for the left and center symbol generators, the captain's VSI, and the first officer's RDMI

3 AIR DATA Switch

Selects the air data computer used as the source of information for the captain's Mach/airspeed indicator, primary altimeter, and vertical speed indicator (via the selected IRS).

- Blank – normal position. The left air data computer is the source for the captain's air data instruments
- ALTN – alternate position. The right air data computer is the source for the captain's air data instruments

Right Instrument Source Selector Panel (Upper)



1 Flight Director (FLT DIR) Source Selector

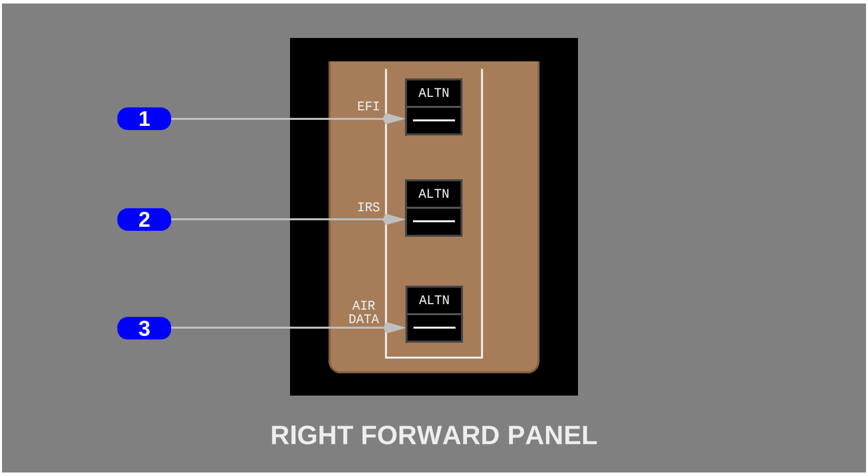
Selects the flight control computer (left, center, or right) used as the source of commands for the first officer's flight director display.

2 **Navigation (NAV) Source Selector**

Selects the source of FMC information used by the right EFIS symbol generator and the right flight control computer (FCC).

- FMC R – normal position. Provides information to the right symbol generator, and to the right FCC
- FMC L – alternate position. Provides information to the right symbol generator, and to the right FCC
- CDU R – provides information to the right symbol generator. Used for operation of the Alternate Navigation System (refer to Chapter 11, Flight Management, Navigation).

Right Instrument Source Selector Panel (Lower)



1 **Electronic Flight Instruments (EFI) Switch**

Selects the EFIS symbol generator, ILS receiver, and radio altimeter used as the sources of information for the first officer's ADI and HSI displays.

- Blank – normal position. The first officer's displays use the right symbol generator, right ILS receiver, and right radio altimeter
- ALTN – alternate position. The first officer's displays use the center symbol generator, center ILS receiver, and center radio altimeter

If both pilots select ALTN (both using center sources):

- both pilots' ADI and HSI displays are controlled by the left EFIS control panel
- the EICAS message INSTR SWITCH displays

2 Inertial Reference System (IRS) Switch

Selects the IRS used as the source of information for the right symbol generator, the first officer's VSI, and the captain's RDMI. Information provided by the IRS includes attitude, heading, and vertical speed.

- Blank – normal position. The right IRS is the source for the right symbol generator, the first officer's VSI, and the captain's RDMI
- ALTN – alternate position. The center IRS is the source for the right symbol generator, the first officer's VSI, and the captain's RDMI.

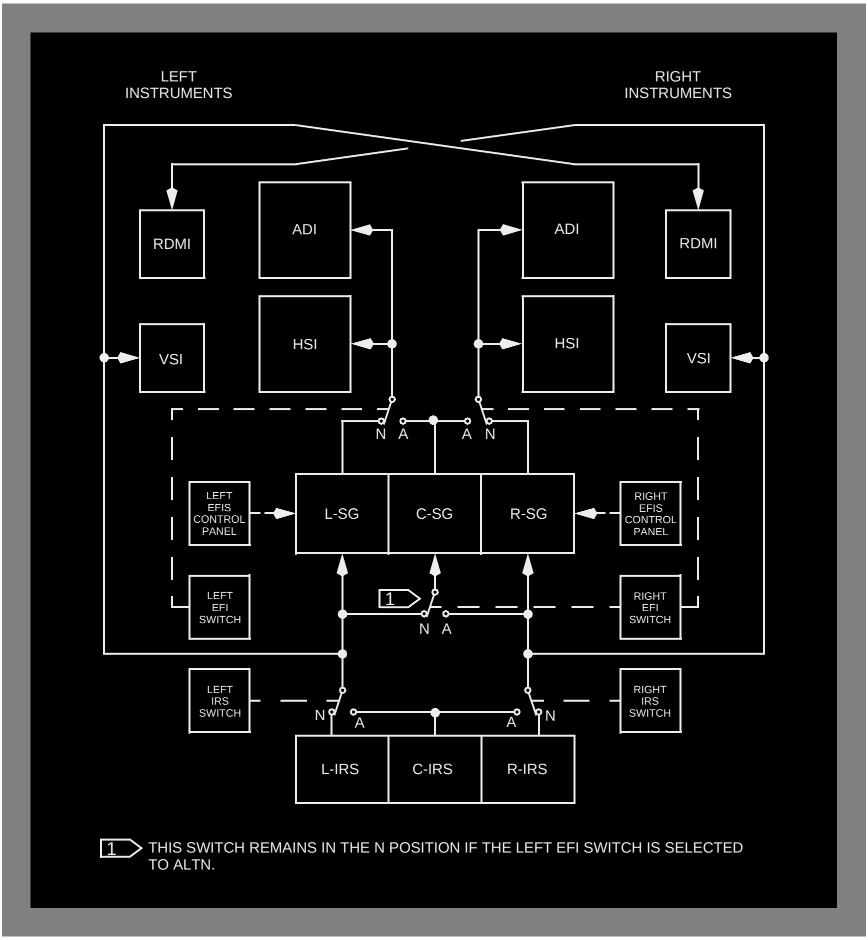
3 AIR DATA Switch

Selects the air data computer used as the source of information for the first officer's Mach/airspeed indicator, primary altimeter, and vertical speed indicator (via the selected IRS).

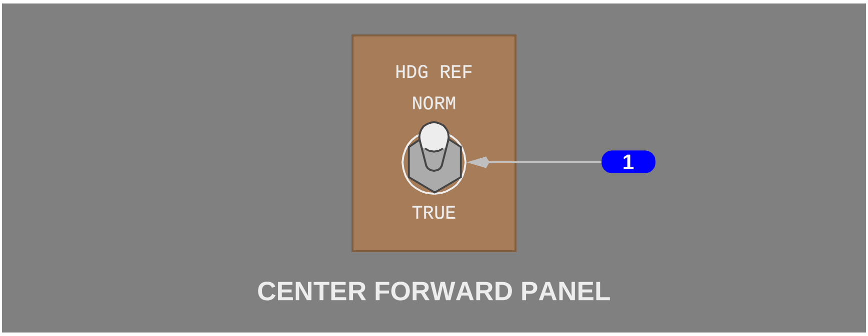
- Blank – normal position. The right air data computer is the source for the first officer's air data instruments
- ALTN – alternate position. The left air data computer is the source for the first officer's air data instruments.

EFI/IRS Interface Diagram

The following diagram shows the normal EFI/IRS interface. EFI switching determines the center symbol generator (C–SG) input and output. Normally, left system instrument sources supply the center symbol generator. When both pilots select ALTN with their EFI switches, the left system instrument sources supply data to the center symbol generator. However, the center symbol generator always uses the center ILS and center radio altimeter. Each EFIS control panel is connected to the symbol generator with the EFI switch. Each IRS switch permits pilot selection of the alternate data source for heading, attitude, and vertical speed.



Heading Reference Switch



1 Heading Reference (HDG REF) Switch

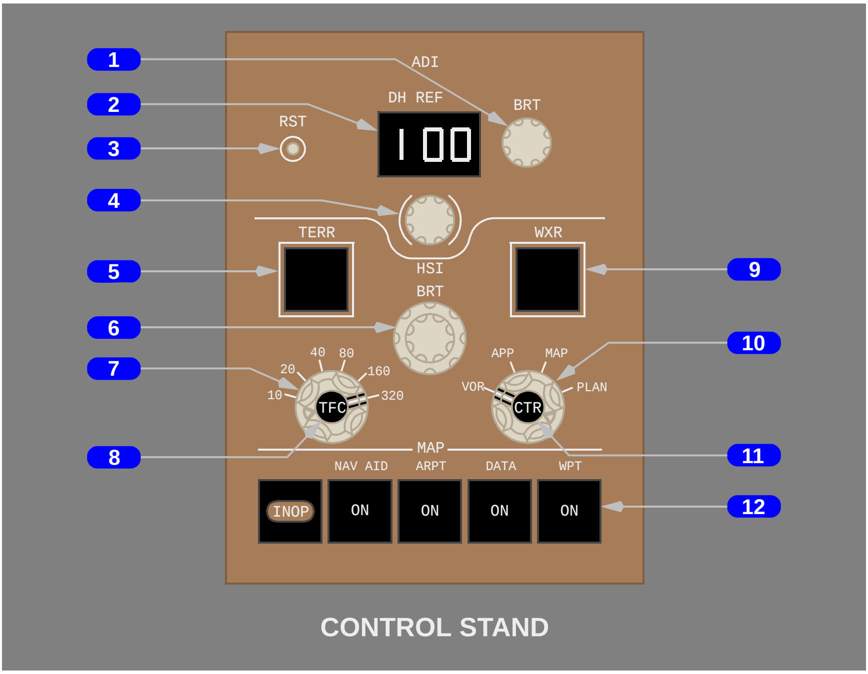
NORM –

- references each compass card to magnetic north when operating outside polar regions
- references each HSI to true north and causes each RDMI heading flag to appear when operating within polar regions.

TRUE – references each compass card to true north regardless of latitude.

EFIS Control Panel

The left EFIS control panel controls the left ADI and HSI. The right EFIS control panel controls the right ADI and HSI.



1 ADI Brightness (BRT) Control

Rotate – adjusts brightness of ADI display.

2 Decision Height Reference (DH REF) Window

- displays selected decision height
- displays on ADI (ADI blanks when a negative decision height is selected)

3 Decision Height Reset (RST) Switch

Push –

- resets DH alert on related ADI
- changes RA display from amber to white

N316LA
- blanks height alert on related ADI

4 Decision Height Selector

Rotate – selects decision height for DH alerting.

5 Terrain (TERR) Switch

Push –

- displays terrain data on the HSI in MAP, CTR MAP, VOR, and APP
- deselects the weather radar display regardless of the mode selector position

For a description of the ground proximity warning system, refer to Chapter 15, Warning Systems.

6 HSI Brightness (BRT) Control

Rotate –

- outer control – adjusts overall brightness of HSI display
- inner control – adjusts brightness of weather radar or terrain display

7 HSI Range Selector

Rotate –

- selects nautical mile range for MAP, CTR MAP, and PLAN displays
- when the WXR switch or TCAS TFC switch is ON, also selects the desired range for the VOR and APP mode displays

8 Traffic (TFC) Switch

Note: TCAS must be activated on the Transponder Panel (refer to Chapter 11, Flight Management, Navigation).

Push –

- displays or removes TCAS traffic information on HSI

9 Weather Radar (WXR) Switch

Push – displays weather radar information (refer to Chapter 11, Flight Management, Navigation).

10 HSI Mode Selector

VOR, CTR VOR –

- displays VOR navigation information
- selects manual VOR and DME tuning on the VOR/DME panel (automatic tuning inhibited)

APP, CTR APP –

- displays ILS navigation information
- selects manual VOR and DME tuning on the VOR/DME panel (automatic tuning inhibited)

MAP, CTR MAP –

- displays a dynamic map
- allows selection of manual or automatic VOR and DME tuning on the VOR/DME panel
- allows remote manual VOR and DME tuning on the PROGRESS page

PLAN –

- displays static FMC map in true–north–up orientation
- displays heading information in heading–up form
- allows selection of manual or automatic VOR and DME tuning on the VOR/DME panel
- allows remote manual VOR and DME tuning on the PROGRESS page
- activates the MAP CTR STEP prompt on the LEGS page for stepping through the displayed route

11 Center (CTR) Switch

Push –

- when the HSI Mode Selector is in the MAP, VOR, or APP positions, toggles between full and expanded rose displays
- does not affect display in PLAN mode

12 Map Switches

NAV AID –

- displays only high altitude VHF navigation aids when HSI range is 80nm or greater
- displays all VHF navigation aids when HSI range is 40nm or less

Airport (ARPT) –

Displays all airports in the display range.

DATA –

Displays estimated time of arrival and any altitude constraint for each waypoint in the displayed flight path.

Waypoint (WPT) –

- displays all waypoints when HSI range is 40nm or less
- those waypoints associated with NDBs are displayed at any selected range as long as the NDBs are within 80nm of the airplane.

Intentionally
Blank

Introduction

The electronic flight instrument system (EFIS) consists of three (L, C, R) symbol generators (SGs), two control panels (CPs), two attitude director indicators (ADIs), two horizontal situation indicators (HSIs), and ambient light sensing units. The EFIS uses information provided by a variety of aircraft systems to generate the appropriate visual presentations on the HSI and ADI.

Data relating primarily to navigation is provided by aircraft systems such as the navigation radios, flight management computer (FMC), and the inertial reference systems. Data relating primarily to automatic flight is provided by the flight control computers (FCCs), the autothrottle (A/T), and the FMC. Data which is used to display current aircraft state information is provided by the two air data computers (ADCs) and the three inertial reference systems (IRSs).

Automatic adjustment of the display intensity for each display unit is provided by the ambient light sensing units. Flight crew control of the EFIS displays is accomplished by positioning the various controls on the respective EFIS control panels to the desired settings. For information on EFIS/IRS interface, and instrument switching see Section 10, of this chapter.

EFIS Symbol Generators

Three symbol generators form the heart of the EFIS. The SGs receive inputs from various aircraft systems, then generate the proper visual displays for the related ADI and HSI. Each pilot's ADI and HSI displays are provided from the SG selected with their respective EFI switch. The left SG normally provides the captain's displays, and the right SG normally provides the first officer's displays. The center SG is available as an alternate source for either or both pilots.

EFIS Control Panels

The EFIS control panels control display options, modes, ranges and brightness for the respective ADIs and HSIs.

Attitude Director Indicator

The ADI presents conventional displays for attitude (pitch and roll), flight director commands, localizer deviation and glideslope deviation. In addition, the ADI displays information relating to autoflight system mode annunciations, airplane speed, pitch limit, radio altitude, and decision height. The captain's attitude information is provided by the left IRS and the first officer's information is provided by the right IRS. The center IRS provides that data as an alternate source.

Attitude Display

Airplane attitude data is provided by the IRSs. The IRSs' pitch and roll attitude information is valid throughout 360 degrees of rotation in each axis.

Mode Annunciations

Mode annunciations for the A/T and the AFDS are displayed at the top of the ADI displays. For a detailed description of the various autoflight mode annunciations and their meanings, refer to Chapter 4, Automatic Flight.

Flight Director Commands

Flight director guidance commands from the selected FCC are displayed via the flight director symbol on the ADI.

A flight director failure in either axis causes the respective command bar to disappear. If both axes become unreliable, both command bars disappear and the FD flag appears.

Glideslope and Localizer Deviation Displays

Conventional ILS information is provided from the ILS receiver selected with each pilot's EFI switch. All three ILS receivers are commonly tuned on the ILS panel.

ILS Deviation Warning

ILS localizer and glideslope deviations are monitored when below 500 feet radio altitude with the mode control panel APP switch selected ON. An alert is displayed if a significant deviation from localizer or glideslope occurs: the respective deviation scale changes color from white to amber and the associated pointer flashes. The alert stops when deviation returns to within normal limits. The glideslope alert is inhibited when below 100 feet radio altitude.

If a localizer alert is active, the stem of the rising runway symbol also flashes.

Rising Runway Symbol

The rising runway symbol is an integral part of the LOC deviation display and is positioned at the top of the LOC deviation pointer. The rising runway symbol is displayed in addition to the radio altitude display and gives an additional cue to the flight crew of the aircraft's close proximity to the ground as the airplane descends below 200 feet radio altitude. Full scale, vertical movement of the rising runway represents the last 200 feet of radio altitude. Zero feet radio altitude is indicated as the top of the runway symbol rises to the base of the airplane symbol.

Attitude Comparator

The EICAS caution message ATT DISAGREE displays when a difference of more than 3 degrees between the captain's and first officer's pitch or roll displays is detected. An amber PITCH or ROLL alerting annunciation is displayed on both ADIs for the parameter that is out of tolerance. Attitude comparison monitoring is inhibited when both pilots are using the center symbol generator by selecting ALTN on the EFI switches.

Height Alert

N316LA

The radio height alert ALT is triggered when the airplane descends below 2,500 feet AGL. The alert is turned off when the airplane continues to descend below 500 feet AGL or climbs above 2,500 feet AGL, or after pressing the decision height reset switch on the EFIS control panel.

Radio Altitude and Decision Height

When radio altitude is less than 2,500 feet AGL, a digital display is depicted on the ADI. At all other times, the digital radio altitude display is blanked.

When a positive decision height has been selected on the related EFIS control panel, the letters DH and the decision height are displayed just above the digital radio altitude display of the associated ADI.

When the airplane is below 1000 feet AGL, a radio altitude dial is added to the radio altitude display, and the digital decision height display is replaced by a magenta pointer located on the radio altitude dial. As the airplane descends, segments of the ring erase and radio altitude is indicated by the remaining ring as well as by the digital value. When descending through the selected decision height, a decision height alert occurs. The radio altitude dial, digital display, and the decision height pointer change color to amber, flash momentarily, then remain steady amber as the airplane continues to descend.

The decision height alert is reset if any one of the following occurs:

- the DH reset switch on the EFIS control panel is pressed
- the radio altitude increases to decision height +75 feet
- the radio altitude is equal to zero feet (i.e. during touchdown).

Pitch Limit Indicator

The position of the pitch limit indicator is a function of the stall warning computer. It is programmed so that stick shaker activation will coincide with a pitch attitude equal to the pitch limit indication.

Airspeed Display

Airspeed is displayed on a tape on the ADI. The current Mach number is digitally displayed below the airspeed tape when the current Mach number is greater than 0.40.

The selected airspeed, takeoff and landing reference speeds, and flap maneuvering speeds are shown on the airspeed tape. Maximum and minimum airspeeds are also displayed on the airspeed tape.

CAUTION: Reduced maneuver capability exists when operating within the amber regions below the minimum maneuvering speed or above the maximum maneuvering speed. During non-normal conditions the target speed may be below the minimum maneuvering speed.

Horizontal Situation Indicator (HSI)

The HSI presents an electronically generated color display of navigational data. Each HSI is capable of displaying the airplane's progress on a dynamic map display.

Display Orientation

During normal operation, heading reference data is supplied to each HSI from the respective IRS.

The compass rose can be referenced to magnetic north or true north. The heading reference switch is used to manually select magnetic or true reference. The compass display is automatically referenced to true north when the airplane is operating within polar regions.

Track

Airplane track data is supplied by the FMC during normal operation and by the CDU when in alternate navigation.

MAP Mode

The MAP mode is recommended for most phases of flight.

Presented track up, this mode shows airplane position relative to the route of flight against a moving map background.

Displayed information can include:

- track
- heading
- wind
- routes

- position trend vector
- altitude range arc
- estimated time of arrival
- selected navigation data points programmed in the FMC

VOR Mode

The VOR mode is presented heading up. The VOR mode displays track, heading, and wind speed and direction with VOR navigation information.

APP Mode

The APP mode is presented heading up. The APP mode displays track, heading, and wind speed and direction with ILS approach information.

PLAN Mode

The PLAN mode is presented true north up. The active route may be viewed using The STEP prompt on the LEGS pages.

Weather Radar Display

Display of weather radar returns on the HSI is enabled or disabled by the WXR switch on the respective EFIS control panel. The weather radar system is described in Chapter 11, Flight Management, Navigation.

Terrain Display

The HSI can display look ahead terrain alerting. For detailed information, refer to Chapter 15, Warning Systems.

Traffic

Traffic information from the TCAS can be displayed on the HSI. TCAS is described in Chapter 15, Warning Systems.

Predictive Windshear

The HSI can display predictive windshear warnings. For detailed information, refer to Chapter 15, Warning Systems.

EFIS Failure Flags and Annunciations

In addition to the normal EFIS displays, various failure annunciations, flags, or indications may be displayed on the ADI or HSI.

The location of the different failure flags and annunciations is depicted in the ADI and HSI Failure Flags and Annunciations figures included in the EFIS Controls and Indicators, section 10 of this chapter.

Not all EFIS displays will be replaced by a failure flag or annunciation if the signal from the sending unit has failed. In these instances, failure is indicated by removal of the data or the affected portions of the display.

During preflight, heading/track data is unavailable until the associated IRS has completed alignment and entered the navigation mode. Heading flags do not appear in this case.

If an FMC FAIL message is observed on a CDU, a MAP flag will appear on the associated HSI when viewing the MAP mode. Selecting the opposite FMC with the NAV selector will restore the map display. If both FMCs fail, selecting CDU on the NAV selector will allow the CDU to provide limited map data to the HSI. For more detailed information on the alternate navigation system, refer to Chapter 11, Flight Management, Navigation.

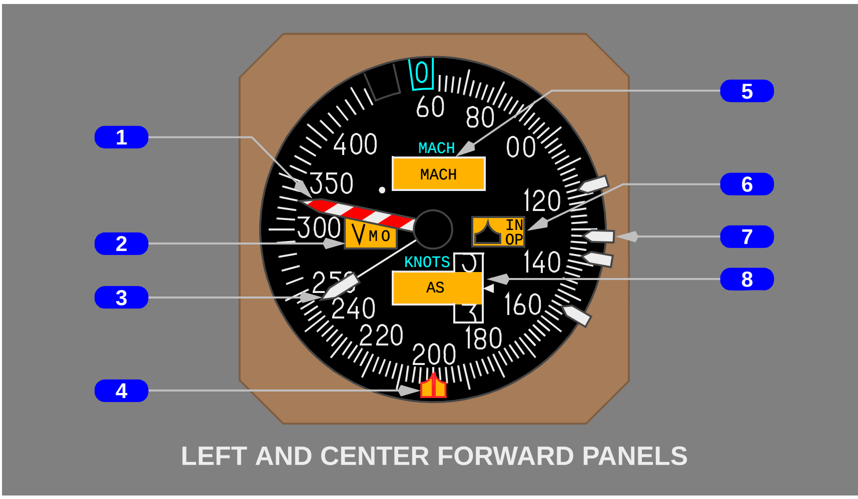
Various fault messages can also be displayed. For example, a WXR/MAP RANGE DISAGREE message is displayed when the ranges for the FMC and weather radar disagree with the range selected on the HSI control panel.

An EXCESS DATA message is displayed if the quantity of information to the display exceeds the HSI’s capability to provide a normal display. If in the MAP mode, deselecting the Map switches may correct the condition and remove the message.

Light Sensing and Brightness Control

Ambient light sensors automatically adjust the brightness of the EFIS displays. Once the desired brightness is set, using the EFIS brightness controls, little or no adjustment is needed throughout a wide range of ambient light conditions both outside and inside the flight deck.

Conventional Flight Instruments
Mach/Airspeed Indicator (Electric)



1 Vmo Pointer

Indicates the maximum operating airspeed in knots.

2 Vmo Flag

Flag in view – indicates the Vmo pointer is inoperative.

3 Airspeed Pointer

Indicates airspeed in knots.

4 Command Airspeed Bug

Indicates airspeed as manually selected with the IAS/MACH selector.

- positioned by FMC when IAS/MACH window is blank
- removed from view when inoperative.

5 Mach Indicator and Flag

Displays Mach number.

Display range:

- .400 to .999 Mach
- masked below.400 Mach
- flag in view – air data system is inoperative.

6 Command Airspeed Inoperative Flag

Flag in view – command airspeed bug is inoperative.

7 Reference Airspeed Bugs

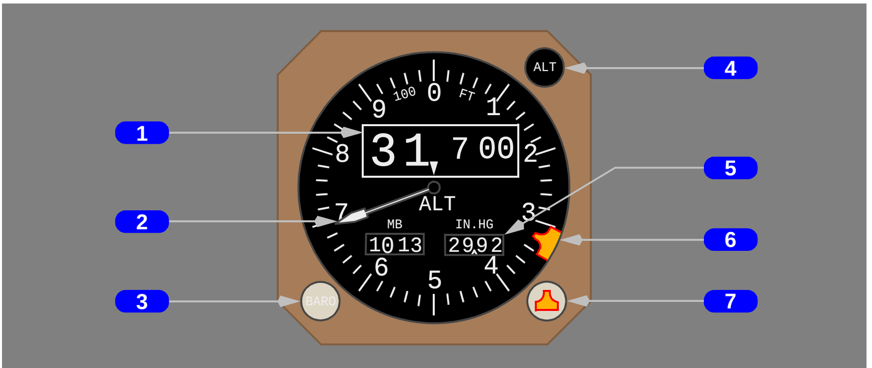
Set at reference airspeeds.

8 Airspeed Indicator and Flag

- displays airspeed when above 30 knots
- flag in view – air data system is inoperative.

Primary Altimeter (Electric)

N316LA



CENTER AND RIGHT FORWARD PANELS

1 Altitude Indicator

Indicates altitude in increments of twenty feet.

OFF flag in view– the altimeter is inoperative

NEG flag in view – displays in the two left–hand windows when altitude below zero feet is displayed.

2 Altitude Pointer

Makes one revolution each one thousand feet.

3 Barometric Setting Control

Rotate – adjusts barometric settings.

4 Altimeter Altitude (ALT) Light

Illuminated (white) –

- between 300 and 900 feet of the altitude selected with the altitude selector

5 Barometric Setting Window

Displays barometric correction (in millibars and inches of mercury) as set by the barometric setting control.

6 Reference Altitude Marker

Manually positioned to the desired reference altitude using the reference altitude marker control.

7 Reference Altitude Marker Control

Used to manually set the reference altitude marker.

N422LA through N526LA

1 Reference Altitude Marker Control

Used to manually set the reference altitude marker.

2 Altitude Indicator

Indicates altitude in increments of twenty feet.

OFF flag in view– the altimeter is inoperative

NEG flag in view – displays in the two left–hand windows when altitude below zero feet is displayed.

3 Altitude Pointer

Makes one revolution each one thousand feet.

4 Barometric Setting Control

Rotate – adjusts barometric settings.

5 Altimeter Altitude (ALT) Light

Illuminated (white) –

- between 300 and 900 feet of the altitude selected with the altitude selector

6 Reference Altitude Markers

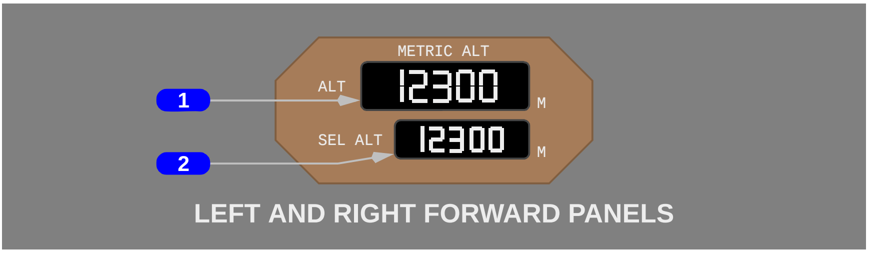
Manually positioned to the desired reference altitude using the reference altitude marker controls.

7 Barometric Setting Window

Displays barometric correction (in millibars and inches of mercury) as set by the barometric setting control.

Metric Altimeter

N422LA through N526LA



1 Altitude Display

Displays altitude in meters.

2 Selected Altitude Display

Displays altitude in meters as selected in the MCP ALT window.

Radio Distance Magnetic Indicator

1 Heading (HDG) Flag

Flag in view –

- selected IRS heading source has failed, or no computed data is available
- instrument failure.

2 Wide Bearing Pointer

- indicates right ADF/VOR magnetic bearing to selected station
- maintains last known bearing on loss of right ADF/VOR signal.

3 Narrow Bearing Pointer

- indicates left ADF/VOR magnetic bearing to selected station
- maintains last known bearing on loss of left ADF/VOR signal.

4 VOR/ADF Selector (Left/Right)

Rotate – selects related VOR or ADF for the bearing pointer.

5 Left/Right DME (DME –L/R) Indicators

Displays distance to the VOR–tuned station (VORTAC or VOR/DME) in nautical miles, except when APP is selected on the associated (L or R) EFIS control panel.

- displays distance to the ILS–tuned station when APP is selected on the associated (L or R) EFIS control panel (L is displayed when valid ILS/DME is available)
- displays dashes when no computed data is available
- displays blank when DME distance is unreliable, or when there are no DME navaids within range for autotuning

6 Compass Card

Indicates airplane heading under lubber line.

- Captain’s heading information as selected by the first officer’s IRS switch
- First officer’s heading information as selected by the captain’s IRS switch

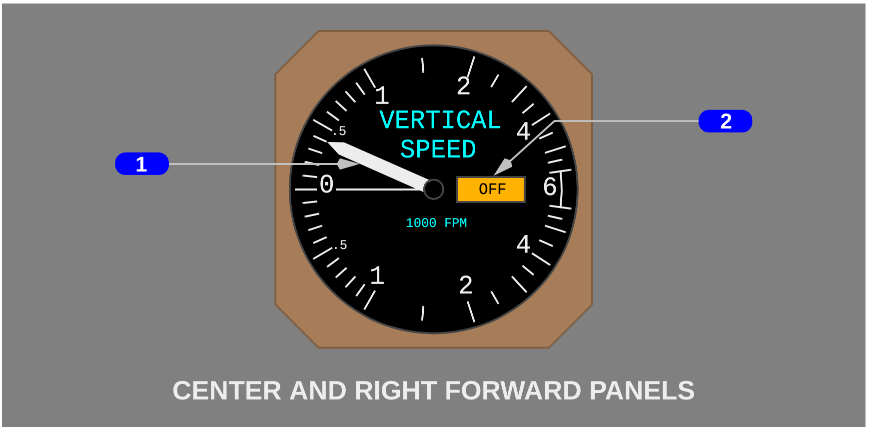
7 Bearing Pointer Failure Flag (Left/Right)

Selected VOR/ADF receiver has failed, or no computed data is available.

- may be in view with heading flag
- instrument failure.

Vertical Speed Indicator

N316LA



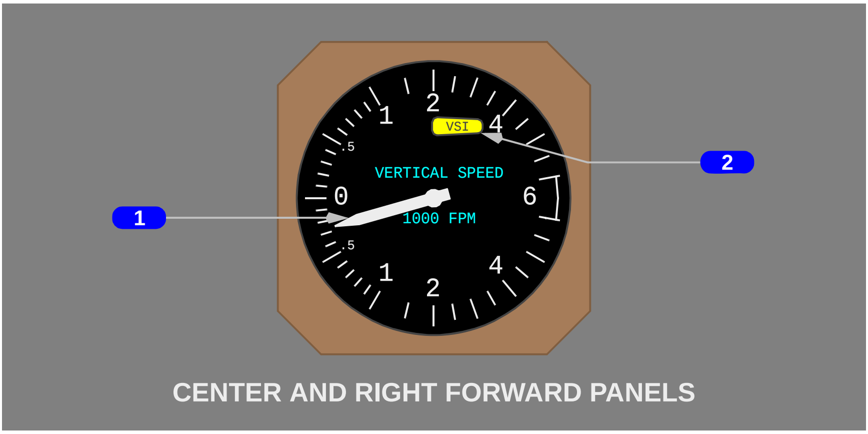
1 Vertical Speed Pointer

Indicates rate of climb or descent from 0 to 6,000 feet per minute.

2 OFF Flag

Flag in view – VSI is inoperative.

N422LA through N526LA



1 Vertical Speed Pointer

- Indicates rate of climb or descent from 0 to 6,000 feet per minute
- Indicates zero when vertical speed is unreliable

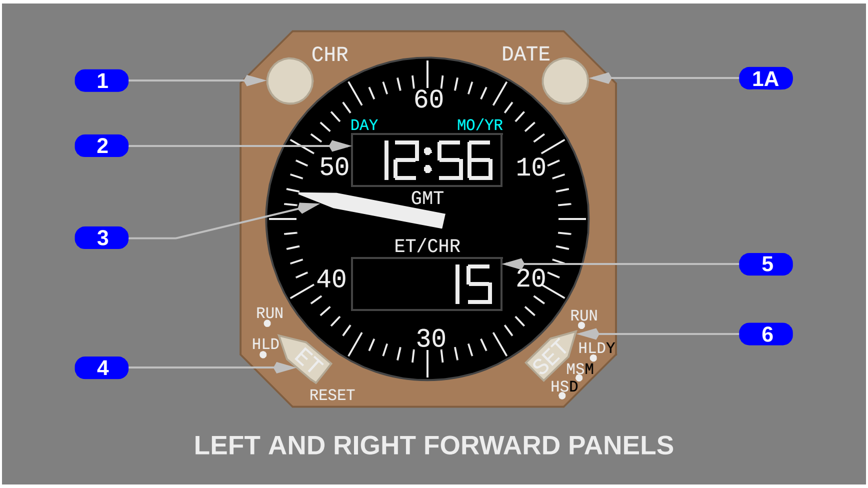
2 VSI Flag

Flag in view – VSI is inoperative.

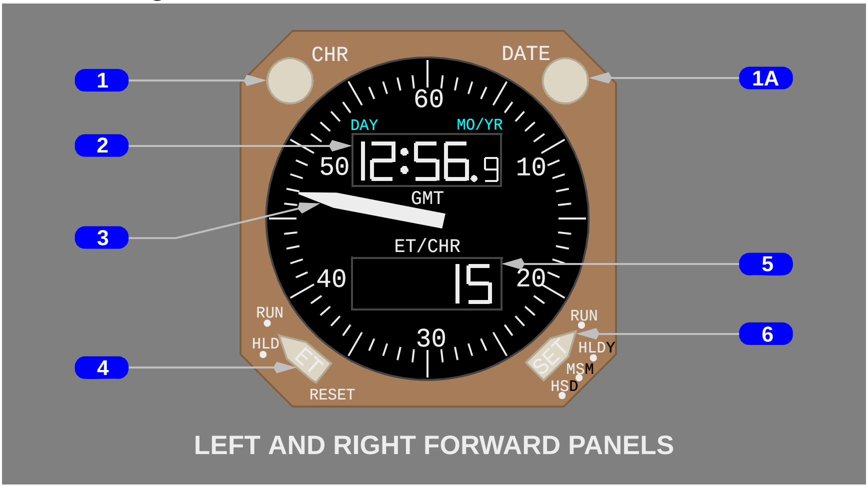
Note: The VSI displays vertical guidance bars when TA/RA is selected with the transponder mode selector. (Refer to Chapter 15, Warning Systems)

Clock

N316LA



N422LA through N526LA



1 Chronograph (CHR) Switch

Push – initiates start, stop and reset functions of the CHR display and second hand

Subsequent pushes –

- overrides any existing ET display
- controls chronograph second hand.

1A DATE Switch

Push – displays day and month, alternating with year.

Subsequent push – returns display to time.

2 Time/Date Window

Displays time (hours, minutes – 24 hour format) when time is selected with the date switch.

Alternately displays day–month and year when date is selected with the date switch.

3 Chronograph Second Hand

Indicates seconds.

4 Elapsed Time (ET) Selector

Controls the elapsed time function.

RUN – starts the elapsed time display.

HLD – stops the elapsed time display.

RESET – (spring–loaded to HLD) returns ET display to zero.

5 Elapsed Time/Chronograph (ET/CHR) Window

Displays elapsed time in hours and minutes, or chronograph minutes.

- when selected, the chronograph display replaces the elapsed time display
- elapsed time continues to run in the background and displays after the chronograph is reset.

6 SET Selector

Sets the time and date when the date switch is set to manual

RUN – starts the time indicator.

HLDY (hold, year) –

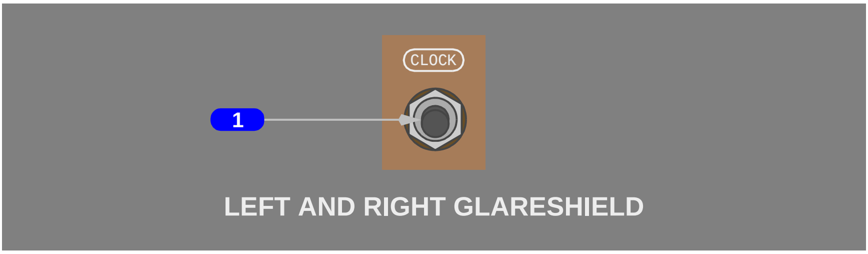
- stops the time indicator and sets the seconds to zero when time is selected with the date switch
- advances years when date is selected with the date switch.

MSM (minute slew, month) –

- advances minutes when time is selected with the date switch
- advances months when date is selected with the date switch.

HSD (hour slew, day) –

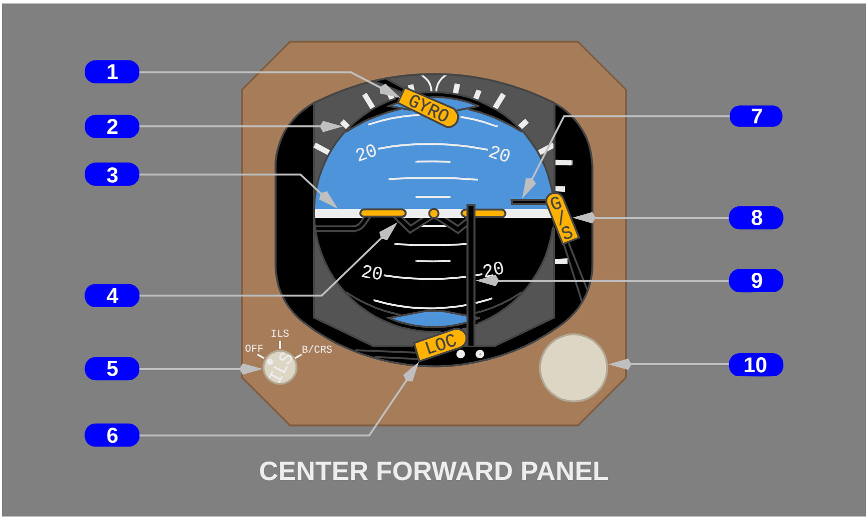
- advances hours when time is selected with the date switch
- advances days when date is selected with the date switch



1 CLOCK Switch

Operates the same as the chronograph switch.

Standby Flight Instruments
Standby Attitude Director Indicator (Standby ADI)



1 GYRO Flag

Flag in view – attitude is unreliable.

2 Bank Indicator and Scale

Indicates bank in reference to the bank scale.

3 Horizon Line and Pitch Angle Scale

Indicates horizon relative to the airplane symbol.

Pitch scale is in 5 degree increments.

4 Airplane Symbol

Indicates airplane attitude with reference to the horizon.

5 ILS Selector

OFF – deviation pointers and failure flags retracted from view.

ILS – pointers indicate deviation from localizer and glideslope.

N316LA
B/CRS – reverses sensing for localizer deviation pointer.

N422LA through N526LA
INOP – B/CRS placarded inoperative,

6 Localizer (LOC) Flag

Flag in view – center localizer receiver has failed.

7 Glideslope Pointer and Deviation Scale

The glideslope pointer indicates glideslope position relative to the airplane.

- scale indicates deviation
- pointer is not displayed when ILS selector is OFF or no computed data exists.

8 Glideslope (G/S) Flag

Flag in view – center glideslope receiver has failed.

9 Localizer Pointer and Deviation Scale

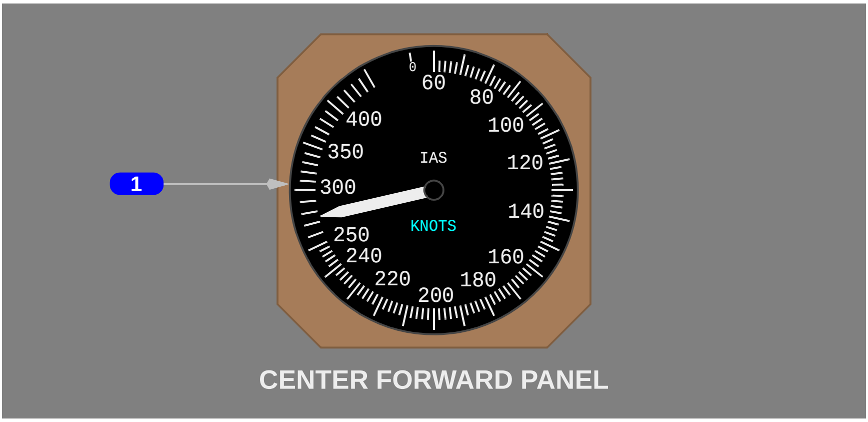
The localizer pointer indicates position relative to the airplane.

- scale indicates localizer deviation
- expanded localizer scale not available
- pointer not displayed when ILS selector is OFF or no computed data exists.

10 Caging Control

Pull – aligns horizon with the airplane symbol.

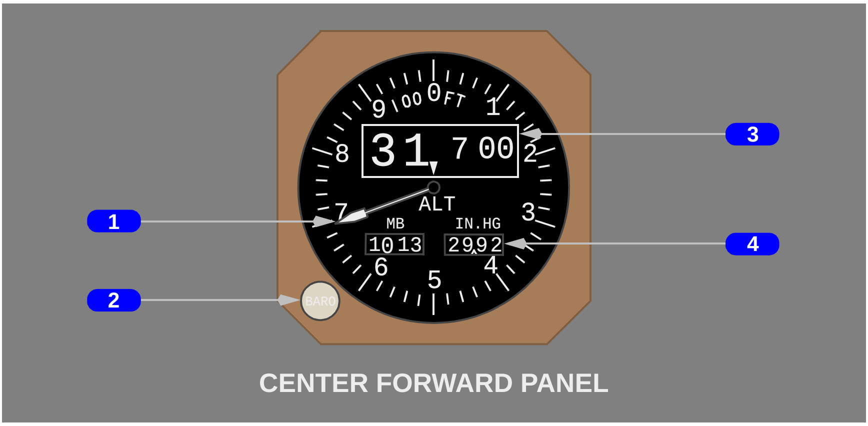
Standby Airspeed Indicator (Pneumatic)



1 Standby Airspeed Indicator

Provides alternate airspeed information.

Standby Altimeter (Pneumatic)



1 Altitude Pointer

Makes one revolution each one thousand feet.

2 Barometric Setting Control

Rotate – adjusts barometric settings.

3 Altitude Indicator

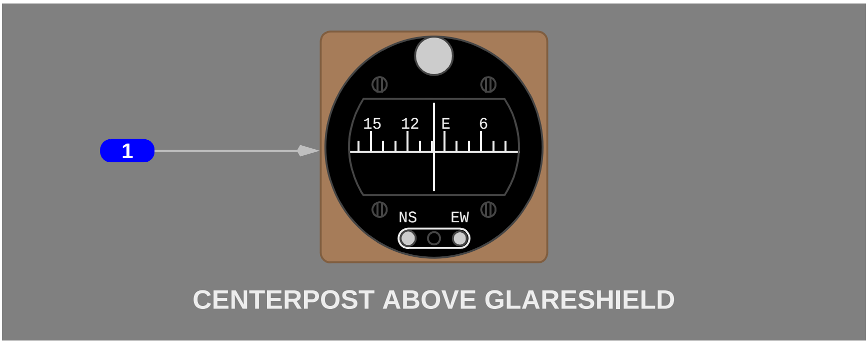
Indicates altitude in increments of twenty feet.

4 **Barometric Setting Window**

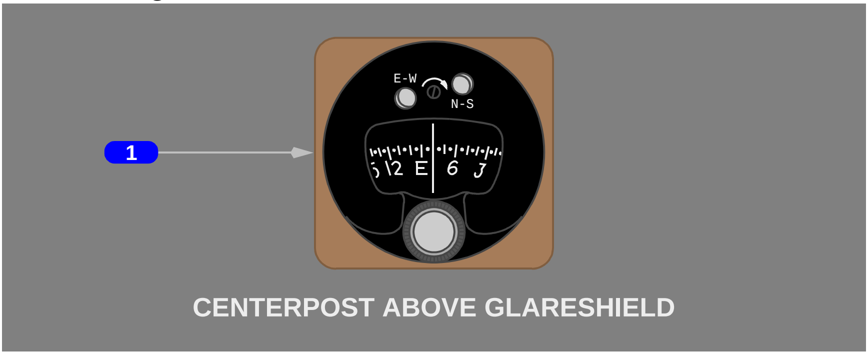
Displays barometric correction (in millibars and inches of mercury) as set by the barometric setting control.

Standby Magnetic Compass

N316LA



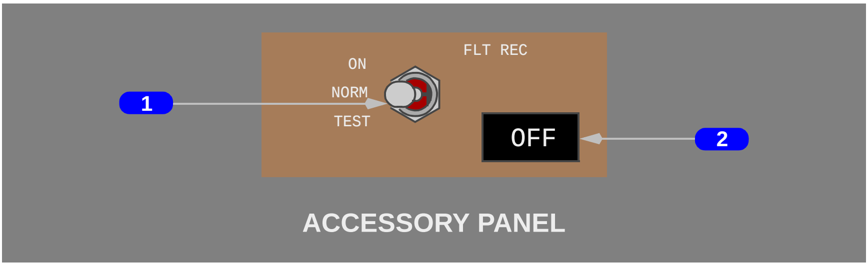
N422LA through N526LA



1 **Standby Magnetic Compass**

Displays magnetic heading.

Flight Recorder



1 Flight Recorder (FLT REC) Switch

ON – applies power to the flight recorder.

NORM –

- in flight – the recorder operates anytime electrical power is available
- on the ground – either engine must also be operating.

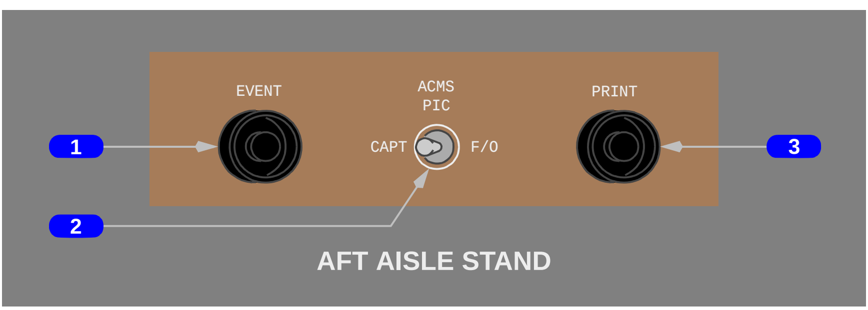
TEST – (Spring – loaded to NORM) initiates a flight recorder test.

2 Flight Recorder OFF Light

Illuminated (white) – indicates the recorder is not operating or the test is invalid.

Flight Recorder – Event Recorder/Printer Panel

N422LA through N526LA



1 EVENT Switch

Push – records and event mark on the DAR and the DFDR

2 ACMS PIC Switch

CAPT – selects Captain as pilot in command input to ACMS.

F/O – selects First Officer as pilot in command input to ACMS.

3 PRINT Switch

Push – prints ACMS data displayed on CDU.

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Introduction

The conventional instruments provide information in addition to the EFIS displays to aid pilots in controlling the airplane throughout its flight regime. This section includes a discussion of the primary instruments, standby instruments, and the pitot static system.

Primary Flight Instruments

Mach/Airspeed Indicator

Two electric mach/airspeed indicators display airspeed, mach, and Vmo from the selected air data source. The Vmo pointer indicates the maximum operating airspeed in knots or the equivalent to the maximum operating mach number. The command airspeed bug on each indicator can be automatically positioned from the FMC, or manually from the MCP IAS/MACH Selector.

Primary Altimeter

Two electric altimeters indicate current altitude in feet. An altimeter altitude light is provided. Altitude alerting is described in Chapter 15, Warning Systems.

Radio Distance Magnetic Indicator (RDMI)

Two radio distance magnetic indicators are installed. Each displays magnetic heading or true heading, VOR or ADF bearing, and (VOR/ILS/DME, VORTAC) distance. The RDMI receives primary heading signals from the opposite side IRS and alternate heading signals from the C–IRS. The RDMI is inoperative until the associated IRS has completed alignment and entered the navigation mode.

With the heading reference switch in NORM, magnetic heading is displayed if the airplane is outside polar regions. In polar regions, a heading flag shows. When the switch is in TRUE, true heading is displayed regardless of latitude. For more information on polar regions refer to Chapter 11, Flight Management, Navigation.

When the RDMI is referenced to true north, positioning an ADF/VOR selector to VOR causes the associated pointer failure flag to appear.

Vertical Speed Indicator

Two electrically–driven vertical speed indicators (VSI) are installed. The captain's VSI is connected to the left IRS and ADC, and the first officer's VSI is connected to the right IRS and ADC. The center IRS provides backup vertical speed data for either crew member when ALTN is selected with the respective IRS switch. The opposite ADC provides backup vertical speed data for either crewmember when ALTN is selected with the respective AIR DATA switch.

The VSI is inoperative until the associated IRS has completed alignment and entered the navigation mode.

Standby Flight Instruments

Standby Attitude Director Indicator (Standby ADI)

A self–contained standby attitude director indicator incorporating an ILS display is installed. In the event that all generator power is lost, the standby ADI will be supplied with electrical power from the standby DC bus. ILS information is provided from the C–ILS receiver.

Standby Airspeed Indicator (Pneumatic)

The standby airspeed indicator provides current airspeed in knots. It is connected directly to the L AUX PITOT and the alternate static ports. (See pitot–static system schematic.)

Standby Altimeter (Pneumatic)

A single indicator is installed for standby reference. Input for the indicator is from the alternate static ports. (See pitot–static system schematic.)

Standby Magnetic Compass

A standard magnetic standby compass is provided. A card located near the compass provides heading correction factors.

Clock

Two electronic clocks are installed, with two digital displays on each clock. Either coordinated universal time (UTC) or local time may be set on the upper time display. The lower ET/CHR display is used for either elapsed time or the chronograph. Separate controls are provided for each display.

In addition to UTC and local time, the date may be set on the upper time display.

Flight Recorder

The flight recorder provides a permanent record of selected operational systems in a sealed, fire–resistant container. The recorder automatically turns on when either engine is operating or the airplane is in flight.

N422LA through N526LA
The AIDS/ACMS event recorder/printer panel provides for selective recording of flight events, selection of the AIDS/ACMS input source, and printer operation.

Air Data System

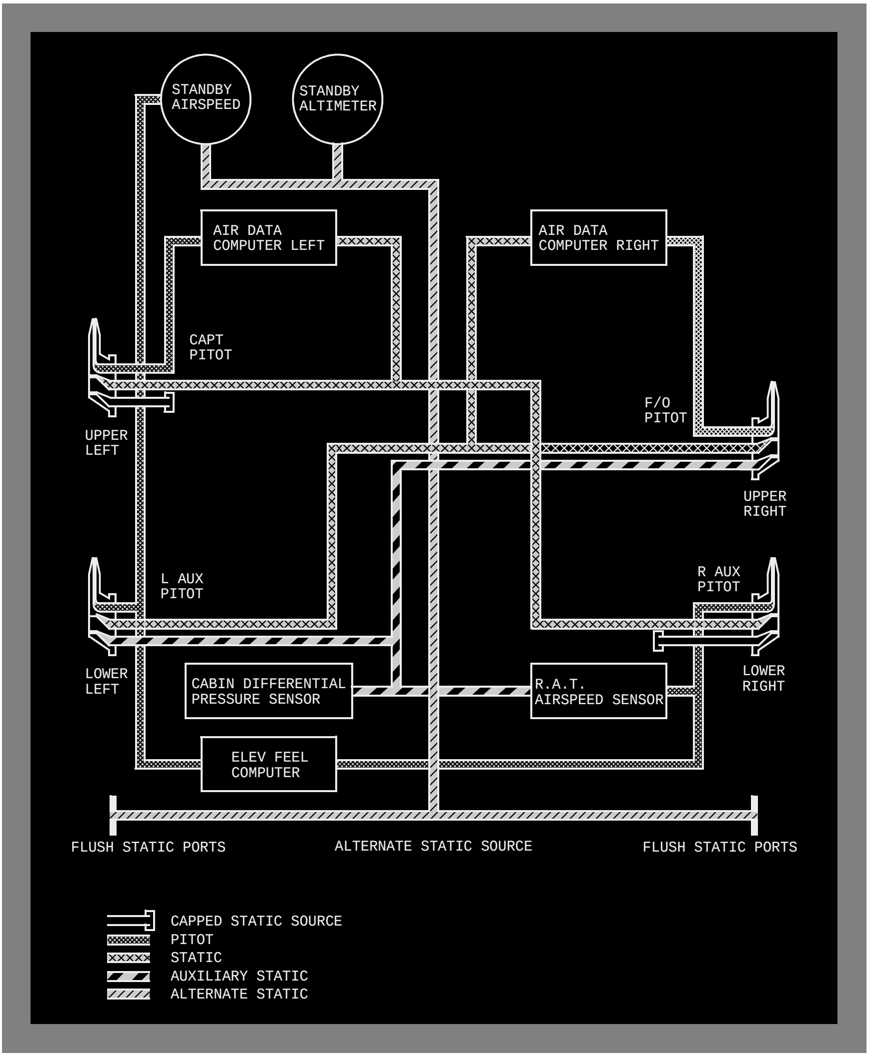
The air data system consists of the pitot–static system, one temperature probe (TAT), two angle of attack probes, two air data computers (ADCs), and electric flight instruments.

The system provides pitot and/or static pressure information to various flight instruments and airplane systems. Standby airspeed and altimeter indicators are also provided.The ADCs use air data information to provide input signals to certain flight instruments (electric mach/airspeed indicator, electric altimeter) and other using systems (AFDS, FMC, etc.). The left instruments use the left ADC and the right instruments use the right ADC. The opposite ADC is available as an alternate air data source.

Warning flags indicate instrument failure or unreliable data. When a malfunction occurs in instruments with failure monitors, warning flags appear.

The EICAS caution messages ALT DISAGREE or IAS DISAGREE display when there is a significant difference between the left and right air data information. These messages are inhibited at low altitude or when both pilots have the same air data source selected.

Pitot–Static System Schematic



Total Air Temperature (TAT)

TAT appears on the primary EICAS display above the engine indications and is supplied by a thrust management or air data computer. The TAT indication is comprised of outside air temperature (OAT) plus ram rise. TAT Indication on the ground will approximate OAT.

True Airspeed/Static Air Temperature (TAS/SAT)

True airspeed (TAS) and static air temperature (SAT) are displayed on the PROGRESS page.

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Flight Instruments, Displays EICAS Messages

Note: The OVERSPEED warning and the ALTITUDE ALERT caution messages are covered in Chapter 15, Warning Systems.

The following EICAS messages can be displayed.

Message	Level	Light	Aural	Condition
ALT DISAGREE	Caution		Beeper	Captain's and first officer's altitude indications disagree.
ATT DISAGREE	Caution		Beeper	Captain's and first officer's attitude indications disagree.
IAS DISAGREE	Caution		Beeper	Captain's and first officer's airspeed indications disagree.
INSTR SWITCH	Caution		Beeper	Both EFI switches are in the ALTN position.

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Flight Management, Navigation — Chapter 11
Table of Contents — Section TOC

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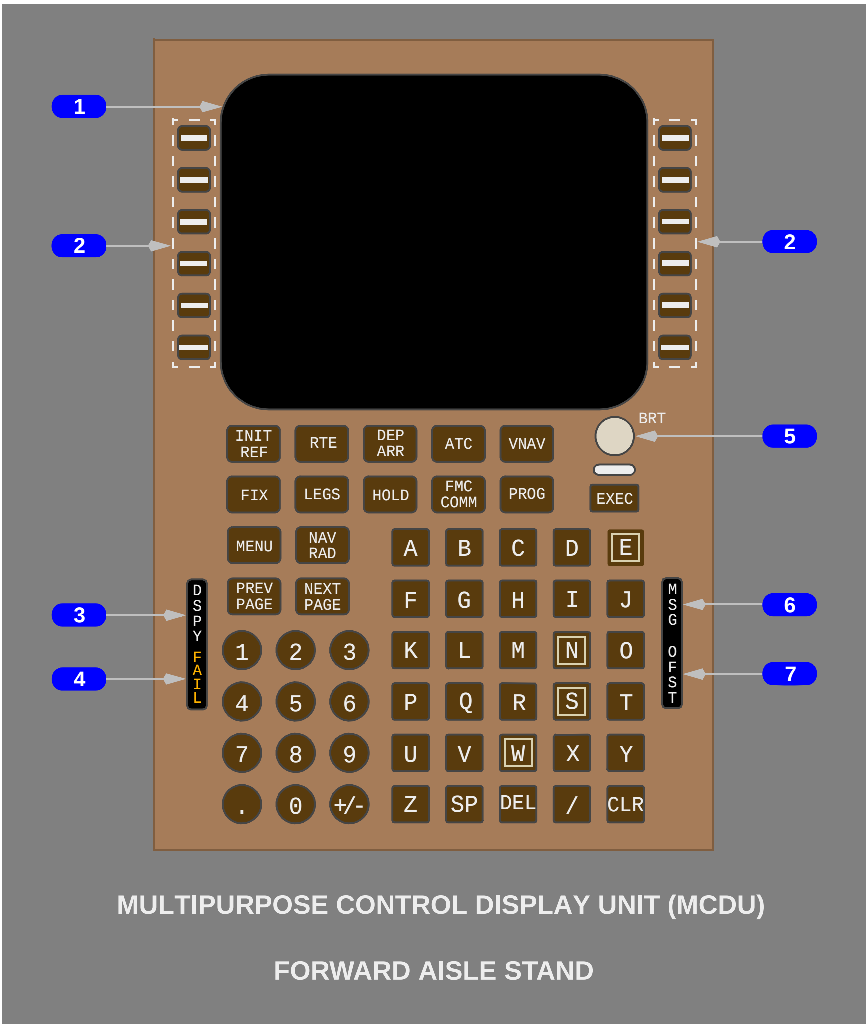
Flight Management System Control Display Unit (CDU)



1 Control Display Unit (CDU) Display

Displays CDU data pages.

2 Line Select Keys

Push –

- moves data from scratchpad to selected line
- moves data from selected line to scratchpad
- selects page, procedure, or performance mode as applicable
- deletes data from selected line when DELETE is shown in scratchpad.

3 Display (DSPY) Light

Illuminated (white) –

- when RTE page 3 or greater, RTE LEGS page 2 or greater, RTE DATA page 2 or greater is shown
- when airplane is not in holding pattern shown on HOLD page
- when modification is in progress, and any RTE, RTE LEGS, RTE DATA, HOLD, CLB, CRZ, or DES page is shown.

4 FAIL Light

Illuminated (amber) – fault detected in related FMC.

5 Brightness Control

Rotate – controls display brightness.

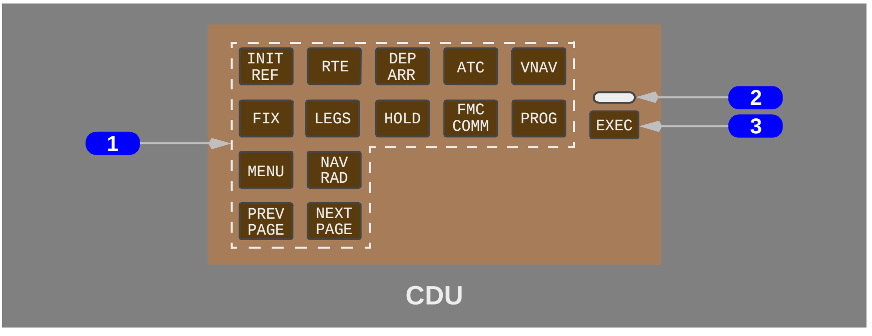
6 Message (MSG) Light

Illuminated (white) – scratchpad message is shown.

7 Offset (OFST) Light

Illuminated (white) – LNAV gives guidance for lateral route offset.

Function and Execute Keys



1 CDU Function Keys

Push –

- INIT REF – displays page for data initialization or for reference data
- RTE – displays page to input or change origin, destination, or route
- DEP ARR – displays page to input or change departure and arrival procedures

N422LA through N526LA
- ATC – displays ATC datalink pages

N316LA
- ATC – displays ATC datalink pages (function inoperative)
- VNAV – displays page to view or change vertical navigation path data
- FIX – displays page to create reference points on the map display
- LEGS –
  - displays page to evaluate or modify lateral and vertical route data
  - displays page to control the center point on the PLAN mode display
- HOLD – displays page to create holding patterns and show holding pattern data

N422LA through N526LA
- FMC COMM – displays FMC data link status page

N316LA
- FMC COMM – displays FMC data link status page (function inoperative)
- PROG – displays page to view dynamic flight and navigation data, including waypoint and destination ETAs, fuel remaining, and arrival estimates
- MENU – displays page to choose subsystems controlled by CDU
- NAV RAD – displays page to monitor or control VOR tuning
- PREV PAGE – displays previous page of related pages (for example, LEGS pages)
- NEXT PAGE – displays next page of related pages.

2 Execute Light

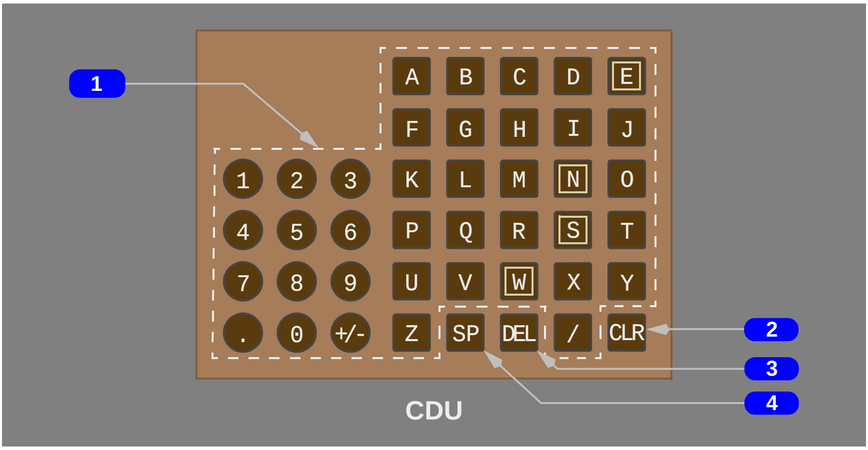
Illuminated (white) – active data is modified but not executed.

3 Execute (EXEC) Key

Push –

- makes data modification(s) active
- extinguishes execute light.

Alpha/Numeric and Miscellaneous Keys



1 Alpha/Numeric Keys

Push –

- puts selected character in scratchpad
- Slash (/) key – puts "/" in scratchpad
- Plus Minus (+/–) key – first push puts "–" in scratchpad. Subsequent pushes alternate between "+" and "–".

2 Clear (CLR) Key

Push –

- if scratchpad message is present – clears scratchpad message.
- if scratchpad entry in progress – clears last scratchpad character

Push and hold – clears all scratchpad data.

3 Delete (DEL) Key

Push – enters "DELETE" in scratchpad.

4 Space (SP) Key

Push – puts space in scratchpad.

Note: The SP key is normally used when keying in messages for datalink communications. If the SP key is inadvertently pressed while keying in data for FMC use, it will result in an INVALID ENTRY scratchpad message when attempting to select the data to the appropriate line. Should this occur, clear the scratchpad and begin again.

CDU Page Components

1 Page Title

Subject or name of data shown on page.

ACT (active) or MOD (modified) displays whether page contains active or modified data.

2 Line Title

Title of data on line below.

3 Line

Displays –

- prompts
- selectors
- data.

4 Prompts

Show pages, select modes, and control displays. Caret, "<" or ">", is displayed before or after the prompt adjacent to the related line select key.

5 Page Number

Left number is page number. Right number is total number of related pages. Page number is blank when only one page exists.

6 Boxes

Data input is mandatory.

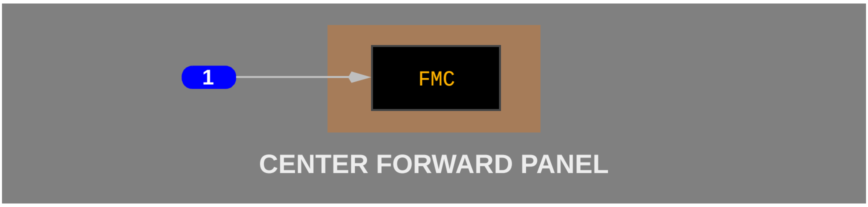
7 Dashes

Data input is optional. The data is not mandatory.

8 Scratchpad

Displays messages, alphanumeric entries or line selected data.

FMC Annunciator Light

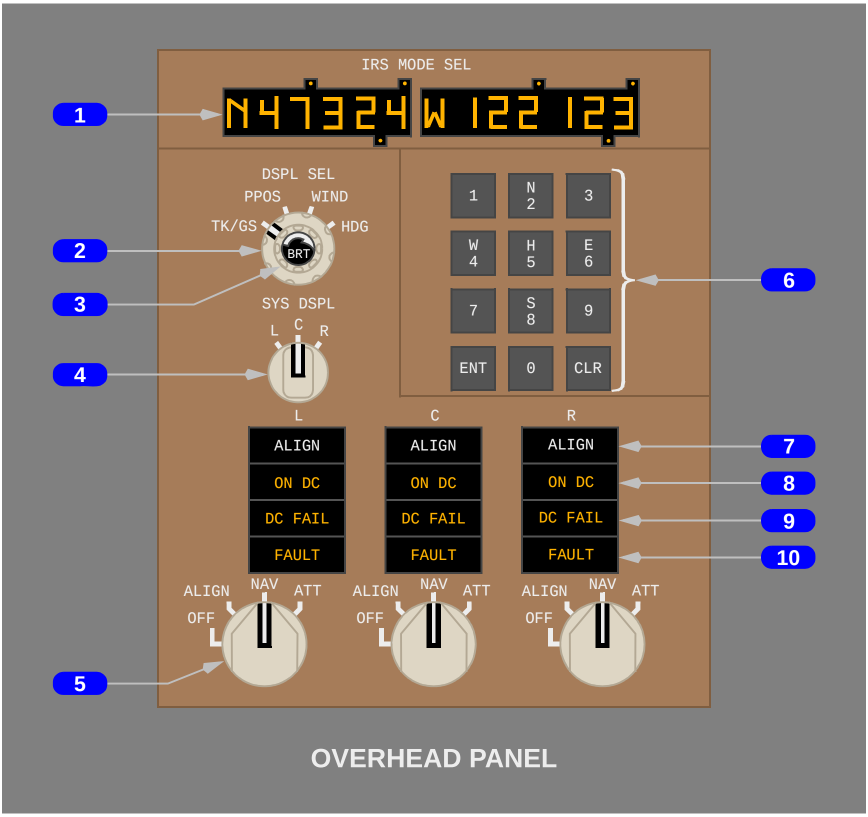


1 FMC Annunciator Light

Illuminated (amber) –

- CDU is displaying an operationally significant message in the scratchpad
- pushing CDU CLR key extinguishes the light and clears the scratchpad message

Inertial System
Inertial Reference System



1 IRS DISPLAY

Displays track, groundspeed, present position, wind or heading as controlled by display selectors or keyboard.

2 IRS Display Selector

Selects data for display when keyboard not in control.

- TK/GS – displays present true track and groundspeed
- PPOS – displays present position
- WIND – displays present true wind when inflight
- HDG – displays present true heading.

3 Brightness Control

Rotate – controls intensity of display.

4 IRS System Display Selector

Selects system to display data when keyboard not in control.

5 IRS Mode Selectors

Rotate – controls mode of related IRS.

Must be pulled out to move from NAV position.

OFF –

- alignment is lost
- ALIGN light illuminates for 30 seconds as system goes through a shutdown sequence
- realignment requires about 10 minutes while the airplane is parked and entry of present position (latitude and longitude).

ALIGN –

- initiates alignment when parked
- initiates a quick alignment if selected when the system is in the navigation mode.

NAV –

- normal operational mode
- permits system to enter NAV mode after completing alignment
- initiates a 10 minute alignment if selected from OFF.

ATT –

- provides only attitude and heading information
- position and ground speed information lost until system realigned on ground
- when selected airborne, ALIGN light illuminates for 30 seconds while system senses local level (requires level flight)
- magnetic heading input required to initialize heading output
- the selector must be cycled through OFF to re–enter ALIGN or NAV mode.

6 IRS Keyboard

Push an alpha key to begin entry.

- pushing the N, S, E or W keys changes the IRS display to keyboard control and arms the keyboard for latitude or longitude entry
- pushing H changes the display to keyboard control and arms the keyboard for heading entry.

Enter (ENT) Key – push

- enters data from display into all three IRS systems
- restores display to the display selector setting

Clear (CLR) Key – push

- clears data keyed into display
- restores display to the display selector setting.

7 ALIGN Lights

Illuminated (white) –

- steady – the related IRS is operating in the ALIGN mode, the initial ATT mode, or the shutdown cycle
- flashing – alignment cannot be completed due to IRS detection of:
  - significant difference between previous and entered positions or an unreasonable present position entry
  - no present position entry.

Extinguished –

- IRS not in ALIGN mode
- with mode selector in NAV, alignment is complete, and all IRS information is available
- with mode selector in ATT, attitude information is available. Heading information is available following entry of initial magnetic heading.

8 ON DC Lights

Illuminated (amber) –

- normal AC power for the related IRS has failed and the IRS is operating on DC backup power from the hot battery bus (AC power not normal)
- if on the ground, the ground–call horn in the nose wheel well sounds, providing an alert that a battery drain condition exists
- EICAS advisory message L, C or R IRS ON DC is displayed
- momentary illumination is normal during alignment self–test.

9 DC FAIL Lights

Illuminated (amber) –

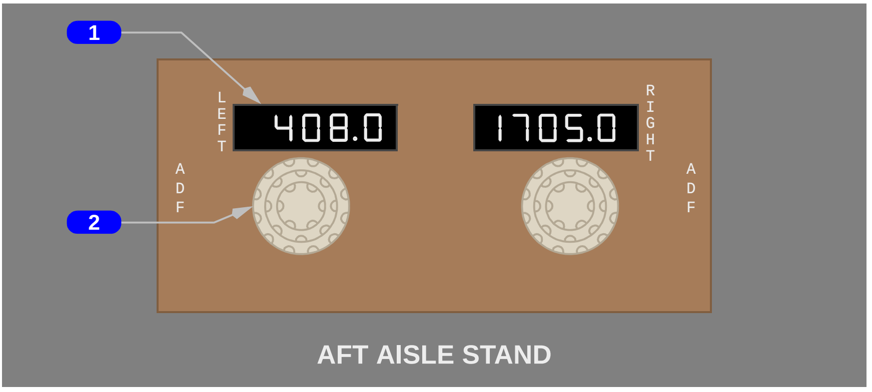
- DC backup power for the related IRS has failed
- if the other lights are extinguished, the IRS is operating normally on AC power.
- EICAS advisory message L, C or R IRS DC FAIL is displayed

10 FAULT Lights

Illuminated (amber) – a system fault affecting the related IRS ATT and/or NAV modes has been detected. The EICAS advisory message L, C or R IRS FAULT is also displayed.

Radio Navigation Systems
Automatic Direction Finding (ADF) Control

N316LA



1 Frequency Indicators

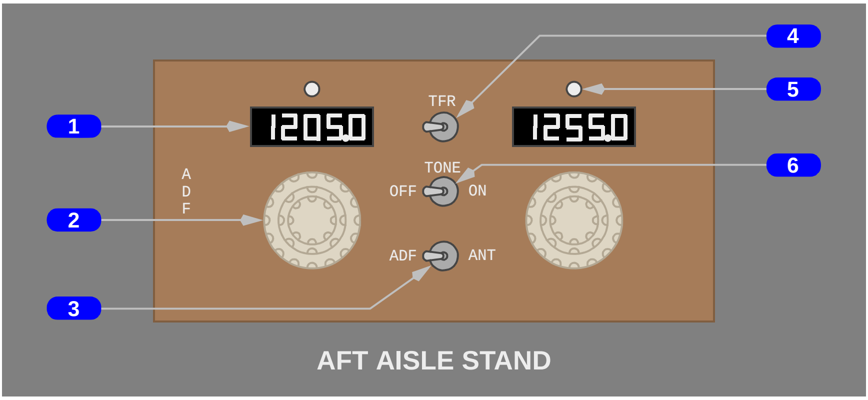
Display the frequency selected with the related frequency selector.

2 Frequency Selectors

Rotate –

- outer knob sets the hundreds number
- middle knob sets the tens number
- inner knob sets the tenths and ones number.

N422LA through N526LA



1 Frequency Indicators

Display the frequency selected with the related frequency selector.

2 Frequency Selectors

Rotate –

- outer knob sets the hundreds number
- middle knob sets the tens number
- inner knob sets the tenths and ones number.

3 Mode Selector

ADF –

- audio reception possible
- ADF bearing sent to displays and RDMI.

ANT –

- audio reception optimized
- no ADF bearing data available.

4 Transfer (TFR) Switch

Selects which frequency selector controls the ADF.

5 ADF Transfer Lights (white)

Illuminate to indicate which frequency selector is active.

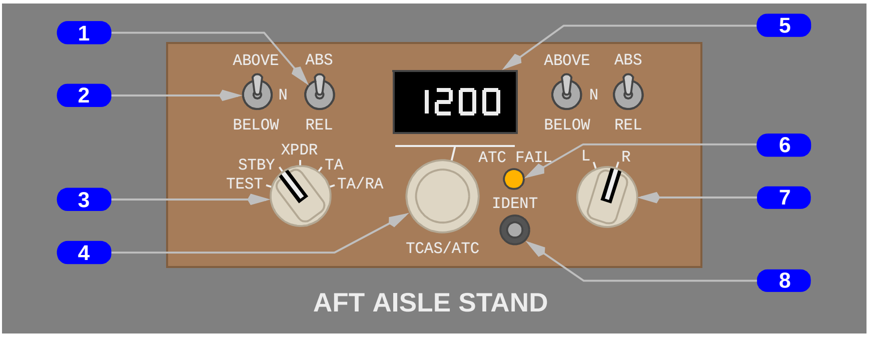
6 TONE Switch

ON – activates tone generator required for receiving audio from unmodulated stations.

OFF – deactivates tone generator.

Transponder Panel

N422LA through N526LA



1 Absolute/Relative (ABS/REL) Switches

Control TCAS displays. (refer to Chapter 15, Warning Systems)

2 Above/Normal(N)/Below Switches

Control TCAS displays. (refer to Chapter 15, Warning Systems)

3 Transponder Mode Selector

TEST – activates test.

STBY – deactivates transponder.

XPDR – activates transponder with altitude reporting if airplane is in–flight.

TA – activates TCAS Traffic Advisory (TA) mode and altitude reporting. (refer to Chapter 15, Warning Systems)

TA/RA – activates TCAS TA and Resolution Advisory (RA) modes. (refer to Chapter 15, Warning Systems)

4 Transponder Code Selector

Sets transponder code in transponder code window and both transponders.

5 Transponder Code Window

Displays transponder code.

6 ATC FAIL Light

Illuminated (amber) – selected transponder has failed.

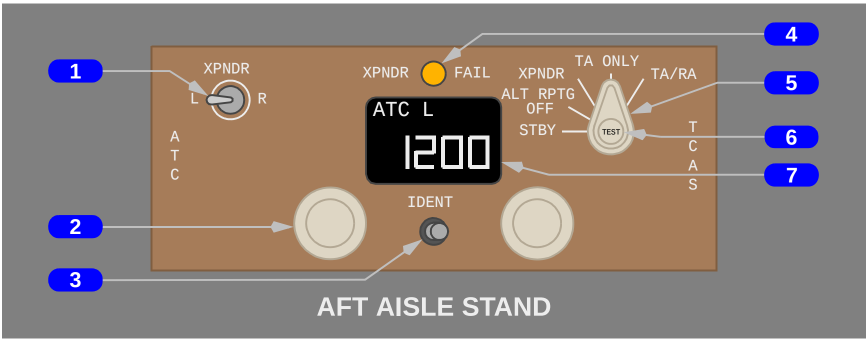
7 **Transponder Selector**

L or R – selects transponder for operation.

8 **Identification (IDENT) Switch**

Push – transmits an identification signal.

N316LA



1 **Transponder (XPNDR) Selector**

L or R – selects transponder for operation.

2 **Transponder Code Selectors**

Sets transponder code in transponder code window and both Transponders. Left selector sets the first two digits, the right selector sets the second two digits.

3 **Identification (IDENT) Switch**

Push – transmits an identification signal.

4 **Transponder (XPNDR) FAIL Light**

Illuminated (amber) – selected transponder has failed.

5 **Transponder Mode Selector**

STBY – deactivates transponder.

ALT RPTG OFF – activates transponder with altitude reporting off if airplane is in–flight.

XPNDR – activates transponder with altitude reporting if airplane is in–flight.

TA ONLY – activates TCAS Traffic Advisory (TA) mode. (refer to Chapter 15, Warning Systems)

TA/RA – activates TCAS TA and Resolution Advisory (RA) modes. (refer to Chapter 15, Warning Systems)

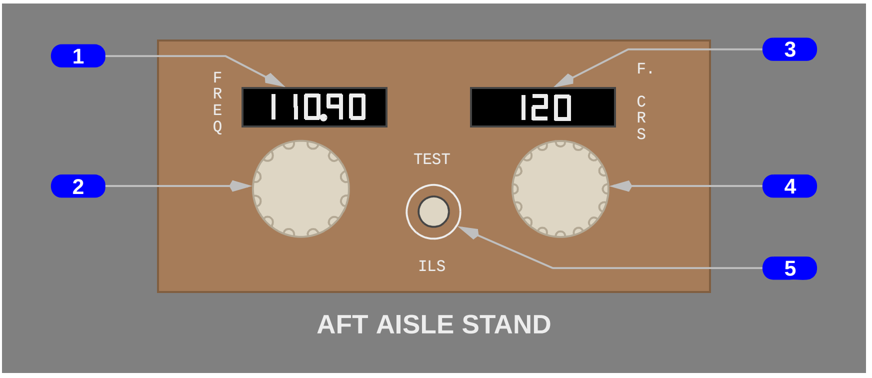
6 Test Switch

Push – initiates transponder test.

7 Transponder Code Window

Displays transponder code. The heading shows which transponder is selected (ATC L or R).

ILS Control Panel



1 ILS Frequency (FREQ) Indicator

Displays frequency tuned in all three ILS receivers or dashes (– – – – –) if the selector is in the standby position. The display is generated by the center ILS receiver.

2 ILS Frequency Selector

Rotate – tunes all ILS receivers.

- tuned frequency displayed in frequency indicator
- received data is displayed on the ADI
- if an ILS mode is selected on the HSI, ILS data is displayed on the related HSI and the associated DME is tuned to the ILS frequency
- VOR frequencies cannot be tuned
- frequency change is inhibited when all three autopilots are armed and either Localizer or Glideslope is captured
- dashes are displayed when turned to the standby position. ILS display symbology is removed from the ADI when dashes are displayed

3 ILS Front Course (F. CRS) Indicator

Displays the selected front course.

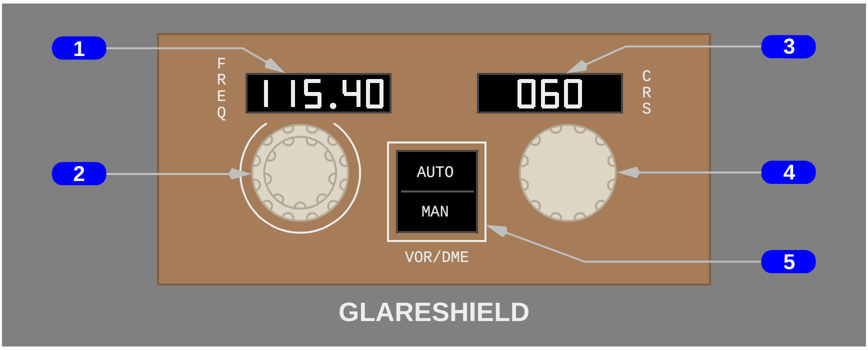
4 **ILS Front Course Selector**

Rotate – selects the ILS front course.

5 **ILS Test Switch**

Push – sends a test signal to all ILS receivers except during multiple autopilot approaches after either the localizer or glideslope is captured.

VOR Control Panel



1 **VOR Frequency (FREQ) Indicator**

Indicates the frequency selected by the frequency selector.

2 **VOR Frequency Selector**

Rotate –

- when MAN light illuminated, tunes related VOR and also tunes DME if HSI mode selector is not in an ILS position
- ILS frequencies cannot be tuned.

3 **VOR Course (CRS) Indicator**

Displays course set by VOR course selector.

4 **VOR Course Selector**

ROTATE – sets course in VOR course indicator and EFIS.

5 **VOR/DME Switch**

Push –

- alternates VOR and DME tuning between the FMC (AUTO) automatic and VOR frequency selector (MAN) manual when the HSI mode selector is in a MAP or PLAN mode.
- only MAN available when the HSI is not in a MAP or PLAN mode.

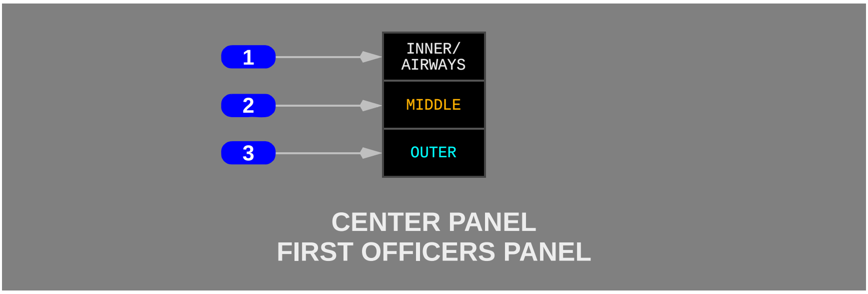
AUTO Light illuminated (white) –

- FMC is tuning related VOR and DME
- HSI selector must be in a MAP or PLAN mode.

MAN Light illuminated (white) –

- VOR frequency selector is tuning VOR
- if the HSI mode selector is not in an ILS mode, the VOR frequency selector tunes the DME
- if the HSI mode selector is in an ILS mode, the ILS frequency selector tunes the DME.

Marker Beacon Lights



1 INNER/AIRWAYS

Illuminates (white) – over an inner or airways marker beacon.

2 MIDDLE

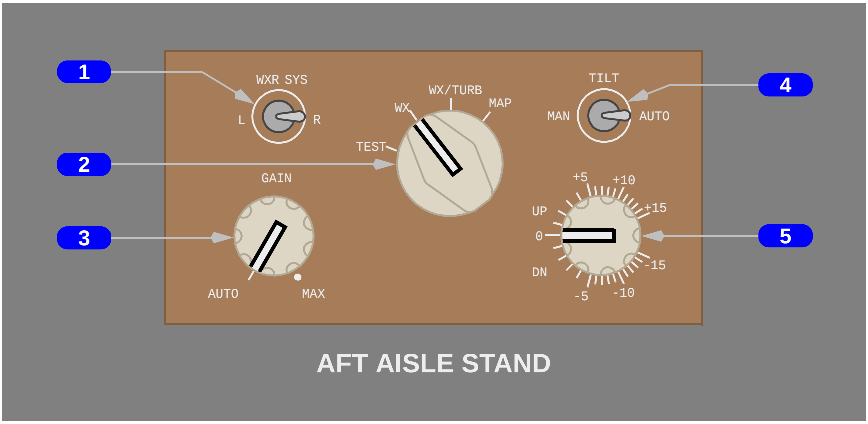
Illuminates (amber) – over a middle marker beacon.

3 OUTER

Illuminates (blue) – over an outer marker beacon.

Weather Radar
Weather Radar Control Panel

N422LA through N526LA



1 System (WXR SYS) Switch

L – selects left weather radar receiver/transmitter (R/T) for operation.

R – selects right weather radar receiver/transmitter (R/T) for operation.

2 Mode Selector

TEST – displays test pattern on HSI if WXR switch on EFIS control panel selected to ON; and initiates a test and fault isolation of the selected R/T.

WX – displays weather radar returns at selected gain level.

WX/TURB – displays weather returns and turbulence. Turbulence display only available with display ranges of 40 nm or less.

Note: Turbulence detection requires presence of detectable precipitation. Clear air turbulence cannot be detected by radar.

MAP – displays ground returns at selected gain level.

3 GAIN Control

AUTO – detent position provides automatic gain control calibrated for optimum weather returns.

Rotate – provides manual control of radar gain. Gain increases as control is rotated clockwise toward MAX.

4 TILT Mode Switch

MAN – antenna tilt can only be adjusted with the TILT control; disables antenna autotilt function.

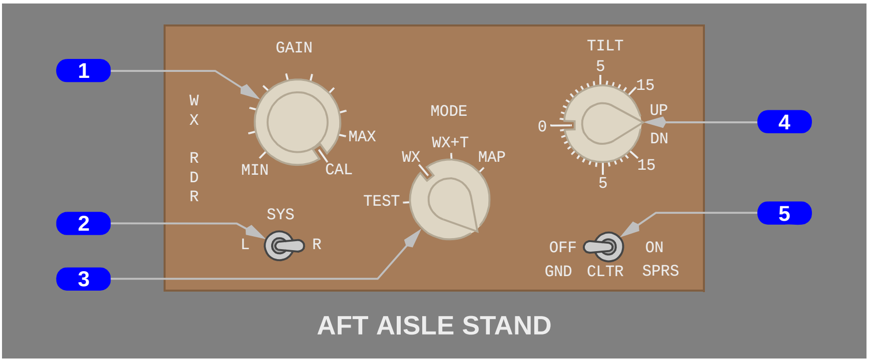
AUTO – enables antenna autotilt function; optimizes antenna tilt to avoid over or under-scanning weather.

5 TILT Control (active only when TILT mode switch selected to MAN)

Rotate clockwise – radar antenna tilts up to selected degrees from horizon.

Rotate counterclockwise – radar antenna tilts down to selected degrees from horizon.

N316LA



1 GAIN Control

Rotate – provides manual control of radar gain. Sets receiver sensitivity from minimum (MIN) to maximum (MAX).

CAL (calibrated)– maintains receiver sensitivity at a preset level for optimum return.

2 System (SYS) Switch

L – selects the left weather radar system for operation.

R – selects the right weather radar system for operation.

3 Mode Selector

TEST – activates system test.

WX – displays weather radar returns at selected gain level.

WX+T – displays weather radar returns plus turbulence. Turbulence is only shown on display ranges of 40 miles or less.

MAP – displays ground returns.

4 TILT Control

Rotate clockwise – radar antenna tilts up to selected degrees from horizon.

Rotate counterclockwise – radar antenna tilts down to selected degrees from horizon.

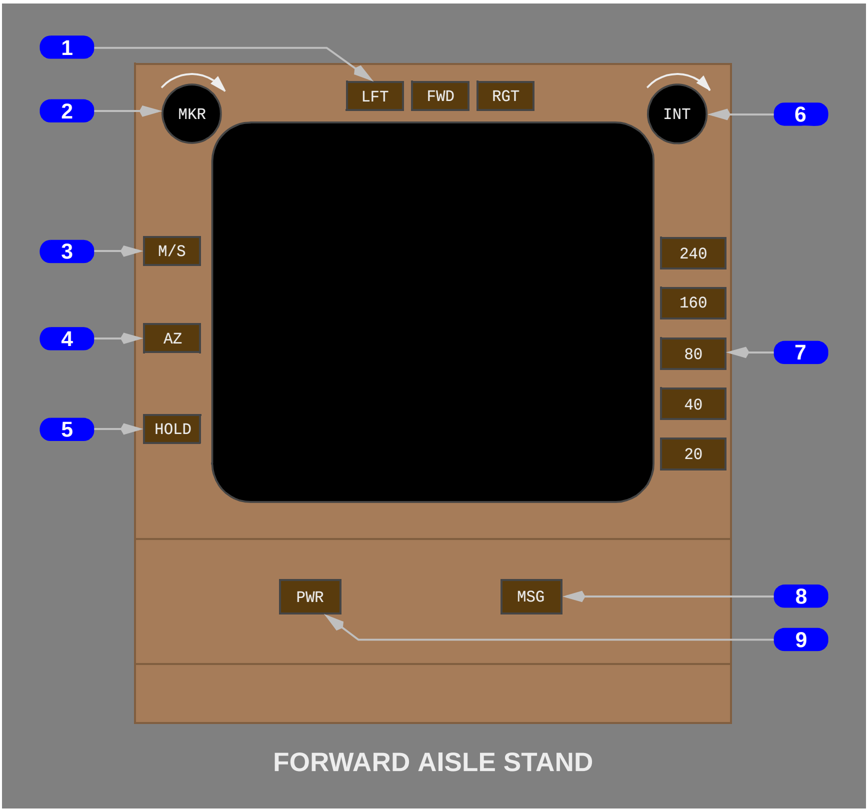
5 Ground Clutter Suppression (GND CLTR SPRS) Switch

OFF – provides normal radar returns.

ON – activates ground clutter suppression mode. Normal operation is with this switch OFF because weather returns can also be suppressed.

Weather Radar Indicator

N316LA



1 Display Select Switches

Selects the desired area for radar scanning

LFT – displays 90° sector forward and to the left of airplane. The origin of the display shifts to the right of the screen.

FWD – normal display centered on airplay heading. Displayed automatically when first powered.

RGT – displays 90° sector forward and to the right of the airplane. The origin of the display shifts to the left of the screen.

2 Marker Control

Rotate – adjusts the brightness of range arcs and azimuth lines.

3 M/S Switch

Function inoperative. Removes radar returns from display.

4 Azimuth Switch (AZ)

Push – displays azimuth marks.

5 HOLD Switch

Push – freezes the displayed image.

6 Intensity (INT) Control

Rotate – adjusts display brightness.

7 Range Select Switches

Push – selects indicated nautical mile range for radar display. Displays 80nm when first powered.

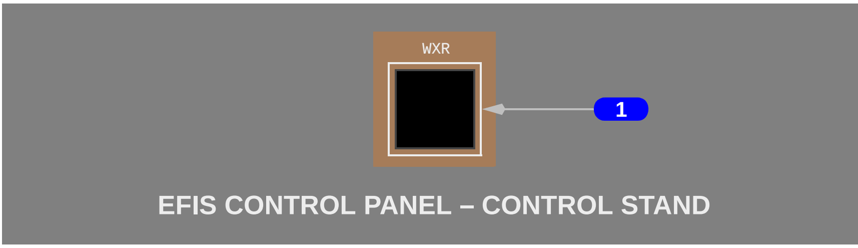
8 Message Switch (MSG)

Push – removes radar returns displays MSG. The message function is inoperative.

9 Power (PWR) Switch

Push – alternately selects the radar and indicator on and off. When selected off, the radar transmitter is deactivated when both EFIS control panel WXR switches are off.

Weather Radar Switch



1 Weather Radar (WXR) Switch

Push – alternately selects the HSI radar display on and off. The radar transmitter is activated when the radar is displayed on either HSI.

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Flight Management, Navigation — Chapter 11
Navigation Systems Description — Section 20

Introduction

Navigation systems include the global positioning system (GPS), inertial reference system (IRS), VOR, DME, ILS, ADF, ATC transponder, weather radar, and the flight management system (FMS). The FMS is described in the Flight Management System Description section of this chapter.

The FMC will provide navigation guidance and map display between 87° North and 87° South latitudes.

Navigation Systems Flight Instrument Displays

Refer to Chapter 10, Flight Instruments, Displays for flight instrument display system operations and typical instrument displays.

Inertial Reference System

The inertial reference system (IRS) calculates airplane position, acceleration, track, vertical speed, ground speed, true and magnetic heading, wind speed and direction. It also supplies attitude data for the displays, flight management system, flight controls, engine controls, and other systems.

The IRS consists of three Inertial Reference Units (IRUs) and the IRS mode selector panel.

Inertial Reference System Operation

The Inertial Reference System is controlled by the IRS Mode Control Panel on the overhead panel. When operating in the navigation mode, the IRS provides attitude, acceleration, ground speed, track, true and magnetic heading, present latitude and longitude, and wind speed and direction to other systems.

N422LA through N526LA
Magnetic heading and track are not available in polar regions. Magnetic reference is provided between N82° and S82° latitude except for areas near the magnetic poles. The north magnetic polar region is bounded by W80° and W130° where magnetic reference is provided to N70°. The southern magnetic polar region is bounded by E120° and E160° where magnetic reference is provided to S60°.

N316LA
Magnetic heading and track are not available in polar regions. Magnetic reference is provided between N73° and S60° latitude. Above these latitudes only true headings are available.

IRS Alignment

An IRS must be aligned before it can enter the NAV mode. Rotating the IRS mode selector from OFF to NAV begins the IRS alignment. The IRS performs a short power test, during which the ON DC light illuminates. When the ON DC light extinguishes, the ALIGN light illuminates. Alignment requires approximately ten minutes.

Present position (latitude and longitude) must be entered on the CDU position initialization page to complete the alignment. If the present position cannot be entered through the CDU, it may be entered through the IRS mode selector keyboard.

If the latitude/longitude position is not near the origin airport, the CDU scratchpad message VERIFY POSITION is displayed. If the entered latitude/longitude position does not pass the IRS internal comparison tests, the scratchpad message ENTER IRS POSITION is displayed.

Alignment can be accomplished only when the airplane is parked. Alignment stops if an IRU detects motion during alignment. When the motion stops, some units automatically restart the alignment. Other units flash the ALIGN Light until the alignment is restarted. Manual restarts are accomplished by moving the IRS Mode Selector to OFF, then back to NAV after the ALIGN Light stops flashing.

The IRS is aligned when all IRUs enter the navigation mode. The latitude and longitude display on the SET IRS POS line of the CDU POS INIT page then blanks. Alignment is lost if the selector is moved out of the NAV position.

High Latitude Alignment

High latitude (between 70°~ 12.0' and 78°~ 15.0') alignments requires an extended alignment time. This extended alignment is accomplished by rotating the Mode Selector from OFF to the ALIGN position and allowing the IRS to align for a minimum of 17 minutes. Present position is entered while in the align mode. After the extended alignment, navigation mode is entered by rotating the mode selector to the NAV position.

Fast Realignment

Following operation in the navigation mode and with the airplane parked, performing a fast realignment removes accumulated track, ground speed, and attitude errors, levels the system, and updates present position. This is accomplished by positioning selectors to ALIGN, entering present position, and repositioning selectors to NAV. Fast realignment completes in approximately 30 seconds.

Fast realignment can be accomplished without entering present position; however, greater navigational accuracy is attained by entering present position.

A full alignment, accomplished by rotating the IRS mode selector to OFF and back to NAV, must be accomplished when the time from the last full alignment exceeds 18 hours.

IRS Attitude

If alignment is lost in flight, the navigation mode is inoperative for the remainder of the flight. Attitude information can be obtained by moving the selector to the attitude (ATT) position. The IRU enters the Align mode for 30 seconds during which the airplane should stay in straight and level flight. This re–levels the system and provides an attitude reference. Some attitude errors may occur during acceleration. After acceleration, errors are slowly removed.

Heading information can be provided in the ATT Mode if a heading entry is made on the CDU POS INIT page or IRS mode selector panel. Magnetic heading must be updated periodically.

IRS Power

Normally the IRSs operate on AC power from the left and right electrical systems. The main airplane battery is used as an alternate power source. The ON DC light illuminates and the EICAS message IRS ON DC is displayed when AC power is lost and DC power is being used. The DC FAIL light illuminates and the EICAS message IRS DC FAIL is displayed when DC power is lost and AC power is being used. Both lights extinguish if both AC and DC power are on or off.

If all AC power sources are lost the IRSs are powered by the Standby power system.

Standby power to the right IRS is limited to 5 minutes to save battery power.

Radio Navigation Systems
Automatic Direction Finding (ADF)

A dual ADF system is installed with the control panel located on the aft electronics panel.

The ADF bearing signals can be displayed on the pointers and flags on the RDMIs.

Distance Measuring Equipment (DME)

Two DME systems are installed and each can be automatically tuned by the FMC or manually tuned by the VOR or ILS control panel.

DME Tuning

When the HSI Mode Selector is in the VOR or ILS position, the related panel tunes the DME. When the HSI selector is in the MAP or PLAN position automatic FMC tuning or manual VOR panel tuning can be selected with the MAN/AUTO switch on the VOR panel.

The DME can also be remotely tuned by entering a VOR frequency on the NAV RADIO page on the CDU.

The FMC uses two DMEs for position updates. If only one DME is available the FMC can use that DME and the associated VOR for a VOR/DME update.

The FMC cannot tune specific DMEs if the navaids are inhibited on the REF NAV DATA page.

When either or both VORs are being auto tuned by the FMCs, the DME receivers are scanned through several frequencies. This provides the FMC with continuous DME–DME updating even when one VOR is being manually tuned or when both VORs are remotely tuned. If both VORs are manually tuned the scanning DME function is disabled.

DME Displays

DME distance is displayed on the RDMI. When the DME is tuned by the ILS receiver the distance display is preceded by an L. DME distance is also displayed on the HSI when a VOR or ILS display is selected.

The POS REF page 2/4 and the NAV RADIO page display the identifiers of the DME stations used for FMC position updates.

VOR

There are two VOR receivers and two control panels installed.

VOR Tuning

In normal operation the FMC tunes both VORs and the associated DMEs for radio position updates. The HSI must be in the MAP or PLAN mode to allow FMC tuning of the VOR.

Specific VOR navaids can be inhibited on the REF NAV DATA page to prevent the FMC from using those navaids for position updating.

The crew can tune the VORs manually using the control panels, or remotely using the CDU. If the HSI is not in a MAP or PLAN mode, the associated VOR must be manually tuned using the control panel.

If the HSI is in the MAP or PLAN mode, the AUTO/MAN switch on the control panel must be selected to MAN to manually tune the VOR.

If the switch is in AUTO, the VOR can be remotely tuned on the CDU NAV RADIO page.

VOR Displays

Left and right VOR bearings can be displayed on the RDMIs. When VOR is selected on the HSI, the selected course and course deviation are displayed.

The tuned frequencies and selected courses are displayed on the VOR control panels on the glareshield.

If the HSI is in a MAP mode, symbols indicate the position of tuned VORs on the map display. If a VOR is manually tuned, the selected course is displayed on the HSI map as a dashed green line.

The identifier and frequency of the navaid tuned on the left and right VOR are displayed on the NAV RADIO page. The current radial of the tuned navaids are also displayed digitally on the NAV RADIO page.

POS REF page 2 displays the identifier of the navaids being used for position updates.

Marker Beacon

Each pilot has a set of marker beacon lights that show outer, middle and inner/airways beacon passage. Both sets are operated by the marker beacon receiver that is part of the left VOR receiver.

Multi–Mode Receiver

Three Multi–Mode Receivers (MMRs) are installed. Each MMR includes an ILS and GPS receiver. The GPS receiver in the center MMR is not used.

Instrument Landing System (ILS)

Three ILS receivers are installed. They are controlled by a single control panel on the aft electronics panel. Frequency changes are inhibited after localizer or glideslope capture if three autopilots are armed for approach. The selected runway front course is locked to prevent changes when the localizer is captured.

ILS Displays

Localizer and glideslope deviation are shown on the ADIs and Standby Attitude Indicator. When the ILS display is selected on the HSI, localizer and glideslope deviation plus the selected course and frequency are displayed. Front or back course deviation is determined from airplane heading.

Global Positioning System (GPS)

N316LA
The left and right GPS receivers are independent and supply very accurate position data to the FMCs. The GPS receivers are contained in the left and right Multi–Mode Receivers (MMRs). All GPS tuning is automatic.

N422LA through N526LA
The left and right GPS receivers are independent and supply very accurate position data to the FMCs, transponders, and other installed systems. The GPS receivers are contained in the left and right Multi–Mode Receivers (MMRs). All GPS tuning is automatic.

GPS Displays

Position Reference, page 3 of 4 (POS REF 3/4) displays the left and right GPS position.

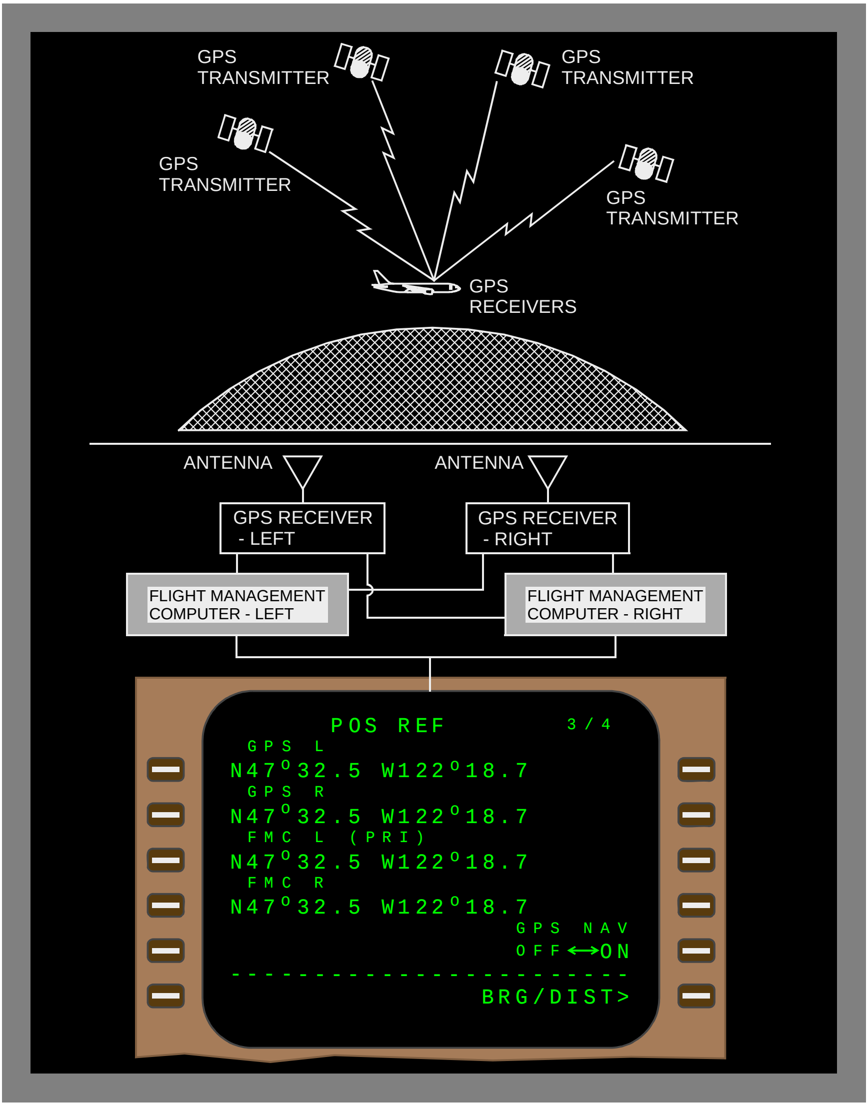
GPS Data

The FMC uses GPS data for position information as long as the GPS is enabled and the GPS data is valid. If GPS data is not available or is unreliable the FMC will use Radio or IRS position data. The GPS NAV prompt on POS REF page 3/4 can be used to inhibit GPS navigation data.

The L GPS and R GPS EICAS messages alert the crew when the respective GPS system has failed. The GPS message is displayed when both GPS systems have failed.

GPS position updates are allowed for all United States National Airspace approach operations. Outside of this region, GPS position updates are allowed during approaches only if the FMC database and approach charts are referenced to the WGS 84 reference datum. GPS updates should be inhibited for all other approach operations unless other appropriate procedures are used.

GPS System Schematic



Transponder

There are two ATC transponders installed. They are controlled by a single control panel and provide normal transponder functions and altitude reporting. The control panel is used to set the ATC code, operating mode, and to select which transponder is active.

N316LA
The transponder is capable of providing traffic alert and collision avoidance system (TCAS) indications. Select TA ONLY or TA/RA to enable traffic displays. Refer to Chapter 15, Warning systems, for a description of TCAS.

N422LA through N526LA
The transponder is capable of providing traffic alert and collision avoidance system (TCAS) indications. Select TA or TA/RA to enable traffic displays. Refer to Chapter 15, Warning systems, for a description of TCAS.

N422LA through N526LA
Failure of a transponder is indicated by the illumination of the amber ATC FAIL light on the control panel and the ATC FAULT advisory message on EICAS.

N316LA
Failure of a transponder is indicated by the illumination of the amber XPNDR FAIL light on the control panel and the ATC FAULT advisory message on EICAS.

Mode S

N422LA through N526LA

Mode S capable transponders can also transmit a unique Flight ID and additional flight parameters such as magnetic heading, indicated airspeed, groundspeed, etc., depending on specific system implementation.

Some airports can monitor airplane position on the ground when the transponder is active (mode selector not in STANDBY or OFF). TCAS modes should not be used on the ground for ground tracking.

Automatic Dependent Surveillance-Broadcast (ADS-B)

Mode S transponders equipped with the Extended Squitter feature enable air traffic controllers in some areas of the world to use ADS-B technology for airplane tracking. ADS-B transponders periodically broadcast messages containing airplane information such as position and velocity data without the requirement for ground–based interrogation.

The left transponder receives position data for ADS-B broadcast messages directly from the left GPS receiver. If left GPS data is not available, then left IRS position data is used. The right transponder receives position data directly from the right GPS receiver. If right GPS data is not available, then right IRS position data is used.

IRS position accuracy is considered inadequate for operations in airspace where ADS-B is required. If a L GPS EICAS message is displayed, the right transponder must be selected to continue broadcasting ADS-B messages containing GPS position data. Likewise, if a R GPS EICAS message is displayed, the left transponder must be selected to continue ADS-B operations.

Weather Radar

The weather radar system consists of two receiver–transmitters, an antenna, and a control panel. The control panel provides manual selection of which receiver-transmitter is used.

Radar returns are displayed on the HSI.

The weather radar switch (WXR) on the EFIS control panel selects the weather radar display. The radar display range is set by the range selected on the EFIS control panel.

The radar system transmits when either WXR switch is selected on.

N316LA
Weather radar returns can also be displayed on the dedicated radar indicator on the forward aisle stand.

Turbulence can be sensed by the weather radar only when there is sufficient precipitation. Turbulence is displayed in magenta. Clear air turbulence can not be sensed by radar.

The predictive windshear alerting system uses the weather radar to sense windshear. To provide windshear alerting the weather radar transmitter is activated on the ground when takeoff power is set and in flight when the airplane is below 2300 feet radio altitude. Weather radar returns are not displayed unless the WXR switch is ON, or a predictive windshear alert occurs. Weather radar returns can only be displayed in VOR, APP, MAP and CTR MAP modes.

N422LA through N526LA
For detecting weather or turbulence it is recommended the WXR antenna tilt mode be selected to AUTO. With antenna tilt in AUTO, terrain information from the EGPWS is used to determine the optimum antenna tilt angle for the existing terrain conditions, preventing over scan or under scan of the weather. This results in optimum weather/turbulence returns while keeping ground clutter to a minimum. Automatic antenna tilt only functions in WX and WX/TURB modes.

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Introduction

The flight management system (FMS) aids the flight crew with navigation, in–flight performance optimization, automatic fuel monitoring, and flight deck displays. Automatic flight functions manage the airplane lateral flight path (LNAV) and vertical flight path (VNAV). The displays include a map for airplane orientation and command markers on the airspeed, and thrust indicators to help in flying efficient profiles.

The flight crew enters the applicable route and flight data into the CDUs. The FMS then uses the navigation database, airplane position, and supporting system data to calculate commands for manual and automatic flight path control.

The FMS tunes the navigation radios for position updating. The FMS navigation database supplies the necessary data to fly routes, SIDs, STARs, holding patterns, and procedure turns. Cruise altitudes and crossing altitude restrictions are used to calculate VNAV commands. Lateral offsets from the programmed route can be calculated and commanded.

Flight Management Computer (FMC)

The heart of the flight management system is the flight management computer. Under normal conditions, one FMC accomplishes the flight management tasks while the other FMC monitors. The second FMC is ready to replace the first FMC if system faults occur.

The FMC uses flight crew–entered flight plan data, airplane systems data, and data from the navigation database to calculate airplane present position and generate the pitch, roll, and thrust commands necessary to fly an optimum flight profile. The FMC sends these commands to the autothrottle, autopilot, and flight director.

Map and route data are sent to the HSIs. The EFIS control panels are used to select the data to be displayed on the HSIs.

The mode control panel selects the autothrottle, autopilot, and flight director operating modes. Refer to the following chapters for operation of these other systems:

- Chapter 4, Automatic Flight
- Chapter 10, Flight Instruments, Displays.

The FMC is certified for area navigation when used with navigation radio and/or GPS updating. The FMC and CDU are used for enroute and terminal area navigation, RNAV approaches, and as a supplement to primary navigation means when conducting other types of nonprecision approaches.

Control Display Units (CDUs)

Two CDUs are used to control the FMC.

The CDUs can provide alternate navigation capability if there is a dual FMC failure (refer to the Alternate Navigation section of this chapter). The CDUs can also provide control of other systems which are accessed through the MENU page.

Introduction

Many FMS functions change depending on the current phase of flight. When first powered, the FMS is in the preflight phase. As a phase is completed, the FMS changes to the next phase in this order:

- preflight
- takeoff
- climb
- cruise
- descent
- approach
- flight complete

Preflight

During preflight, flight plan and load sheet data are manually entered into the CDU. The flight plan defines the route of flight from the origin to the destination and initializes LNAV. Flight plan and load sheet data are provided to the FMC to enable performance calculations and initialize VNAV.

N422LA through N526LA
Some of the preflight data can also be entered by datalink.

Required preflight data consists of:

- initial position
- route of flight
- performance data
- takeoff data

Optional preflight data includes:

- navigation database selection
- route 2
- alternate airport
- SID
- STAR
- wind

Each required or optional data item is entered on specific preflight pages.

Preflight starts with the IDENT page. If the IDENT page is not displayed, it can be selected with the IDENT prompt on the INIT/REF INDEX page. Visual prompts help the flight crew select necessary CDU preflight pages. Preflight pages can be manually selected in any order.

After the necessary data on each preflight page is entered and checked, the lower right line select key selects the next preflight page. When ACTIVATE is selected on the ROUTE page, the execute (EXEC) light illuminates. Push the EXEC key to make the route active.

Use the departure/arrival (DEP/ARR) page to select a standard instrument departure (SID). Selection of the SID may cause a route discontinuity in the flight plan. The modification can be connected to the existing route and executed. This is accomplished on the ROUTE or LEGS page.

When all required preflight entries are complete, PRE–FLT COMPLETE is displayed on the TAKEOFF REF page.

Takeoff

The takeoff phase starts with engagement of takeoff thrust and extends to the thrust reduction altitude where climb thrust is normally selected.

Climb

The climb phase starts at the thrust reduction altitude and extends to the top of climb (T/C) point. The T/C is the position where the airplane reaches the cruise altitude entered on the PERF INIT page.

Cruise

The cruise phase starts at the T/C point and extends to the top of descent (T/D) point. Cruise can include step climbs and en route descents.

Descent

The descent phase starts at the T/D point or when the VNAV descent page becomes active. The descent phase extends to the start of the approach phase.

Approach

The approach phase starts when intercepting the first leg of a published approach selected from the ARRIVALS page.

Flight Complete

Thirty seconds after engine shutdown, the flight complete phase clears the active flight plan and load data. Some preflight data fields initialize to default values in preparation for the next flight.

Operational Notes

When operating in the LNAV and VNAV modes, system operation must be monitored for unwanted pitch, roll, or thrust commands. If unwanted operation is noticed, roll and pitch modes other than LNAV and VNAV must be selected.

The system must be carefully monitored for errors following:

- activation of a new data base
- power interruption
- IRS failure.

The FMC will not sequence the active waypoint when more than 21 nm off the active route and not on an offset route. Return to the active route can be accomplished using the DIRECT TO or INTERCEPT COURSE TO/FROM procedures.

When a waypoint is in the route more than once, certain route modifications (such as DIRECT TO and HOLD) use the first occurrence of the waypoint even if the second occurrence is selected.

Some SIDs or STARS contain a heading vectors leg. VECTORS waypoints display on the map display as a magenta line without an end point leading away from the airplane symbol. If LNAV is engaged, the DIRECT TO or INTERCEPT COURSE TO procedure can be used to start waypoint sequencing beyond the vectors leg.

When entering airways in a route page, the start and end waypoints must be in the data base. Otherwise, the route segment must be entered as a DIRECT leg.

If the engines remain operating between flights, entering a new cruise altitude before the next flight recalculates the proper vertical profile.

If a climb to cruise altitude is necessary after completing a descent, a new cruise altitude entry must be made. Cruise altitude can be entered on the CLB page.

Direct–to courses are segments of a great circle route. When entering a direct–to waypoint on the LEGS page, the course above the waypoint before execution is the arrival course at the waypoint. However, after execution, the course is the current course to fly to the waypoint. These courses may not be the same.

Terminology

The following paragraphs describe FMC and CDU terminology.

Active – flight plan data being used to calculate LNAV or VNAV guidance commands.

Activate – the procedure to change an inactive route to the active route for navigation. It is a two step procedure.

- select the ACTIVATE prompt
- push the execute (EXEC) key.

Altitude constraint – a crossing restriction at a waypoint.

Delete – using the delete (DEL) key to remove FMC data and revert to default values, dash or box prompts, or a blank entry.

Econ – a speed schedule calculated to minimize operating cost. The economy speed is based on the cost index. A low cost index causes a lower cruise speed. Maximum range cruise or the minimum fuel speed schedule may be obtained by entering a cost index of zero. This speed schedule ignores the cost of time.

A low cost index may be used when fuel costs are high compared to operating costs.

A minimum time speed schedule may be obtained by entering a cost index of 9999. This speed schedule calls for maximum flight envelope speeds.

Enter – insert data in the CDU scratchpad and line select the data to the applicable location. New characters can be typed or existing data can be line selected to the scratchpad for entry.

Erase – remove entered data, which has resulted in a modification, by selecting the ERASE prompt.

Execute – push the EXEC key when the light is illuminated to make modified data active.

Inactive – data not being used to calculate LNAV or VNAV commands.

Initialize – entering data required to make the system operational.

Message – FMC information displayed in the scratchpad.

Modify – to change active data. When a modification is made to the active route or performance mode, MOD displays in the page title, ERASE displays next to line select key 6 left, and the EXEC key illuminates.

Prompt – CDU symbol that aids the flight crew in accomplishing a task. Prompts can be boxes, dashes, or symbols (< or >) to remind the flight crew to enter or select data.

Reset – a self protection function which causes an FMC to shutdown and restart when an error is detected. Current flight and performance data is automatically re–loaded from the other FMC during the reset.

Select – pushing a key to obtain the necessary data or action, or to copy selected data to the scratchpad.

Speed restriction – an airspeed limit associated with a specified altitude entered by the flight crew.

Speed transition – an airspeed limit associated with a specified altitude entered from the database.

Waypoint – a point on the route or in the navigation database. It can be a fixed point such as a latitude and longitude, VOR or ADF station, or an airway intersection. A conditional waypoint is not associated with a land reference; it is based on a time or altitude requirement. An example of a conditional waypoint is "when reaching 1000 feet".

Navigation Position

The FMC determines present position from these navigation systems:

- IRS
- navigation radios
- GPS

The FMC uses its calculated present position to generate lateral steering commands along the active leg to the active waypoint. The FMC requires position data from the IRS. All other position sources are validated against the IRS position and are used to refine the FMC position.

FMC Position Determination

The FMC position is based on the IRS position adjusted with updates from available navigation signals.

FMC Position Update

FMC position may be manually updated to any of the navigation system positions. This update is accomplished on POS REF page 2/4.

On the ground, the FMC calculates present position based on IRS and the GPS data.

If GPS NAV is OFF, the FMC updates position to the takeoff runway threshold when the autothrottle is engaged for takeoff. The runway data is on the TAKEOFF REF page. When an intersection takeoff is made, the intersection displacement distance from the runway threshold must be entered on the TAKEOFF REF page. If GPS NAV is ON, this update is inhibited. GPS navigation can be selected on or off on POS REF page 3/4.

In flight, the FMC position is continually updated from the GPS, navigation radios, and IRS. Updating priority is based on the availability of valid data from the supporting systems.

The FMC automatically tunes the VOR, DME, and ILS radios for position updates.

FMC position updates from navigation sensor positions follow this priority:

- one LOC and GPS (tuned for approach)
- one LOC and collocated DME (tuned for approach)
- one LOC and VOR with a collocated DME (tuned for approach)
- LOC (tuned for approach)
- GPS
- two DME stations
- one VOR with a collocated DME
- IRS.

The selected station identifiers of the radio navigation aids are displayed on POS REF page 2/4.

Primary FMC Position Update Source	POS REF page 2/4
GPS	GPS
LOC, GPS valid*	LOC–GPS
LOC, DME DME valid; GPS invalid*	LOC–RADIO
LOC, VOR DME valid; GPS invalid*	LOC–RADIO
LOC valid; GPS, DME, VOR invalid*	LOC
DME DME valid; GPS invalid	RADIO
VOR DME valid; GPS invalid	RADIO
GPS, VOR, DME invalid	IRS
IRS invalid (no navigation capability)	blank
* The FMC changes to LOC updating when: • the tuned localizer is associated with the destination runway • valid localizer signal is being received • the airplane is within the criteria to ensure accurate LOC updating.	

FMC Polar Operations

The FMC automatically starts polar operations when the calculated airplane position enters a polar region. The FMC switches all flight display inputs to reference true north while in these regions.

Automatic switching to a true north reference is annunciated by a flashing white box around the word TRU on the HSI. A TRUE heading reference can be selected with the heading reference switch when outside the polar region. The HSI displays a green box around the word MAG to annunciate the change back to magnetic reference. If the heading reference is TRU in the descent phase, the HSI displays an amber box around the word TRU.

The navigation and display system does not support operations at latitudes greater than 87° North or South.

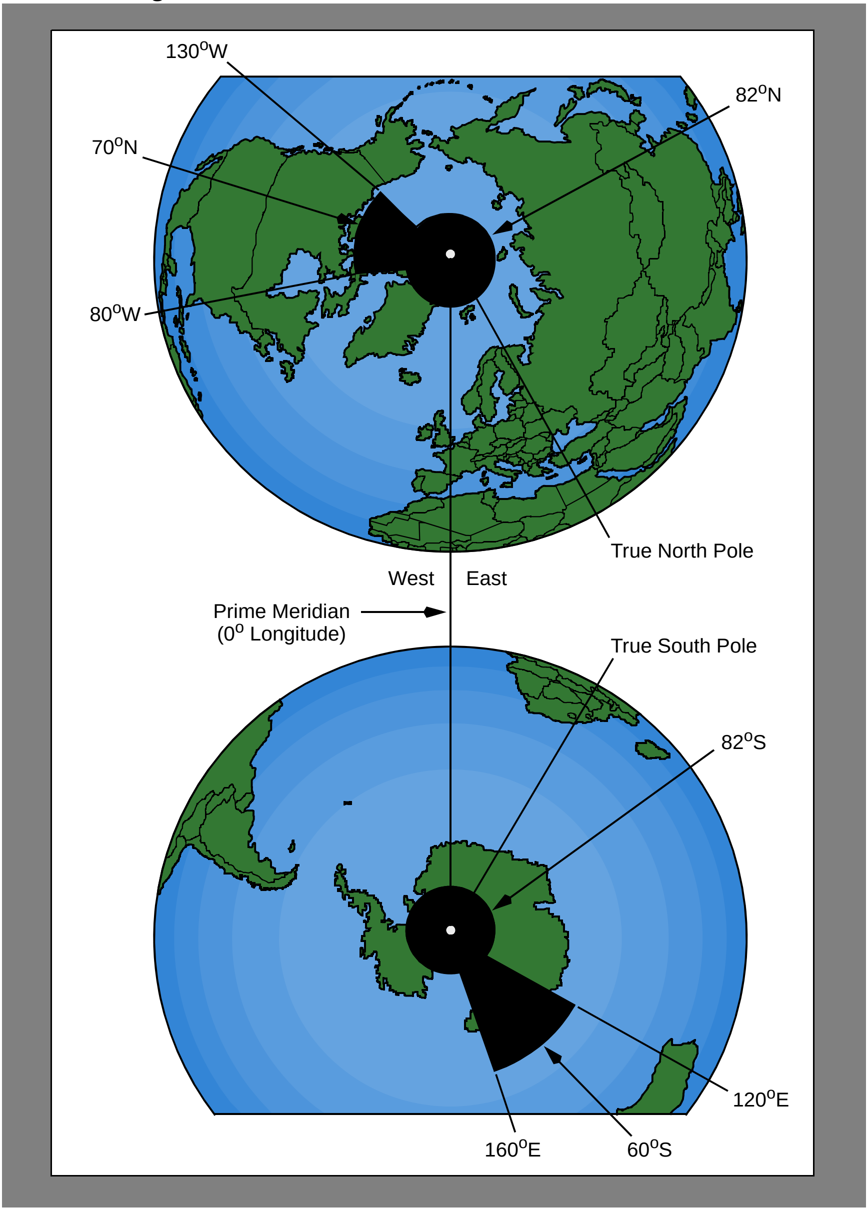
FMC Polar Regions

N316LA
Polar regions are all areas above 73° North or below 60° South. Magnetic headings are not available in these areas.

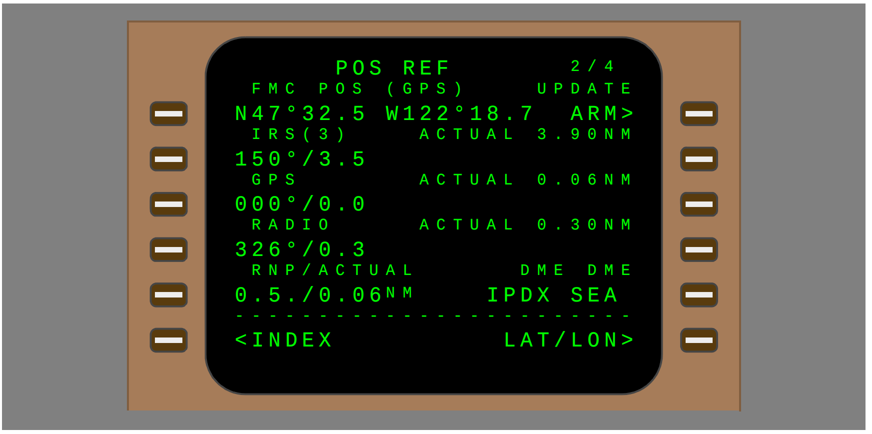
N422LA through N526LA

Polar regions are shown in the graphic(s) below. Magnetic headings are not available in these areas.

N422LA through N526LA



Navigation Performance



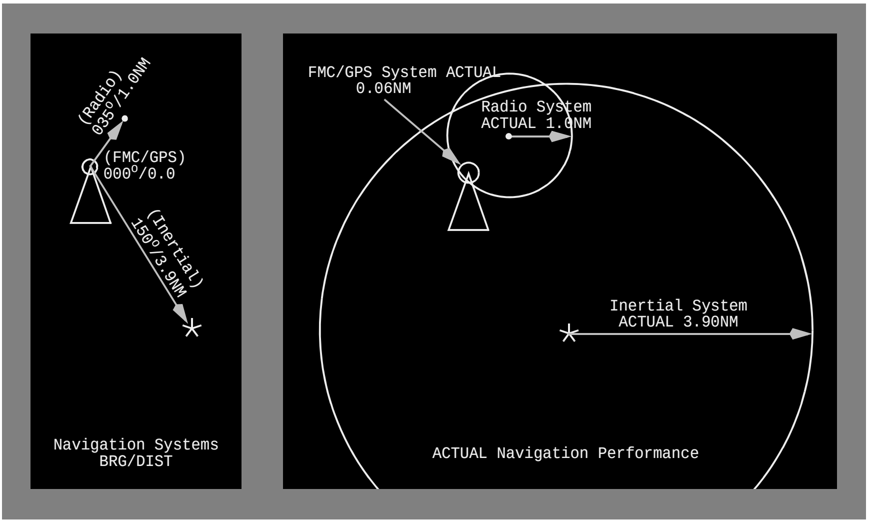
The FMC uses data from the navigation systems to accurately calculate the position of the airplane. The current FMC position is displayed on line 1 of POS REF page 2. The primary source of update is shown in parentheses above the FMC position. The positions of each of the navigation systems are shown in lines 2 through 4. The flight crew can change the display format from latitude/longitude to bearing/distance format. The bearing/distance is from the FMC position to the individual navigation system position.

Actual Navigation Performance

Actual navigation performance (ANP) is the FMC current computed position accuracy. It is shown on POS REF page 2 (line 5L) titled ACTUAL. ACTUAL navigation performance is expressed in nautical miles. It represents the radius of a circle centered at the FMC position which defines the limit of the potential error in that position. The smaller the ANP the more accurate the FMC position.

ACTUAL navigation performance is also computed for each of the navigation systems and those values are displayed on POS REF page 2 adjacent to the system name. The systems' ACTUAL navigation performance is equivalent to the one calculated for the FMC.

After a manual position update, the ACTUAL navigation performance of the FMC changes to the ACTUAL navigation performance of the selected navigation system. In the example above, a manual position update to the INERTIAL system would change the FMC ACTUAL navigation performance to 3.9 NM. The FMC then updates from the best available navigation system and eventually, the manual update has no effect on position calculation. Some automatic updates can be inhibited: GPS on POS REF page 3 and VOR/DME updates on the REF NAV DATA page. Inertial and DME/DME updates can not be inhibited.



Required Navigation Performance

Required navigation performance (RNP) values have been created and published for certain areas of operation and procedures. The RNP, expressed in nautical miles, defines the accuracy of the navigation equipment required to fly the route or procedure for which it is published. ACTUAL navigation performance should not exceed RNP. The FMC triggers the EICAS advisory or caution level message UNABLE RNP to alert the flight crew if ANP exceeds RNP. The FMC supplies a default RNP value for takeoff, enroute, oceanic/remote, terminal, and approach phases of flight. RNP is displayed on POS REF page 2. The flight crew may enter an RNP value, if required.

Lateral Navigation (LNAV)

LNAV provides steering commands to the next waypoint or the selected route intercept point. When armed on takeoff, LNAV engages at or above 50 feet when laterally within 2.5 nautical miles of the active route leg. FMC LNAV guidance normally provides great circle courses between waypoints. However, when an arrival or approach from the FMC data base is entered into the active route, the FMC commands a heading, track, or a DME arc to comply with the procedure.

Waypoints

Waypoint (navigation fix) identifiers are displayed on the CDU and on the map display.

The CDU message NOT IN DATABASE is displayed if a manually entered waypoint identifier is not in the data base. The waypoint can still be entered as a latitude/longitude, place–bearing/distance or a place–bearing/place–bearing waypoint.

FMC–generated waypoints contain a maximum of five characters assigned according to the following rules.

Navaid Waypoints

VHF – waypoints located at VHF navaids (VOR/DME/LOC) are identified by one, two, three or four character facility identifier. Examples:

- Los Angeles VORTAC – LAX
- Tyndall TACAN – PAM
- Riga Engure, Latvia – AN

NDB (non–directional beacon) – waypoints located at NDBs are identified by use of the station identifier. Example: FORT NELSON, CAN – YE.

Fix Waypoints

Waypoints located at fixes with names containing five or fewer characters are identified by the name. Examples:

- DOT
- ACRA
- ALPHA

Long Waypoint Names

Waypoints with more than five characters are abbreviated using the following rules sequentially until five characters remain. For double letters, one letter is deleted. Example:

- KIMMEL becomes KIMEL.

Keep the first letter, first vowel and last letter. Delete other vowels starting from right to left. Example:

- BAILEY becomes BAILY.

The next rule abbreviates names even further. Apply the previous rule, then delete consonants from right to left. Example:

- BRIDGEPORT becomes BRIDGPRT then BRIDT.

Fixes with multi-word names use the first letter of the first word and abbreviate the last word, using the above rules sequentially until a total of five characters remain. Examples:

- CLEAR LAKE becomes CLAKE
- ROUGH ROAD becomes RROAD.

Unnamed Waypoints

If an unnamed turn point, intersection, or fix is collocated with a named waypoint or navaid on a different route structure (such as low altitude routes or an approach), the name or identifier of the collocated waypoint is used. Example:

- Unnamed turn point on J2 between the Lake Charles (LCH) and New Orleans (MSY) VORTACs is coincidental with the Lafayette (LFT) low altitude VORTAC. LFT is used as the identifier for the turn point.

Identifier codes for unnamed turn points not coincidental with named waypoints are constructed from the identifier of a navaid serving the point and the distance from the navaid to the point. If the distance is 99 nautical miles or less, the navaid identifier is placed first, followed by the distance. If the distance is 100 nautical miles or more, the last two digits are used and placed ahead of the navaid identifier. Examples (NAVAID – DISTANCE – IDENT):

- INW – 18 – INW18
- CSN – 106 – 06CSN

Waypoint located at unnamed flight information region (FIR), upper flight information region (UIR), and controlled airspace reporting points are identified by the three–letter airspace type identification followed by a two–digit sequence number. Example:

- FRA01

Unnamed oceanic control area reporting points in the northern hemisphere use the letters N and E, while points in the southern hemisphere use the letters S and W. Latitude always precedes longitude. For longitude, only the last two digits of the three digit value are used.

Placement of the designator in the five character set indicates whether the first longitude digit is 0 or 1. The letter is the last character if the longitude is less than 100° and is the third character if the longitude is 100° or greater.

N is used for north latitude, west longitude. E is used for north latitude, east longitude. S is used for south latitude, east longitude. W is used for south latitude, west longitude. Examples:

- N50° W040° becomes 5040N
- N75° W170° becomes 75N70
- N50° E020° becomes 5020E
- N06° E110° becomes 06E10
- S52° W075° becomes 5275W
- S07° W120° becomes 07W20
- S50° E020° becomes 5020S
- S06° E110° becomes 06S10.

Procedure Arc Fix Waypoint Names

Unnamed terminal area fixes along a DME arc procedure are identified with the first character D. Characters 2 through 4 indicate the radial on which the fix lies. The last character indicates the arc radius. The radius is expressed by a letter of the alphabet where A = 1 mile, B = 2 miles, C = 3 miles and so forth. Example:

- EPH252°/24 = D252X

An unnamed waypoint along a DME arc with a radius greater than 26 miles is identified by the station identifier and the DME radius. Example:

- CPR338°/29 = CPR29

When there are multiple unnamed waypoints along a DME arc with a radius greater than 26 miles, the station identifier is reduced to two characters, followed by the radius, and then a sequence character. Examples:

- CPR134°/29 = CP29A
- CPR190° /29 = CP29B

DME step down fixes are identified by the distance and a "D".
Examples: 138D, 106D, 56D, 3D.

Procedure Fix Waypoints

Marker beacons are identified by the marker type identifier followed by the runway number. Examples:

- Outer Marker 13R = OM13R
- Middle Marker 21 = MM21

Waypoints located at unnamed runway–related fixes are identified by adding a two–letter prefix to the runway number. The following list is used to determine the applicable prefix:

- RX – runway extension fix
- FA – VFR final approach fix
- CF – final approach course fix
- FF – final approach fix
- IF – initial approach fix
- OM – outer marker
- MM – middle marker
- IM – inner marker
- BM – back course marker
- MD – minimum descent altitude
- A – (+ an alpha) step down fix
- RW – runway threshold
- MA – missed approach point other than RW
- TD – touchdown point inboard of RW.

Examples: OM25L, MM09, IM23, RW04, RW18L.

For airports with more than one approach to the same runway, the two letter prefix may change to allow different identifiers for the same waypoint. The first letter identifies the type of fix and the second letter identifies the type approach as follows:

- C( ) – final approach course fix
- F( ) – final approach fix
- P( ) – missed approach point
- I( ) – initial approach fix
- D( ) – minimum descent altitude
- T( ) – touch down point
- R( ) – runway centerline intercept.
- ( )I – ILS
- ( )L – localizer only
- ( )B –backcourse ILS
- ( )D – VOR/DME
- ( )V – VOR only
- ( )S – VOR with DME points
- ( )N – NDB
- ( )Q – NDB with DME points
- ( )M – MLS
- ( )T – TACAN
- ( )R – RNAV

Examples: CI32R, PV15, FN24L.

Unnamed turn points that are part of a procedure are identified as a latitude and longitude waypoint. These include waypoints (except conditional waypoints) defined by flying a course or track from a waypoint (except conditional waypoints) to a radial or DME distance. These waypoints are automatically entered in a route by selection of a procedure using these waypoints, from the departures or arrivals page.

Airport reference points are identified by the ICAO identifier.

Duplicate Waypoints

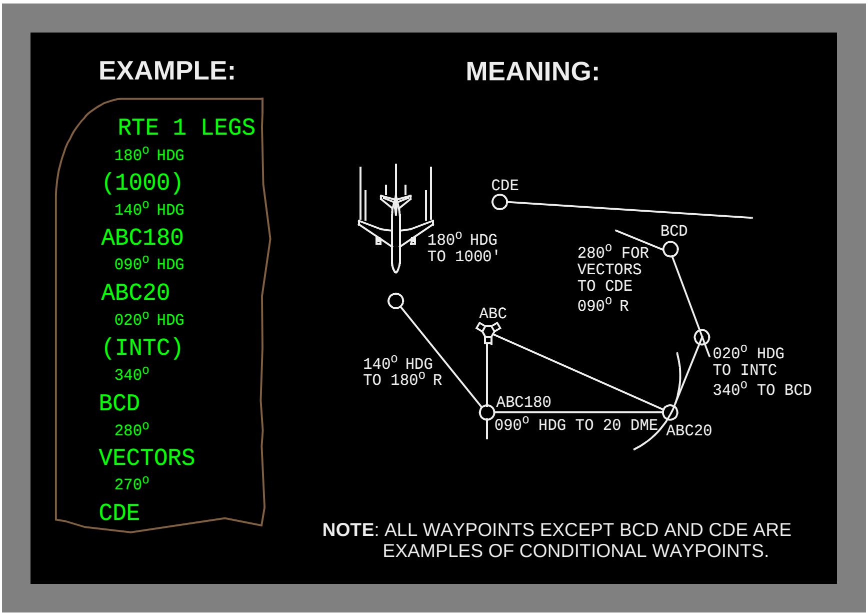
Application of the abbreviation rules may create identical identifiers for different waypoints. When a duplicate waypoint identifier is entered, the page changes to the SELECT DESIRED WPT page. The page lists the latitude, longitude, and the type of facility or waypoint of all the waypoints with the same identifier. Select the latitude/longitude of the correct waypoint to enter the correct waypoint on the original page.

Conditional Waypoints

Conditional waypoints are automatically entered into a route as a result of selecting a procedure on a DEPARTURES or ARRIVALS page. They are not geographically fixed. They are defined by satisfying a condition such as passing an altitude or flying a heading to a radial. Some conditional waypoints are displayed on the map display. The conditions that may define conditional waypoints are:

- climb/descent through an altitude
- flying a heading to a radial or DME distance
- intercepting a course
- heading vectors to a course or fix.

Altitude and course intercept conditional waypoints display on the CDU inside (parenthesis) marks. The diagram below shows conditional waypoints.



Manually Entered Latitude/Longitude Waypoints

Pilot defined waypoints entered as a latitude and longitude are shown in a seven–character format. Latitude and longitude waypoints are entered with no space or slash between the latitude and longitude entries. Leading zeroes must be entered. All digits and decimal points (to 1/10 minute) must be entered unless the latitude or longitude are full degrees. Examples:

- N47° W008° is entered as N47W008 and is displayed as N47W008
- N47° 15.4’ W008° 3.4’ is entered as N4715.4W00803.4 and is displayed as N47W008.

Manually Entered Place–Bearing/Distance or Place–Bearing/Place–Bearing Waypoints

Waypoints entered as a place–bearing/distance or place–bearing/place–bearing are identified by the first three characters of the entry followed by a two–digit sequence number. Examples:

- SEA330/10 becomes SEA01
- SEA330/OLM020 becomes SEA02.

The two digit sequence numbers reserved for RTE1 are 01 through 49. The two digit sequence numbers reserved for RTE2 are 51 through 99.

Manually Entered Airway Crossing Waypoints

Airway crossing fixes are entered as a five character waypoint name or by entering consecutive airways on the ROUTE page. In the latter case, the display is an X followed by the second airway name. Example: entering J70 on the VIA line of the ROUTE page causes box prompts to display opposite on the same line. Leaving the TO box prompts empty and entering J52 on the next VIA line, directly below J70, causes the FMC to calculate the intersection of the two airways and replace the boxes with the waypoint identifier, XJ52.

Manually Entered Latitude or Longitude Reporting Point Waypoints

Latitude or longitude reporting waypoints are entered as the full latitude or longitude followed by a dash, then the increment chosen for the following multiple waypoints. Example:

- W060–10 adds waypoints starting at W060 in ten degree increments from that point to the destination
- the entry must be made on a LEGS page on any line before the first reporting point
- usually, this entry is made on the active waypoint line and proper sequencing is performed by the FMC.

Manually Entered Along–Track Waypoints

Along–track waypoints are created on the active route and do not cause route discontinuities when they are created.

Along–track waypoints are entered using the waypoint name (the place), followed by a slash and minus sign, for points before the waypoint, or no sign for points after the waypoint, followed by the mileage offset for the newly defined waypoint. The created waypoint is then inserted over the original waypoint. The distance offset must be less than the distance between the originating waypoint and next (positive value) or preceding (negative value) waypoint. Latitude and longitude waypoints cannot be used to create along–track waypoints. Examples:

- VAMPS/25 is 25 miles after VAMPS on the present route and displays as VAM01
- ELN/–30 is 30 miles before ELN on the present route and displays as ELN01.

EO SID

An engine out SID is a procedure developed by an airline for a particular runway to provide unique routing if an engine fails on takeoff. If the database contains an EO SID for the takeoff runway and an engine fails while the flaps are extended, the active route is automatically modified to the engine out route. The modification may be either executed or erased.

Map Displays

The route is displayed on the HSI when a MAP or PLAN mode is selected.

The display color and format represent the following status:

- an inactive route is displayed as a cyan dashed line
- an activated, but not yet executed route, is displayed as a white dashed line
- the active route is displayed in magenta
- modifications to an active route are shown as dashed white lines
- modified waypoints are displayed in white
- executed route offsets are displayed as a dashed magenta line
- prior to execution, entered route offsets are displayed as a dashed white line.

The MAP displays the FMC position at the apex of the airplane symbol. All MAP data is displayed relative to this apex.

When adequate position updating is not available, the map may display a shift error. This error results in the displayed position of the airplane, route, waypoints and navigation aids being shifted from their actual position. An undetected, across track map shift may result in the airplane flying a ground track that is offset from the desired track. An undetected, along track map shift may result in the flight crew initiating altitude changes earlier or later than desired. In either case, an undetected map shift may compromise terrain or traffic separation.

Map shift errors can be detected by comparing the position of the airplane on the map with data from the ILS, VOR, DME, and ADF systems.

Vertical Navigation (VNAV)

VNAV provides vertical profile guidance through the climb, cruise, and descent phases of flight.

Speed/Altitude Constraints

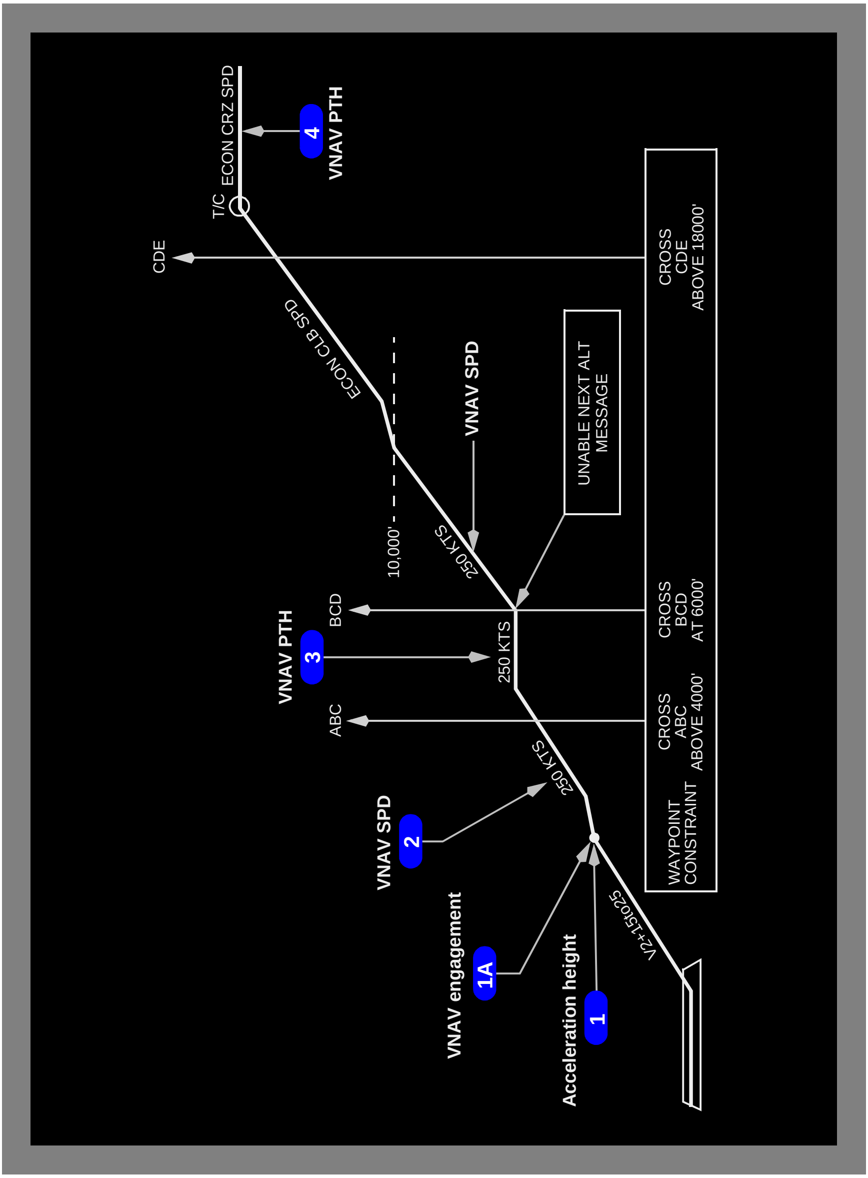
VNAV controls the path and speed to comply with waypoint crossing constraints. Waypoint crossing constraints are entered on the LEGS page waypoint line by pushing the applicable key on the right side of the CDU. Barometric altitude constraints must be below the cruise altitude to be valid. Values entered as part of a procedure and manually entered constraints are shown in large font. FMC predicted values do not act as constraints, and are displayed in small font.

Waypoints can have altitude or airspeed/altitude constraints. Speed constraint entries require an altitude constraint at the same waypoint. All speed constraints are considered by the FMC as at or below constraints.

At or above altitude constraints are entered with a suffix letter A (example: 220A). At or below altitude constraints are entered with a suffix letter B (example: 240B). Mandatory altitude constraints are entered without any suffix letter (example: 270).

Altitude constraints with two altitudes may be entered in either order. The lower altitude constraint, followed by a suffix letter A, and the upper altitude constraint, followed by a suffix letter B (example: 220A240B or 240B220A).

Takeoff and Climb



1 Acceleration Height

Height at which acceleration is initiated for flap retraction, normally 1000 feet. Takeoff (TO) pitch mode is used for takeoff and initial climb up to this point.

1A VNAV Engagement

VNAV is normally engaged at acceleration height. Pitch guidance then commands:

- an airspeed increase to 250 knots, or
- the speed transition associated with the origin airport, or
- the takeoff target airspeed (between V2 + 15 and V2 + 25 knots) if the acceleration altitude entered on TAKEOFF REF page 2/2 has not been reached.

Initial reduction of flaps after VNAV is engaged also initiates pitch guidance to accelerate to 250 knots.

When VNAV is engaged (above 400 feet) the thrust reference changes to climb.

2 VNAV Climb

The VNAV climb profile uses VNAV SPD or VNAV PTH at the default climb speed, or pilot selected climb speed to remain within all airspeed and altitude constraints that are part of the SID entered into the active route. Autothrottle uses selected climb thrust limit.

3 Climb Constraints

VNAV enters the VNAV PTH mode to remain within departure or waypoint constraints. Speed maintained during this time can be:

- procedure based speed restriction
- waypoint speed restriction
- default VNAV climb speed
- manually entered climb speed.

N422LA through N526LA
(SB Adds N316LA . SB adds speed/altitude constrained waypoint functionality for airplanes with Pegasus 2009 FMC software. Information valid for "SB Adds..." airplanes after SB incorporation.)

When executing a SID with a speed and altitude constrained waypoint, VNAV will maintain the speed constraint during the climb until the respective waypoint is sequenced, regardless of the associated altitude constraint.

If the FMC predicts the airplane will not reach an altitude constraint, the message UNABLE NEXT ALTITUDE is displayed on the CDU. Speed intervention can be used by pushing the IAS/MACH selector and manually setting a lower airspeed to provide a steeper climb or climb derates can be deleted.

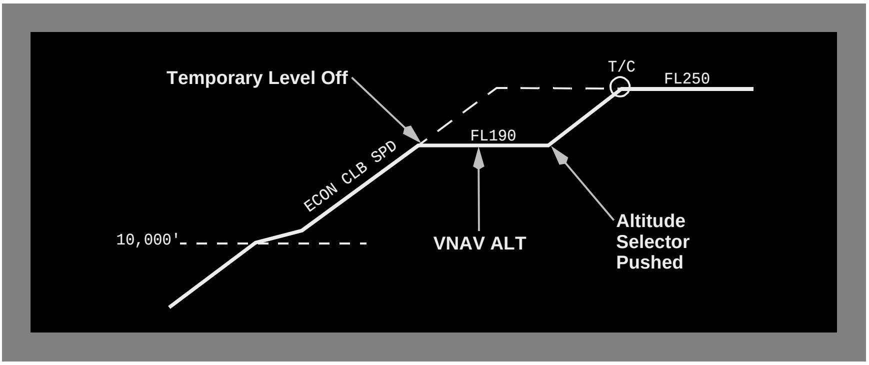
4 Top Of Climb (T/C)

The point where the climb phase meets the cruise altitude is called the top of climb. Approaching this point, the FMC changes from the climb phase to the cruise phase. The T/C is displayed any time the FMC calculates a change from a climb phase to a cruise phase, such as a step climb.

The T/C point is displayed on the map as a green open circle with the label T/C.

MCP Altitude Intervention

N422LA through N526LA



Whenever the airplane levels off at an MCP altitude which is not in the FMC climb profile, VNAV ALT annunciates. For example, FMC cruise altitude is FL250 and the clearance altitude, FL190, is set in the MCP. Pitch maintains altitude and thrust maintains FMC target speed. In the example, the speed after the temporary level off would be ECON CLB SPEED.

Setting the clearance altitude in the MCP window and pushing the altitude selector continues the climb. VNAV SPD activates. Pitch maintains FMC speed and thrust increases to the armed reference thrust limit. In the example, the airplane climbs to FMC CRZ ALT and then levels at FL250 in cruise.

Cruise

At cruise altitude, the FMC commands economy cruise speed or the pilot entered speed until reaching the top–of–descent (T/D) point. Alternate cruise speed options are:

- long range (LRC)
- engine out (ENG OUT), or
- flight crew entered speed.

If the cost index is set to zero the FMC commands maximum range cruise speed. Cost index modifications are allowed until within ten miles of the top of descent.

Cruise Climb

N316LA
When VNAV is engaged, resetting the MCP to an altitude higher than the current cruise altitude causes that altitude to be displayed in the scratchpad of the CDU. The altitude can then be entered on the CRZ ALT line on the cruise page. When the modification is executed the airplane will climb to the new cruise altitude. The CRZ page displays ACT ECON CRZ CLB.

N422LA through N526LA
Setting an altitude above the current cruise altitude in the MCP altitude window and pushing the altitude selector causes the cruise altitude to be set to the MCP altitude and the airplane to climb to the new cruise altitude. The CRZ page displays ACT ECON CRZ CLB.

Step Climb

Fuel and ETA predictions assume the airplane climbs at each predicted step climb point as airplane weight decreases.

FMC predicted step climb increments are based on the step size shown on the CRZ page. Entering a step size of zero causes the FMC to assume a constant altitude cruise.

Flight crew entry of a step altitude on the CRZ or RTE LEGS page overrides the FMC step climb predictions. Entry of a planned step altitude on the RTE LEGS page overrides a "Step To" entry made on the CRZ page.

Predicted step altitudes display on the RTE LEGS page. The distance and ETA to the next step point (predicted or flight crew entered) display on the CRZ and progress pages. They also display on the map display with a green circle and S/C label.

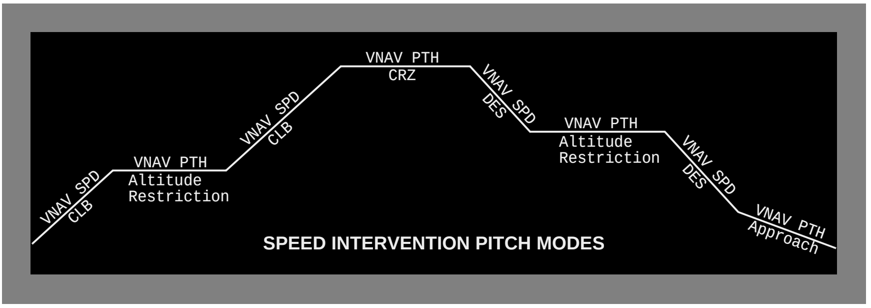
Cruise Descent

N316LA
Resetting the MCP to an altitude below the current cruise altitude causes the new altitude to be copied to the scratchpad if the altitude change is 4000 feet or less. The new cruise altitude can be entered on the cruise page. When the modification is executed the CRZ page displays ACT ECON CRZ DES. If the altitude set in the altitude window is below the speed transition (SPD TRANS) or restriction (SPD RESTR) altitude displayed on the DES page, those altitudes and speeds are deleted and the airplane will maintain cruise speed during the descent. Transition or speed restrictions must be maintained by flight crew action.

N422LA through N526LA
Setting an altitude below the current cruise altitude in the MCP altitude window and pushing the altitude selector (more than 50 nm from a T/D) causes the cruise altitude to be set to the MCP altitude and the airplane to descend to the new cruise altitude. The CRZ page displays ACT ECON CRZ DES. If the altitude set in the altitude window is below the speed transition (SPD TRANS) or restriction (SPD RESTR) altitude displayed on the DES page, those altitudes and speeds are deleted. Transition or speed restrictions must be maintained by flight crew action.

Mode Control Panel Speed Intervention

With VNAV engaged, pushing the IAS/MACH selector enables speed intervention. Speed intervention allows the flight crew to change airplane speed with the IAS/MACH selector.



The above illustration shows VNAV mode for each phase of flight during speed intervention.

Note: The FMC does not use the speed set on the MCP for fuel or ETA predictions so FMC predictions are not accurate if speed intervention is used for an extended period.

In VNAV PTH mode, thrust controls speed; in VNAV SPD mode, pitch controls speed.

If speed intervention is selected during a VNAV PTH descent, VNAV PTH pitch mode changes to VNAV SPD and the airplane may depart the FMC calculated descent path. In all other phases of flight, the AFDS captured pitch mode remains unchanged when speed intervention is selected.

In approach phase (see Approach topic this chapter/section), during speed intervention, pitch mode remains in VNAV PTH and the vertical path is maintained regardless of IAS MACH selector changes.

Descent

The FMC calculates a descent path based on airspeed and altitude constraints and the end of descent (E/D) point. Dashes display on the LEGS page for speed and altitude descent waypoints. When an arrival or approach procedure is selected on the ARRIVALS page and incorporated into the flight plan, the FMC creates an E/D. The E/D is located 50 feet above the runway threshold (RW waypoint) for all approaches except VOR approaches. The E/D for VOR approaches is the missed approach point; which may be the VOR, runway waypoint (RWXXX), or a named waypoint. During cruise, an E/D is also created when an altitude constraint is entered on the LEGS page on a downstream waypoint.

The top of descent (T/D) is the point where the cruise phase changes to the descent phase. It displays on the HSI as a green circle with the label T/D. The descent path starts at the T/D and includes waypoint altitude constraints. The path to the first constraint is based on:

- idle thrust
- speedbrakes retracted
- FMC cruise wind
- wind entries on the DESCENT FORECAST page
- predicted use of anti-ice
- applicable target speed.

The descent may be planned at economy Mach/CAS (based on Cost Index) or a manually entered Mach/CAS. VNAV will not command an economy target speed greater than VMO/MMO minus 16 knots or a pilot entered speed greater than VMO/MMO minus 11 knots.

The FMC creates the descent path with a deceleration at the speed transition altitude (typically 250 knots below 10,000 feet). VNAV plans a speed target 10 knots below the transition speed to allow for unknown tailwinds.

Descent path segments after the first altitude constraint waypoint are constructed as straight line point-to-point segments. If the VNAV path segment is too shallow to be flown satisfactorily at IDLE thrust, the FMC commands speed on thrust levers (SPD). Elevators control the shallow descent path.

N422LA through N526LA

If the airplane passes the T/D point and the window altitude has not been set lower, or if the airplane levels at an MCP altitude not in the FMC descent profile, VNAV ALT annunciates. The MCP altitude must be reset and altitude selector pushed to initiate/continue the descent.

N316LA

If the airplane passes the T/D point and the altitude window has not been set lower, or if the airplane levels at an MCP altitude not in the FMC descent profile, ALT HOLD annunciates. The MCP must be reset and VNAV re–engaged to initiate/continue the descent.

If flight plan modifications or unknown winds occur when above the first speed constraint, VNAV varies speed to maintain the path up to the following limits:

- with greater than 15 knots below the target speed, the autothrottle changes from IDLE/HOLD to SPD to provide thrust to accelerate to the target speed. If the autothrottle is not active, the scratchpad message THRUST REQUIRED displays. The airspeed may decrease to minimum maneuvering speed. Subsequently, VNAV commands the airplane to fly below the path to stop the deceleration. If VNAV can no longer maintain the airplane within 150 feet of the path without further deceleration, speed reversion occurs, the pitch mode annunciation changes from VNAV PTH to VNAV SPD, VNAV resets the target speed to 5 knots above the greater of best holding speed or minimum maneuvering speed, and the scratchpad message THRUST REQUIRED displays again
- with greater than VMO/MMO minus 16 knots, the scratchpad message DRAG REQUIRED displays. The airplane may accelerate up to VMO/MMO minus 11 knots to maintain the path. If further correction is required, VNAV may allow the airplane to rise up to 150 feet above the path. If VNAV can no longer maintain the airplane within 150 feet of the path without further acceleration, speed reversion occurs, the pitch mode annunciation changes from VNAV PTH to VNAV SPD, VNAV resets the target speed to VMO/MMO minus 16 knots, and the scratchpad message DRAG REQUIRED displays again.

If flight plan modifications or unknown winds occur when below the first speed constraint, VNAV varies speed to maintain the path up to the following limits:

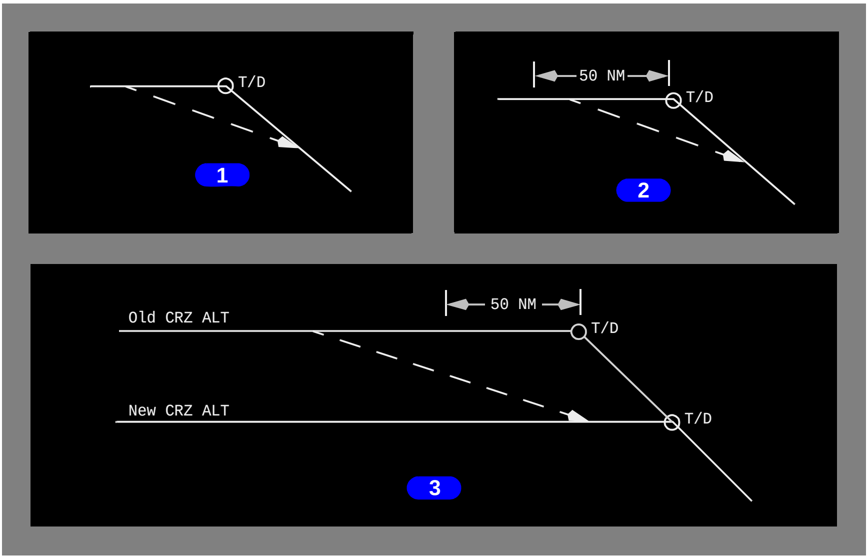
- with greater than 10 knots below the target speed, the autothrottle changes from IDLE/HOLD to SPD to provide thrust to accelerate to the target speed. If the autothrottle is not active, the scratchpad message THRUST REQUIRED displays. The airspeed may decrease to minimum maneuvering speed. Subsequently, VNAV commands the airplane to fly below the path to stop the deceleration. If VNAV can no longer maintain the airplane within 150 feet of the path without further deceleration, speed reversion occurs, the pitch mode annunciation changes from VNAV PTH to VNAV SPD, VNAV commands a speed 10 knots less than the transition speed for the destination airport (not less than minimum maneuvering speed), and the scratchpad message THRUST REQUIRED displays again
- with greater than 10 knots above target speed, the scratchpad message DRAG REQUIRED displays. The airplane may accelerate up to 15 knots above target speed to maintain the path. The maximum speed excursion allowed is 5 knots above the transition speed after the airplane is below transition altitude for the destination airport or 5 knots below the flaps placard speed if flaps are extended. If further correction is required, VNAV may allow the airplane to rise up to 150 feet above the path to stop the acceleration. If VNAV can no longer maintain the airplane within 150 feet of the path without further acceleration, speed reversion occurs, the pitch mode annunciation changes from VNAV PTH to VNAV SPD, VNAV commands a speed 10 knots less than the transition speed for the destination airport, and the scratchpad message DRAG REQUIRED displays again.

Early Descent

When a descent is started before the T/D, VNAV commands a descent at a reduced descent rate until the idle descent path is intercepted.

N316LA
Start an early descent by resetting the MCP altitude, then selecting the DES NOW prompt on the DES page. In an early descent, the autothrottle mode annunciation is initially THR, followed by HOLD, allowing the pilot to adjust the rate of descent. The pitch mode is VNAV SPD.

N422LA through N526LA
Start an early descent by selecting the DES NOW prompt on the DES page or by pushing the MCP altitude selector. In an early descent, the autothrottle mode annunciation is initially THR, followed by HOLD, allowing the pilot to adjust the rate of descent. The pitch mode is VNAV SPD.



1 DES NOW

Use the DES NOW prompt on the VNAV DES page. VNAV starts an early descent and captures the idle descent path.

Note: When more than 50 NM from the top of descent point, perform a cruise descent rather than a descend now for descent to intermediate altitudes. During cruise descent the FMC computes a new top of descent for the new cruise altitude and accurate destination fuel predictions. Fuel predictions using DES NOW more than 50 NM from the top of descent point can cause a fuel computation error.

2 Within 50 NM of Top of Descent Point

Use the MCP altitude selector to start an early descent. Within 50 NM of the top of descent point, VNAV starts an early descent and captures the idle descent path.

3 More than 50 NM from Top of Descent Point

Use the MCP altitude selector to start a cruise descent. If the distance from the top of descent is more than 50 NM, VNAV begins a cruise descent to the new cruise altitude. VNAV may not capture the idle descent path since the target airspeed is economy cruise and the descent path is based on idle thrust and economy descent airspeed. In the example, VNAV levels at the new cruise altitude.

Approach

For VFR and nonprecision approaches, VNAV will fly the computed descent path to the E/D point altitude if the MCP altitude is set at or below the E/D point altitude. However, it is the responsibility of the flight crew not to descend below the MDA of the approach being flown until adequate visual contact is achieved.

"On Approach" Mode

The FMC transitions to "on approach" mode for any of the following conditions:

- an approach procedure selected into the active route from the destination airport ARRIVALS page becomes the active procedure on the RTE 1 or RTE 2 page.
- distance to the destination airport is less than 12 nm and the active leg is not part of a procedure
- the MAP (or last waypoint on the approach procedure) is the active waypoint and the distance to that waypoint is less than 25 nm
- VNAV engaged in DES mode and flaps extended.

Transition to the "on approach" FMC mode may be delayed if the flight crew manually inserts, bypasses, or deletes an approach waypoint on the LEGS page.

When the FMC is "on approach", the following features are available:

- the IAS/MACH window can be opened and the command speed can be set while VNAV remains in VNAV PTH descent; VNAV commands the set speed
- the MCP altitude can be set above the airplane altitude for the missed approach. When the MCP altitude setting is at least 300 feet above the current airplane altitude, VNAV continues to command a descent
- VNAV remains in VNAV PTH and follows the descent path unless the airplane accelerates to within 5 knots of the current flap placard and the airplane rises more than 150 feet above the path. In this case, VNAV PTH changes to VNAV SPD.

The FMC transitions out of approach under the following conditions:

- the airplane lands
- selecting GA
- the airplane flies beyond the missed approach waypoint.

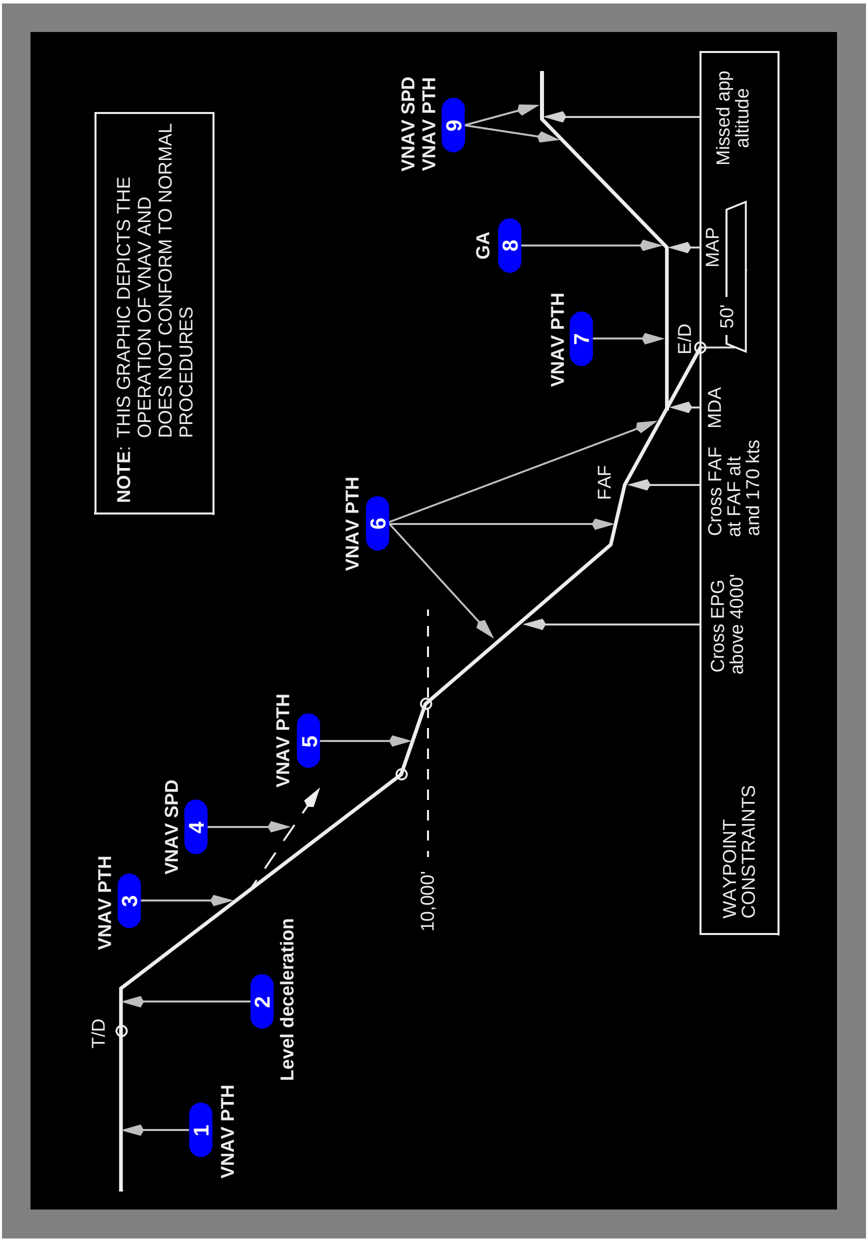
A side step to another approach can be accomplished by selection of a new approach on the ARRIVALS page. An along-course intercept to the next logical approach waypoint in the new approach can be selected on the "INTC CRS TO" line on the LEGS page or by selecting the "XXXXX INTC>" prompt on the ARRIVALS page.

Missed Approach

A missed approach is accomplished by selection of either GA switch. The following features are available:

- VNAV (and LNAV) can only be activated when the airplane climbs above 400 feet radio altitude
- all descent altitude constraints below the current airplane altitude are deleted; the waypoints are retained in the active flight plan
- the higher of the altitude in the MCP altitude window or the highest altitude in the missed approach procedure becomes the new cruise altitude
- the FMC transitions from active descent to active climb
- AFDS guidance to fly the published missed approach procedure to the new cruise altitude is active when VNAV (and LNAV) are selected
- when cruise phase is active, the speed target is the most restrictive of 250 knots (below speed transition altitude), best hold speed, or ECON cruise (above speed transition altitude).

Cruise and Descent Profile (Nonprecision Approach)



1 **Cruise**

Before the top of descent, FMC is in cruise mode and uses VNAV PTH and ECON cruise speed.

2 **Level descent phase**

After top of descent, FMC is in descent mode, VNAV decreases airspeed to ECON descent speed, maintains altitude in VNAV PTH.

3 **Descent**

Upon reaching descent speed, VNAV descends in VNAV PTH at ECON descent speed.

4 **Speed Limit Protection**

If a tailwind which was not entered on the descent forecast page causes the airplane to accelerate, the DRAG REQUIRED scratchpad message will be displayed. If the speedbrakes are not deployed, the pitch mode will change to VNAV SPD and depart the path before the speed reaches the limit.

5 **Speed Restriction Deceleration**

Before the speed restriction altitude, VNAV decelerates to commanded speed using VNAV PTH.

6 **Descent and Approach**

When at restricted speed, VNAV descends and starts approach in VNAV PTH at commanded speed.

7 **Minimum Descent Altitude**

When the MDA is reached with VNAV engaged the airplane will maintain the MDA altitude in VNAV PTH.

If the missed approach point is crossed without selecting GA, VNAV will continue to the end of descent point altitude until GA is selected.

8 **Go–Around (GA)**

The missed approach go–around is commenced by pushing a Go–Around switch.

Pushing a Go–Around switch

- starts a missed approach
- sets go–around thrust
- and deletes altitude constraints between the airplane and the missed approach waypoint.

9 Missed Approach Level Off

If VNAV is selected during missed approach, VNAV engages in VNAV SPD. At the missed approach altitude the pitch mode changes to VNAV PTH.

VNAV Engine Out Operation

The FMC provides single engine performance guidance which is accessed with the ENG OUT prompt on the VNAV pages (CLB, CRZ or DES). After the engine out page is selected the execute key must be pushed to activate the single engine guidance.

The autothrottle system does not have a single engine capability and the autothrottle should be disconnected after an engine failure. VNAV thrust settings and thrust reference modes must be manually set when operating single engine.

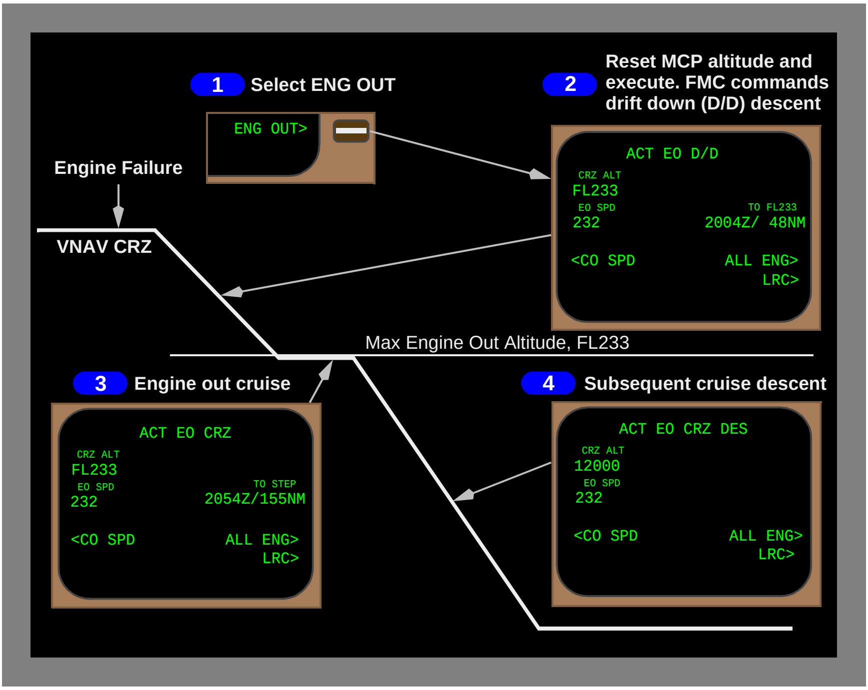
Climb (Engine Out Above Engine Out Max Alt)

When the airplane is above the engine out maximum altitude, selection of the ENG OUT> prompt on the CLB page creates a modification and displays the applicable engine out driftdown (D/D) performance data to enable the airplane to descend to the engine out maximum altitude. Execution of the modification activates the engine out driftdown function.

Cruise (Engine Out Above Engine Out Max Alt)

Selection of ENG OUT> may also be selected on the CRZ page. If the current altitude is above the engine out maximum altitude, the FMC will command a cruise drift down.

Selection of ENG OUT> may also be accomplished on the XXXX ALTN page in conjunction with a diversion modification.



1 Engine Out Modification

Select the ENG OUT> prompt on the VNAV CRZ page. Disconnect the autothrottle and set maximum continuous thrust on the operating engine.

Result: The FMC creates a modification and displays the applicable engine out driftdown (D/D) performance data to enable the airplane to descend to the engine out maximum altitude.

2 Drift Down Execution

Set the MCP altitude at or below EO MAX altitude and execute the FMC modification. This assumes clearance is approved to descend slowly to a non–standard altitude; for example, FL233.

Result: VNAV commands a driftdown at EO SPD, and the EO MAX altitude becomes the cruise altitude at 1L. The descent rate is controlled to a minimum of 300 feet per minute (fpm). Time and distance for the D/D to EO MAX altitude are displayed at 2R.

The initial drift down speed defaults to E/O (minimum drag) speed. Prompts for LRC (long range cruise) and CO SPD (company speed) are displayed or a manual speed entry may be made.

3 Engine Out Cruise

When VNAV captures the engine out maximum altitude, the page changes to the engine out cruise page and the pitch annunciation is VNAV PTH. Predictions for engine out step climb are displayed at 2R.

The VNAV single engine speed can be adjusted to LRC speed, company speed, or a speed entered by the crew. Any change in the single engine speed will change the maximum altitude.

4 Subsequent Cruise Descent

N316LA
With the FMC in engine out mode more than 50 nm from T/D, set a lower MCP altitude, select the entered altitude from the CDU scratchpad to the CRZ ALT line on the CRZ page and execute.

N422LA through N526LA
With the FMC in engine out mode more than 50 nm from T/D, set a lower MCP altitude and push the altitude selector.

Result: VNAV cruise descent at approximately 1,250 fpm at the current speed. When the engine out cruise descent intersects the planned descent profile, descent mode becomes active.

Required Time of Arrival (RTA)

N422LA through N526LA

When an RTA is entered for a waypoint on the active route, VNAV controls cruise speed to arrive at the waypoint within ± 30 seconds of the specified time. If the RTA is not achievable, the FMC displays the scratchpad message UNABLE RTA.

Data Entry Rules

Altitude Entry

Altitudes can be entered into the FMC as three digit (XXX), four digit (XXXX), five digit (XXXXX), or flight level (FLXXX) numbers. The FMC displays altitude or flight level entries in the proper form based on the transition altitude. Some data lines further restrict the valid entry forms.

Three digit entries represent altitude or flight levels in increments of 100 feet. Leading zeros are required.

Examples of three digit (XXX, FLXXX) entries with transition altitude = 10,000 feet:

- 800 feet is entered as 008 or FL008; displays as 800
- 1,500 feet is entered as 015 or FL015; displays as 1500
- 11,500 feet is entered as 115 or FL115; displays as FL115
- 25,000 feet is entered as 250 or FL250; displays as FL250.

Four digit entries represent feet, rounded to the nearest ten feet. Leading zeros are required. This form is used when the altitude does not exceed 9,994 feet.

Examples of four digit (XXXX) entries with transition altitude = 18,000 feet:

- 50 feet is entered as 0050; displays as 50
- 835 feet is entered as 0835; displays as 830
- 1,500 feet is entered as 1500; displays as 1500
- 8,500 feet is entered as 8500; displays as 8500
- 9,994 feet is entered as 9994; displays as 9990.

Five digit entries represent feet, rounded to the nearest ten feet. This form is used when the altitude exceeds 9,994 feet

Examples of five (XXXXX) digit entries with transition altitude = 4,000 feet:

- 50 feet is entered as 00050; displays as 50
- 836 feet is entered as 00836; displays as 840
- 1,500 feet is entered as 01500; displays as 1500
- 8,500 feet is entered as 08500; displays as FL085
- 9,996 feet is entered as 09996; displays as FL100
- 11,500 feet is entered as 11500; displays as FL115
- 25,000 feet is entered as 25000; displays as FL250.

Negative altitude entries are allowed to –1000 feet.

Airspeed Entry

Airspeeds can be entered into the FMC as calibrated airspeed (CAS) or Mach number (M). CAS is entered as three digits (XXX) in knots. Mach numbers are entered as one, two, or three digits following a decimal point.

Data Pairs

Many CDU pages display data in pairs separated by a slash "/." Examples of these pairs include wind direction/speed and waypoint airspeed/altitude constraints. When entering both values in a pair, the slash is inserted between the values. When it is possible to enter only one value of the pair, the slash may not be required. When entering only the outboard value of a pair, the trailing or leading slash may be entered, but is not required before transferring to the data line. When entering the inboard value of a pair, the trailing or leading slash must be entered before transferring to the data line. Omission of the required slash normally results in an INVALID ENTRY message.

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FMC Databases

The FMC contains the following databases:

- performance database
- navigation database
- airline modifiable information (AMI).

The performance database supplies all the necessary performance data to the flight crew. It supplies the FMC with the necessary data to calculate pitch and thrust commands. All necessary data can be shown on the CDU. The database includes:

- airplane drag and engine characteristics
- maximum and optimum altitudes
- maximum and minimum speeds.

The navigation database includes data usually found on navigation charts. The database contains:

- the location of VHF navigation aids
- airways
- airports
- runways
- other airline selected data, such as SIDs, STARs, approaches, and company routes
- transition altitudes.

The FMC contains two sets of navigation data, each valid for 28 days. Each set corresponds to the usual navigation chart revision cycle. The flight crew selects which set of navigation data is active for navigation calculations. The contents of the navigation database are periodically updated and are transferred to the FMC before the expiration date of the active data.

The Airline Modifiable Information (AMI) file contains airline specified data. If the FMC senses a conflict in an AMI value after a new AMI data load, the scratchpad shows the message CHECK AIRLINE POLICY.

Thrust Management

The autothrottle is controlled by the thrust management computer. When VNAV is engaged, the FMC controls the autothrottle by setting the command speeds and thrust reference modes on the thrust management computer.

When VNAV is not engaged, the thrust management is controlled by the flight crew through selections made on the TMSP and AFDS.

Fuel Monitoring

The FMC receives fuel quantity data from the fuel quantity system or from manual entries. Fuel quantity values are shown on the PERF INIT page as calculated (CALC), MANUAL, or SENSED. They are shown on PROGRESS page 2 as TOTALIZER and CALCULATED. TOTALIZER and SENSED values are the same data with different names.

The FMC usually uses the calculated value for performance computations. Before engine start, the calculated value is the same as the fuel quantity indicating system totalizer value. When the FMC receives a positive fuel flow signal at engine start, the calculated value is independent of the fuel quantity system and decreases at the fuel flow rate.

The FMC will accept manual entry of the fuel quantity. The line title changes to MANUAL and the manual value is then updated by fuel flow rate. When the fuel quantity calculations are based on a manual entry the FUEL QUANTITY DISAGREE message is inhibited. Deleting the manual entry resets the fuel quantity to the totalizer value and the title returns to CALCULATED.

The calculated value is invalid if fuel flow data is invalid. The FMC uses the fuel quantity indicating system quantity for performance computations. The line title on the PERF INIT page changes to SENSED and is shown as TOTALIZER on PROGRESS page 2. The fuel used by each engine is calculated with its related fuel flow signal.

FUEL USED is also shown on PROGRESS page 2. It is calculated by the FMC from the fuel flow rate beginning at engine start.

Fuel used is reset to zero on the ground after engine shutdown when electrical power is removed or when the FMC receives a positive fuel flow at the next engine start.

The scratchpad shows the message FUEL DISAGREE–PROG 2 (or FUEL DISAGREE–PROG 2/2) if the FMC calculates a large difference between the total fuel value determined by the fuel quantity indicating system and the total fuel value calculated by the FMC. When the fuel disagree message appears, PROGRESS page 2 is used to select one of those two values for use by the FMC for its fuel calculations for the remainder of the flight.

Note: The FUEL DISAGREE message is inhibited if the fuel quantity on the PERF INIT page is entered manually. Deleting a manual entry sets the fuel quantity back to the totalizer value, changes the line title back to CALC and enables the FUEL DISAGREE message.

The FMC continually estimates the fuel at the destination airport if the active route is flown. The CDU message INSUFFICIENT FUEL is shown if the estimate is less than the fuel reserve value entered on the PERF INIT page.

Note: FMC calculated fuel predictions assume a clean configuration. Flight with gear or flaps extended cause fuel prediction errors. Fuel predictions are accurate after the gear and flaps are retracted if the active route in the FMC is flown.

Loss of FMC Electrical Power

The FMC must have continuous electrical power to operate. When the electrical power is interrupted and returns, the FMC automatically restarts.

After the restart, the performance data must be re–entered on the PERF INIT page. The route previously in use is available but must be reactivated.

The flight crew must modify the active waypoint to engage LNAV. Select the applicable active waypoint and proceed direct or intercept a course to the waypoint.

FMC Failure

Single FMC Failure

The scratchpad shows the message SINGLE FMC OPERATION after loss of a single FMC. The EICAS shows the advisory message L (or R) FMC FAIL and the MAP flag is displayed on the side with the failed FMC.

The crew member on the side with the failed FMC selects the opposite FMC with the NAV selector to regain CDU access to the operating FMC and map displays. LNAV and VNAV, if engaged, stay engaged and all flight plan and performance data is kept.

Note: If the MENU page and the scratchpad message TIMEOUT RESELECT is shown, the FMC is no longer connected to the CDU. Use the <FMC prompt on the MENU page to connect the CDU to the FMC.

Dual FMC Failure

In the unlikely event that both FMCs fail, the EICAS advisory messages L FMC FAIL and R FMC FAIL are displayed. LNAV and VNAV are not available.

Selecting CDU-L or CDU-R with the NAV selector on the instrument select panel provides route data to the MAP display. Alternate navigation using the CDUs is discussed in Section 50 of this chapter.

Note: The MENU page is shown and the <FMC prompt is not shown in line 1. Push the LEGS function key to show the IRS LEGS page or the PROG key to show the IRS PROGRESS page.

FMC Resets

A software reset may occur in dual or single FMC operation. When a software reset occurs, the active route becomes inactive, the performance data is erased, and LNAV and VNAV modes (if engaged) fail. There is not an EICAS message or an FMC scratchpad message to alert the crew of a reset condition. To regain FMC operation, activate and execute the flight plan, reenter the necessary performance data, and reengage LNAV and VNAV.

Flight Management, Navigation — Chapter 11
Air Traffic Control Data Link — Section 33

This Section Applies to N422LA through N526LA

Air Traffic Control Data Link

Air Traffic Control data link functions are accomplished on the CDU. The CDU is used as an input keyboard for downlink message forms. Uplink messages which contain route modifications are loaded into the FMC using the LOAD prompts on the ATC CDU pages. Execution of an ATC loaded modification is accomplished using normal FMC modification procedures.

Refer to chapter 5, Communications, section 45, ATC Communications, for a description of ATC data link.

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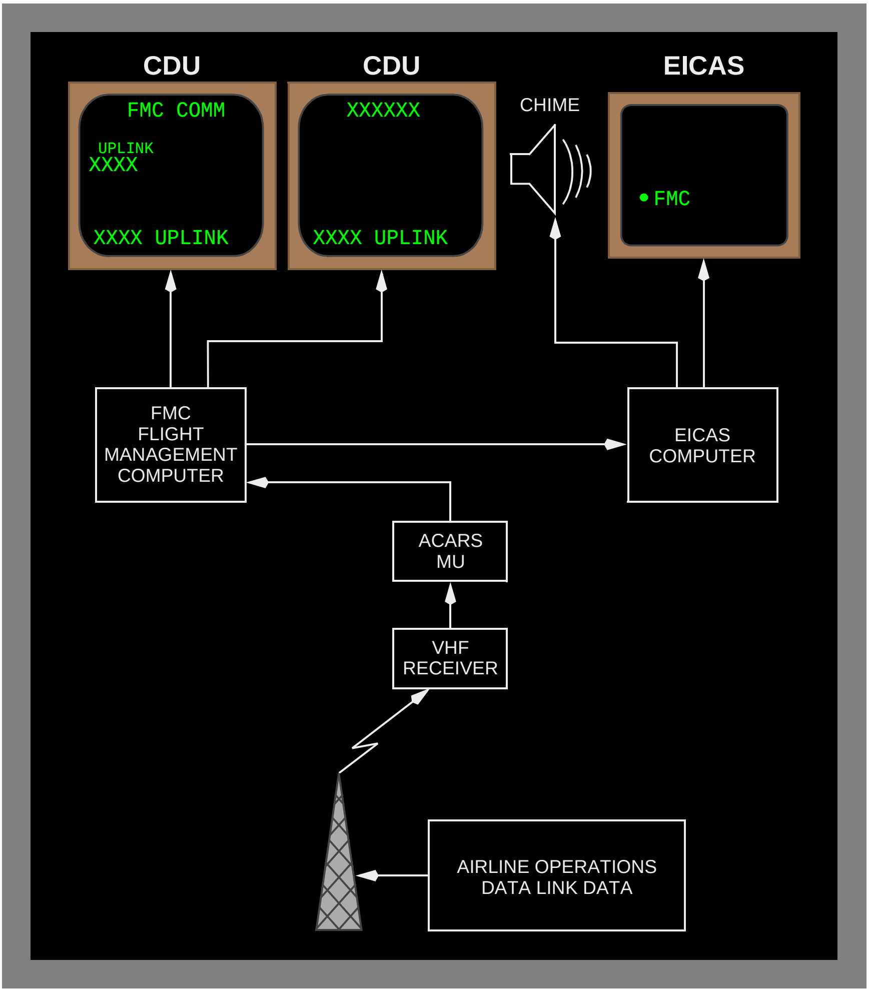
Flight Management, Navigation — Chapter 11

Company Data Link — Section 34

This Section Applies to N422LA through N526LA

Company Data Link

The airplane communications system enables two–way data link communications between the FMC and airline operations. A downlink occurs when data is transferred from the FMC and transmitted through the airplane communications system to a receiver on the ground. An uplink is the opposite of a downlink; data is transmitted from a ground station for input to the FMC. Data may be uplinked at the discretion of the airline operations dispatcher or in response to a downlink request.



Data Link Management

The flight crew should monitor system status of FMC data link.

This is accomplished on various CDU pages or on the FMC COMM page.

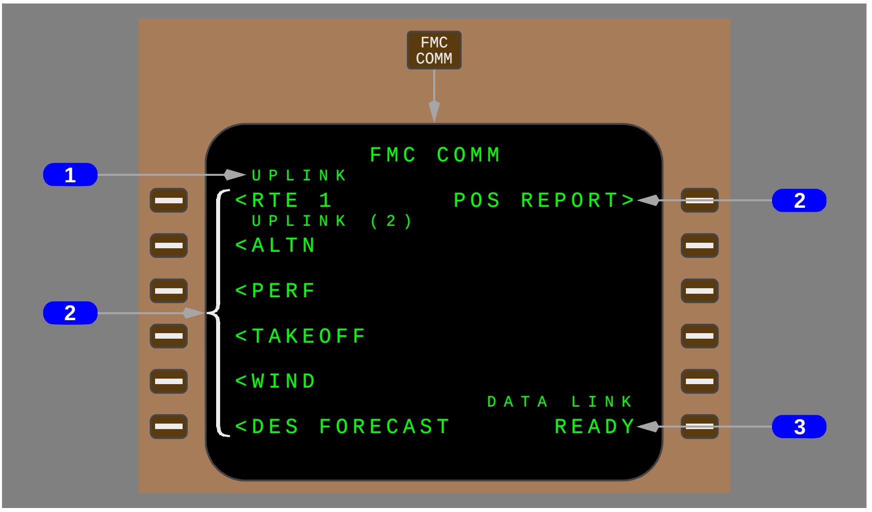
CDU Data Link Status Displays

Data link operation is verified when the correct prompt is displayed. In the example below, the REQUEST SEND prompt indicates the data link status is READY.

When the data link system status is not READY, the line titles change to DATA LINK and the line displays the system status, NO COMM, VOICE or FAIL.

FMC Communications Page

General data link status is shown on the FMC COMM page. Page select prompts are shown for each FMC page with access to data link data.



1 Uplink Status

The page line heading shows UPLINK when an uplink message is pending and all preprocessing is complete. Preprocessing of uplinks makes sure all of the prerequisite data is available before the uplink message can be selected. Examples of preprocessing include:

- RTE ALTN, ALTN LIST, PERF, TAKEOFF, and WIND uplinks are held until route activation or modifications are complete.
- Subsequent uplinks of the same type are held until previous uplinks are included or discarded by the flight crew.
- TAKEOFF uplink is held until gross weight is entered, a pending PERF uplink is included or discarded, or a takeoff runway is entered.

When both ALTN and ALTN LIST uplinks are pending, (2) is shown to the right of UPLINK in the line heading.

The EICAS message •FMC is shown whenever any UPLINK message is pending.

2 Page Select Prompts

Selection of any of these prompts shows the related page:

- RTE X
- ALTN
- PERF
- TAKEOFF

- WIND
- DES FORECAST
- POS REPORT.

3 DATA LINK

Shows the data link system status.

System status can be:

- READY
- NO COMM
- VOICE
- FAIL.

Data Link Messages

Downlinks are data link message transmitted to a ground station. Requests for data and reports of FMC data are two types of downlinks. Requests are made manually by the flight crew. Reports can be made manually or may occur automatically.

Uplinks are messages transmitted to the airplane. Most uplinks require manual selections by the flight crew. Some uplinks are input automatically.

Manual Downlinks

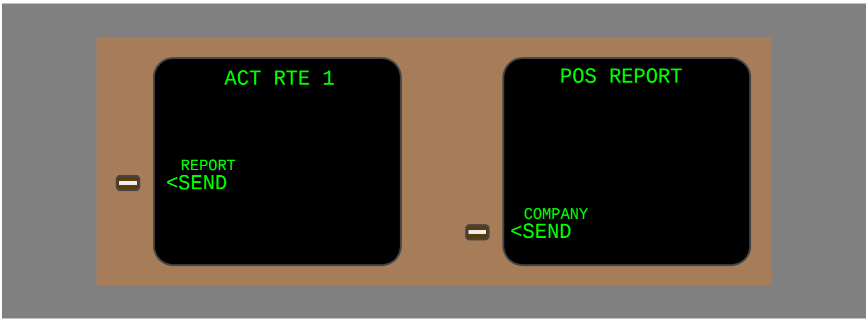
Select a REQUEST SEND prompt to start a downlink request for data. REQUEST SEND prompts are on PERF INIT, TAKEOFF REF, DESCENT FORECAST, RTE, ALTN, ALTN LIST, or RTE DATA pages. Downlink reports of the active route may be accomplished by selection of the REPORT SEND prompt on the RTE page and a position report may be downlinked by selection of the COMPANY SEND prompt on the POS REPORT page.

When the communications function is unable to downlink FMC messages, the words DATALINK FAIL, NO COMM, or VOICE are shown on the CDU pages in place of the REQUEST SEND and REPORT SEND prompts. The data link status is also shown on the FMC COMM page. The status messages are:

- FAIL –
  - the data communications management function is inoperative, or
  - the data radios have failed.
- NO COMM –
  - the radios are operational but not available
- VOICE – all available radios are operating in the VOICE mode.

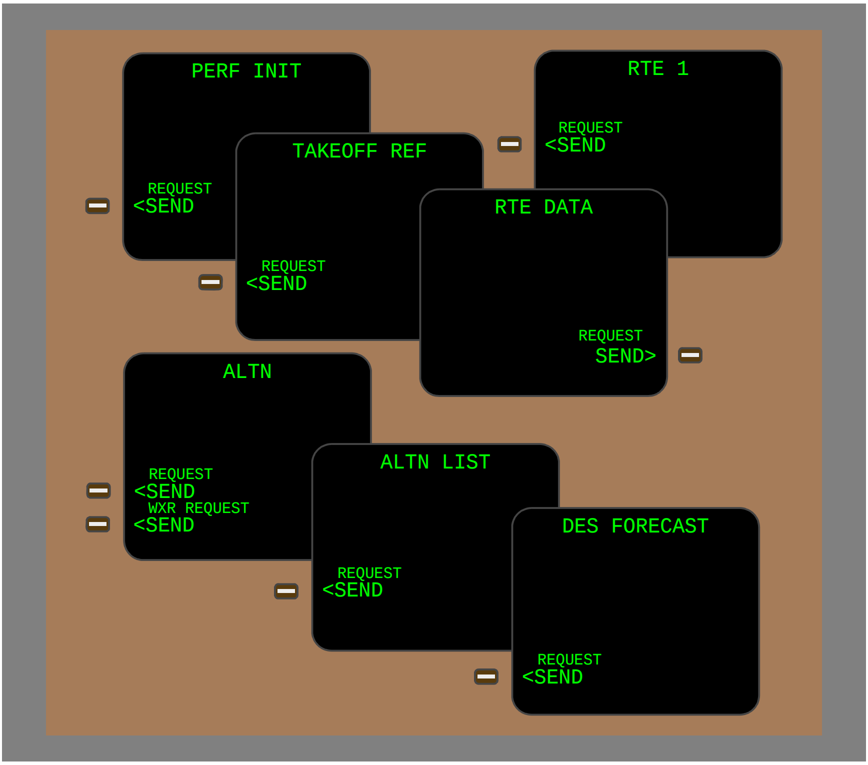
Reports

Selecting the REPORT SEND or COMPANY SEND prompt downlinks a unique report. The pages below contain report prompts.



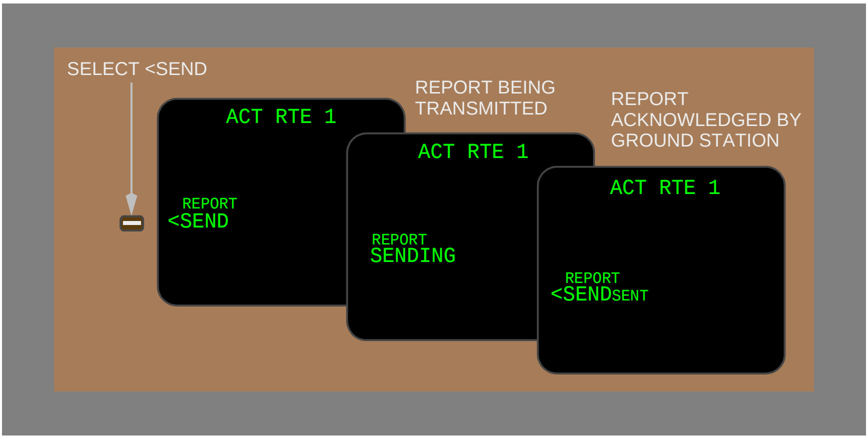
Requests

A REQUEST SEND prompt downlinks a unique request applicable to the displayed page. The pages below contain REQUEST SEND prompts as shown.



Downlink Status

When a SEND prompt is selected the line changes to show the status of the downlink message. Below is a typical sequence of the status display in response to sending a report. The same sequence appears when sending a request.



Automatic Downlinks

The FMC can be configured by the airline to automatically transmit downlinks of FMC data at predetermined points during the flight or in response to specific data requests from the airline dispatcher. The FMC response in these cases is completely automatic and no flight crew action is necessary.

Uplinks

Uplinked data may be loaded automatically or may require flight crew action. Two uplinks automatically load data into the FMC and do not require execution. Uplinked data that waits in system memory for flight crew action are considered to be pending.

A pending uplink is loaded or discarded when the flight crew selects the applicable prompt. Flight crew response to an uplink depends on the type of uplink. Flight crew action is made with ACCEPT/REJECT or LOAD/PURGE prompts, FMC modification ERASE prompt or EXEC key, or when the page with the uplink is selected.

Data can be uplinked from the airline dispatcher directly to the PERF INIT, TAKEOFF REF, DESCENT FORECAST, RTE, ALTN, ALTN LIST, and WIND pages. The uplinks are annunciated to the crew by the •FMC EICAS communications alert and a chime. The uplink is identified by a CDU scratchpad message and by the presence of an UPLINK label over the applicable COMM page prompt.

Takeoff uplinks are not annunciated until:

- gross weight is entered on the PERF INIT page
- a route is activated
- the active route has a departure runway (and intersection, if applicable) matching the TAKEOFF uplinks (up to six takeoff records can be uplinked).

If there is no active route, wind uplinks are not annunciated, and the <WIND prompt on the COMM page is not shown.

FMC Data Link Uplinks (Accept/Reject)

ACCEPT and REJECT prompts are shown on the PERF INIT, TAKEOFF 1/2, and ALTN pages after receipt of uplink data.

Uplink data is shown initially in small font for preview.

Select ACCEPT prompt:

- shows uplinked data in large font
- replaces previous data with uplinked data
- page changes to pre–uplink format
- clears scratchpad message
- transmits a downlink accept message (if enabled).

Select REJECT prompt:

- replaces uplinked data with previous data
- page changes to pre–uplink format
- clears scratchpad message
- transmits a downlink reject message (if enabled).

FMC Data Link Uplinks (Load/Purge)

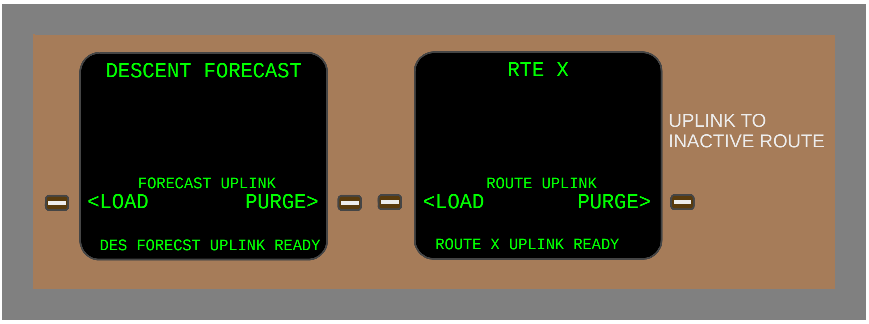
LOAD and PURGE are shown on the DESCENT FORECAST page after receipt of uplink data. LOAD and PURGE are shown on the RTE 1 or RTE 2 page when there is an uplink to the inactive route.

Select LOAD prompt:

- loads uplinked data into FMC for viewing
- clears scratchpad message
- replaces previous data with uplinked data
- page changes to pre–uplink format
- transmits a downlink accept message (if enabled).

Select PURGE prompt:

- replaces uplinked data with previous data
- page changes to pre–uplink format
- clears scratchpad message
- transmits a downlink reject message (if enabled).



FMC Data Link Uplinks (Load/Exec–Erase)

LOAD shows on the RTE and WIND pages after receipt of uplink data.

After the uplinked data is loaded, the EXEC light illuminates and the ERASE prompt is shown.

Select LOAD prompt:

- loads uplinked data into FMC
- loaded data can be viewed
- clears scratchpad message
- replaces existing data with modified uplinked data
- page title changes to MOD
- shows ERASE prompt
- illuminates EXEC light.

Push the EXEC key to:

- put modified data in active flight plan
- change page format to pre–uplink format
- transmit a downlink accept message (if enabled).

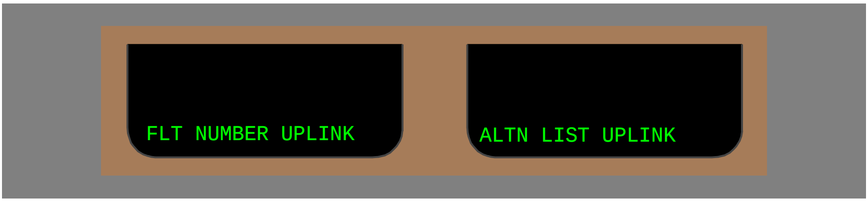
Select ERASE prompt to:

- remove modified data
- return page display to pre–uplink format
- transmit a downlink reject message (if enabled).

FMC Data Link Uplinks (Automatic)

FLT NO and ALTN LIST data can be automatically uplinked and loaded. FLT NO automatically loads into the RTE 1/x page without flight crew action. The list of up to 20 alternates automatically loads into the ALTN LIST page without flight crew action.

The scratchpad messages FLIGHT NUMBER UPLINK or ALTN LIST UPLINK stay in the scratchpad display queue until the applicable CDU page is selected.



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Introduction

FMC preflight is required before flight.

Completion of the FMC preflight requires data entry in all minimum required data locations. Additional entry of optional preflight data optimizes FMC accuracy.

N422LA through N526LA
Data link can be used to load preflight data from airline ground stations. Using data link reduces the number of required flight crew actions. Manual flight crew entries replace existing data.

N422LA through N526LA
Data link can also be used to load takeoff data onto the TAKEOFF REF pages.

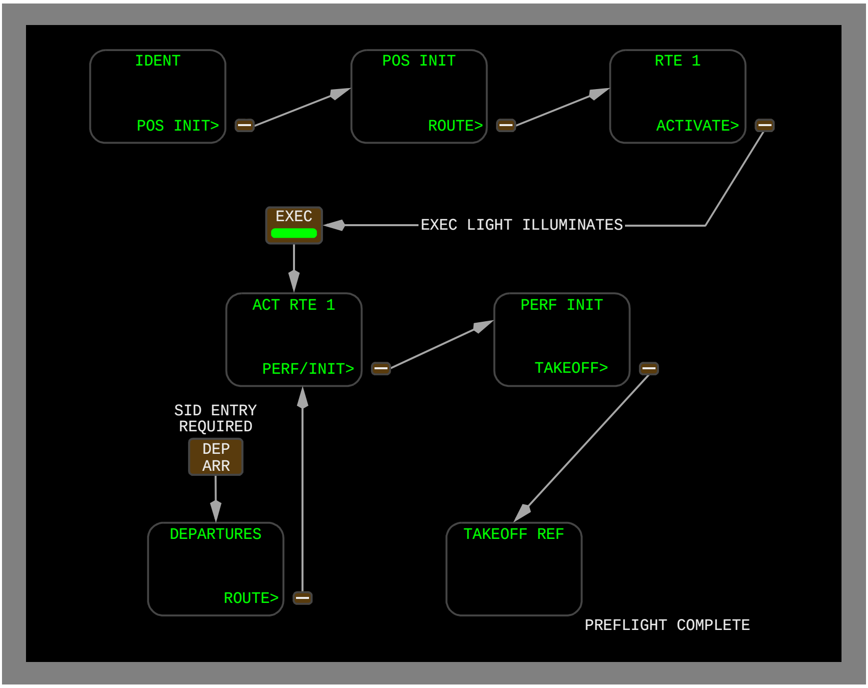
Preflight Page Sequence

The usual FMC power–up page is the identification page. Preflight flow continues in this sequence:

- identification (IDENT) page
- position initialization (POS INIT) page
- ROUTE page
- DEPARTURES page (no automatic prompt)
- performance initialization (PERF INIT) page
- takeoff reference (TAKEOFF REF) page.

Some of these pages are also used in flight.

Minimum Preflight Sequence



During preflight, a prompt in the lower right directs the flight crew through the minimum requirements for preflight completion. Selecting the prompt key displays the next page in the flow. If a required entry is missed, a prompt on the TAKEOFF page leads the flight crew to the preflight page missing data.

Airplane inertial position is necessary for FMC preflight and flight instrument operation.

A route must be entered and activated. The minimum route data is origin and destination airports, and a route leg.

Performance data including the airplane weight and cruise altitude is required.

Takeoff data requires a flap setting.

Supplementary Pages

Supplementary pages are sometimes required, these pages have no prompts and interrupt the usual sequence. Discussions of each page includes methods to display the page.

When the route includes SIDs and STARs, they can be entered using the DEPARTURES or ARRIVALS pages.

Route discontinuities are removed and the route is modified on the ROUTE and RTE LEGS pages. Speed/altitude restrictions are entered and removed on the RTE LEGS page. The RTE LEGS page is described in the FMC Cruise section of this chapter.

Waypoint, navaid, airport, and runway data is referenced on the REF NAV DATA page. The REF NAV DATA page is described in the FMC Cruise section of this chapter.

Alternate airports are added on the ALTN page. The ALTN page is described in the FMC Descent/Approach section of this chapter.

VNAV performance is improved if forecast winds and temperatures are entered during the preflight.

Wind and temperature information for specific waypoints is entered on the WIND page. The WIND page is described in the FMC Cruise section of this chapter.

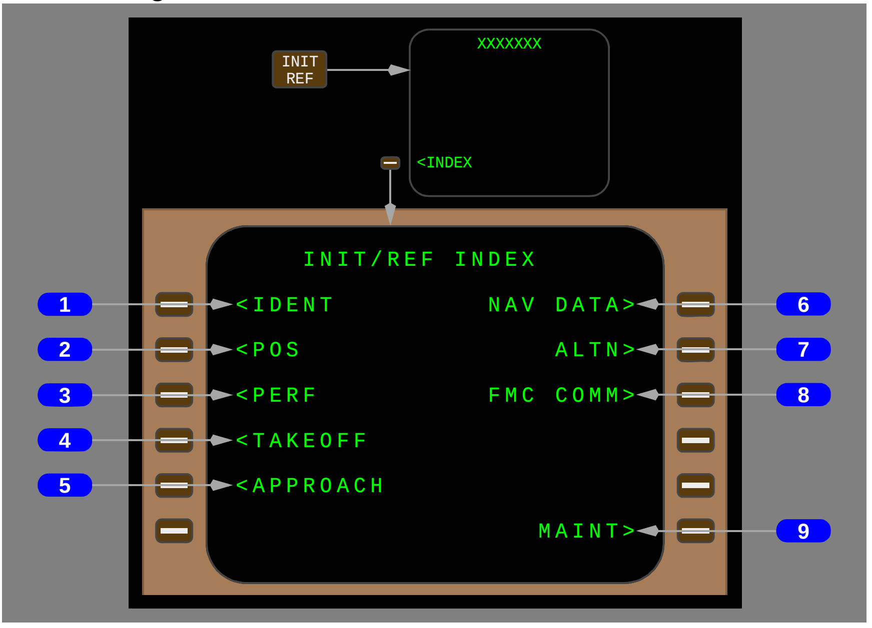
Preflight Pages

The preflight pages are presented in the sequence used during a typical preflight.

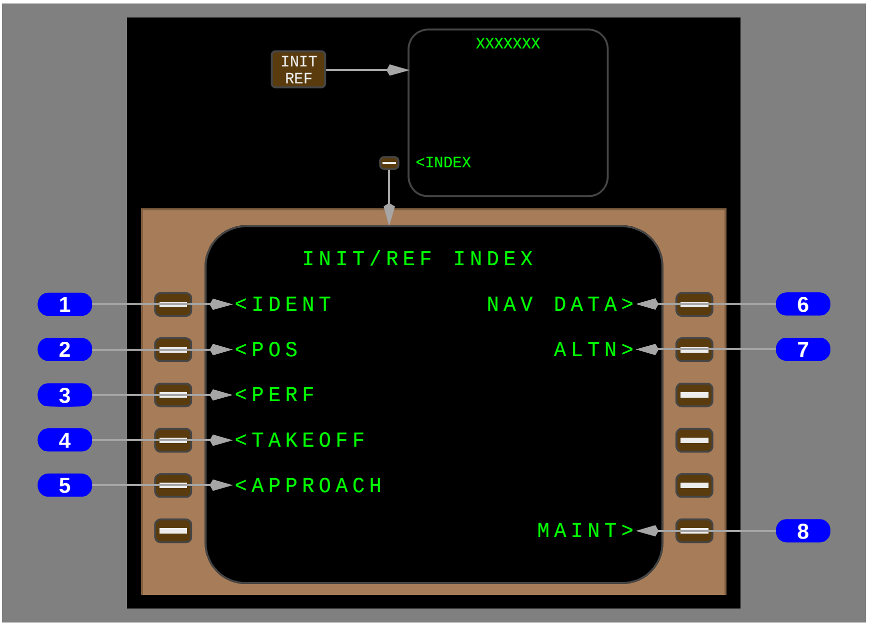
Initialization/Reference Index Page

The initialization/reference index page allows manual selection of FMC pages. It gives access to pages used during preflight and not usually used in flight.

N422LA through N526LA



N316LA



1 **Identification (IDENT)**

The IDENT page is the first page in the preflight sequence.

2 **Position (POS)**

The POS INIT page is used for input of reference position for inertial alignment.

3 **Performance (PERF)**

The PERF INIT page is used for initialization of data required for VNAV operations and performance predictions.

4 **TAKEOFF**

The TAKEOFF REF page is used to enter takeoff reference data and V speeds.

5 **APPROACH**

The APPROACH REF page is used to set the approach VREF speed bug on the ADI speed tape for the planned landing flap configuration.

6 **Navigation (NAV) DATA**

The REF NAV DATA page is used for data on waypoints, navaids, airports, and runways. NAV DATA pages are accessible only from this page.

7 Alternate (ALTN)

The ALTN page is used for alternate airport planning and diversions.

N422LA through N526LA

8 FMC Communication (COMM)

The FMC COMM page is used to access other pages from which FMC datalink messages can be accessed or sent.

N316LA

8 Maintenance (MAINT)

For maintenance use only; displays maintenance pages.

N422LA through N526LA

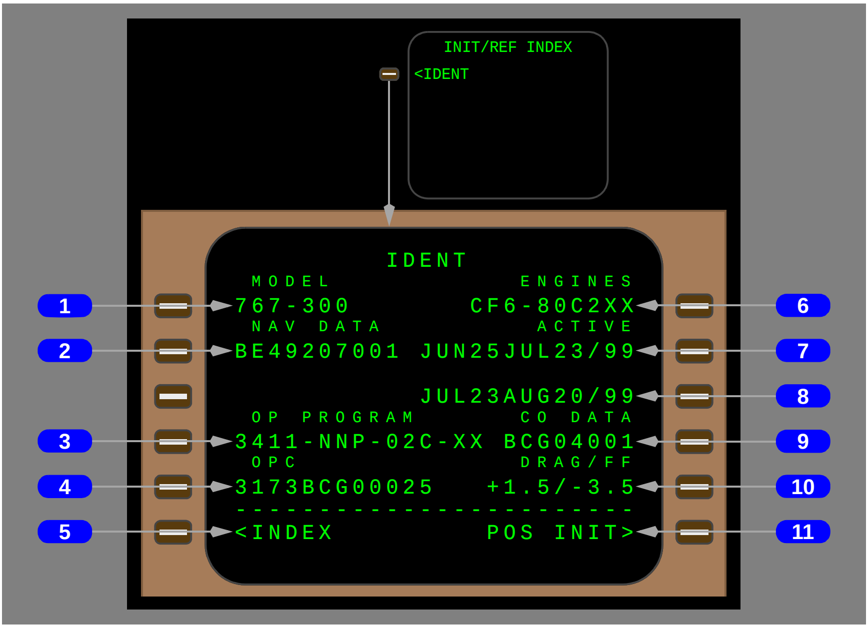
9 Maintenance (MAINT)

For maintenance use only; displays maintenance pages.

Identification Page

Most of the data on this page is for flight crew verification. The active navigation database can be selected.

The flight crew verifies FMC data, selects the current navigation database, and checks drag and fuel flow factors on the identification page.



1 MODEL

Displays the airplane model from the FMC performance database.

2 Navigation (NAV) DATA

Displays the navigation database identifier.

3 Operating (OP) PROGRAM

Displays the operating program identifier.

4 Operational Program Configuration (OPC) PART NUMBER

Displays the Operational Program Configuration part number.

5 INDEX

Push – displays the INIT/REF INDEX page.

6 ENGINES

Displays the engine model from the FMC performance database.

7 ACTIVE

Displays range of effective dates for the active navigation database.

The active navigation database can be replaced with the inactive database while on the ground. Changing the navigation database removes all previously entered route data.

8 Inactive Date Range

Displays range of effective dates for the inactive navigation database. May be line selected to the scratchpad and inserted to the ACTVE line while on the ground.

9 Company (CO) DATA

Displays the last eight characters of the Airline Modifiable Information (AMI) part number.

10 DRAG/Fuel Flow (FF) Factors

Displays the airplane drag and fuel flow correction factors.

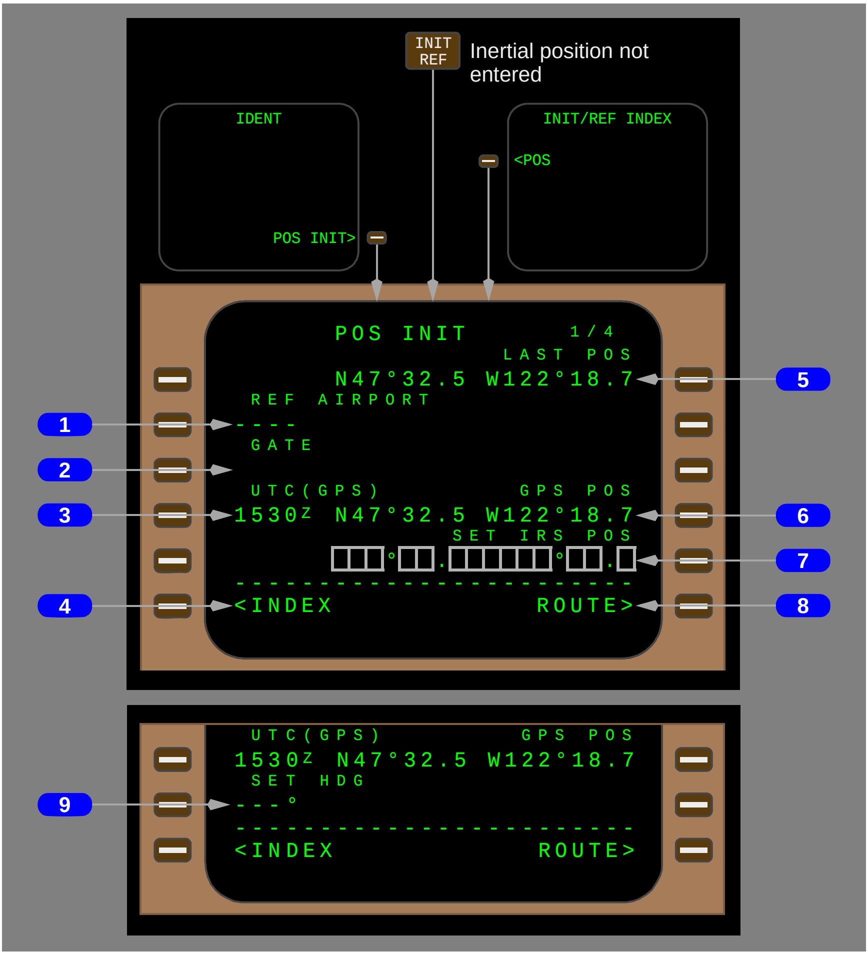
For maintenance use only.

11 Position Initialization (POS INIT)

Push – displays the POS INIT page.

Position Initialization Page

The position initialization page allows entry of airplane present position for IRS alignment. This page is also used to enter the heading when an IRS is in the ATT mode.



1 Reference Airport (REF AIRPORT)

Entry of the reference airport displays the airport latitude/longitude.

Optional entry.

Valid entries are ICAO four letter airport identifiers.

Removes previous GATE entry.

Entry blanks when airborne.

2 GATE

The gate entry allows further refinement of the latitude/longitude position.

Optional entry after reference airport entered.

Valid entry is a gate number at the reference airport.

Displays the latitude and longitude of the reference airport gate.

Changes to dashes when a new reference airport is entered.

Entry blanks when airborne.

3 Universal Time Coordinated (UTC)

UTC (GPS) – displays time from GPS.

UTC (MAN) –

- displays time from captain’s clock when operative; otherwise, displays time from first officer’s clock
- hours can be set by entering desired hour reference
- minutes set by resetting appropriate pilot’s clock.

4 INDEX

Push – displays the INIT/REF INDEX page.

5 Last Position (LAST POS)

Displays the last FMC calculated position.

6 GPS Position (GPS POS)

Displays the GPS present position. During preflight, the GPS POS may not display due to satellite availability, performance, or unfavorable geometry.

7 Set IRS Position (SET IRS POS)

The set inertial position entry is required to initialize the IRS. Select the most accurate latitude/longitude from LAST POS, REF AIRPORT, GATE, GPS POS, or a manual entry to initialize the IRS.

If an entry is not made before the IRS completes the initial alignment, the scratchpad message ENTER IRS POSITION is displayed.

If the manually entered position fails the IRS internal check, the scratchpad message ENTER IRS POSITION is displayed.

The manually entered position is also compared with the FMC origin airport position. If the entered position is not within 6 NM of the FMC origin airport position, the scratchpad message IRS POS/ORIGIN DISAGREE is displayed.

Boxes display within one minute of IRS power–up.

Blanks when the IRS changes from the alignment to the navigation mode.

8 ROUTE

Push – displays the ROUTE page.

9 Set Heading (SET HDG)

Dashes display when an IRS selector is placed in the ATT position.

Enter magnetic heading to initialize the IRS in the ATT mode to provide headings. Heading should be updated regularly if extended operation in ATT is necessary.

Valid entry is 0 to 360 (0 or 360 displays as 0°).

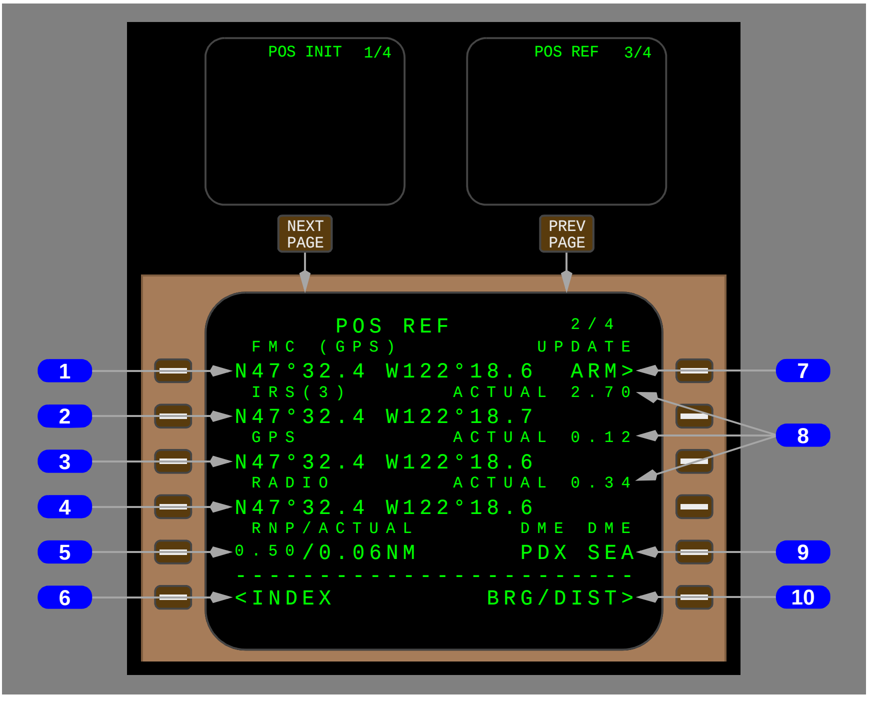
Position Reference Pages

The position reference pages are not part of a normal preflight. They are presented here in a logical sequence because they are accessed from the position initialization page.

Position Reference Page 2/4

Position reference page 2 displays positions calculated by the FMC, IRS, GPS, and radio navigation receivers. The FMC position can be updated to IRS, GPS, or radio position on this page.

Positions are displayed as the latitude/longitude calculated by the individual systems. When BRG/DIST is selected the IRS, GPS, and radio positions are shown as bearing and distance from the FMC position.



1 FMC

The source used by the active FMC for position data is displayed next to the FMC line title. In the example, the FMC uses GPS for position data.

Displays the FMC calculated latitude/longitude.

Identifies the source for calculating the FMC position:

- GPS – position calculated from GPS and inertial position data
- IRS – position calculated from inertial position data only
- RADIO – position calculated from navigation radio and inertial position data
- LOC–GPS – position is calculated from localizer, GPS and inertial data
- LOC–RADIO – position is calculated from localizer, navigation radio and inertial data
- LOC – position is calculated from localizer and inertial data.

2 IRS

Displays latitude/longitude position or the bearing and distance from the FMC position determined by the IRS. If the displayed position is derived from all three IRSs, (3) is displayed. If the position is from a single IRS then (L), (C), or (R) is displayed to indicate which IRS position is displayed.

3 GPS

Displays latitude/longitude position or the bearing and distance from the FMC position determined by the GPS.

4 RADIO

After airborne, displays latitude/longitude position or the bearing and distance from the FMC position determined by navigation radios.

5 Required Navigation Performance and Actual Navigation Performance (RNP /ACTUAL)

Displays the RNP and actual navigational performance (ACTUAL) of the FMC.

Default RNP is in small font.

Valid RNP entries are in the range 0.01 to 99.9. ACTUAL entry not allowed.

When ACTUAL exceeds RNP, EICAS displays UNABLE RNP message.

Note: The FMC stops GPS updating if GPS data accuracy degrades due to satellite availability or unfavorable geometry. Subsequently, the FMC receives updates from another system.

6 INDEX

Push – displays the INIT/REF INDEX page.

7 UPDATE ARM

Push –

- arms FMC position update function
- changes prompt to ARMED
- adds NOW prompts to right side of INERTIAL, GPS, and RADIO lines.

Push a NOW prompt key to momentarily update FMC position to the selected source. If another source with a smaller ANP exists, the FMC position will correct back to the most accurate position available.

8 ACTUAL

Displays actual navigation performance (ANP) of the IRS, GPS and navigation radios.

9 Radio Update Station(s)/Mode

Displays radio station identifiers.

Position update mode is indicated in the line title:

- DME DME
- VOR DME

Line and title are blank when no radio position is computed.

10 Bearing/Distance (BRG/DIST) or Latitude/Longitude (LAT/LON)

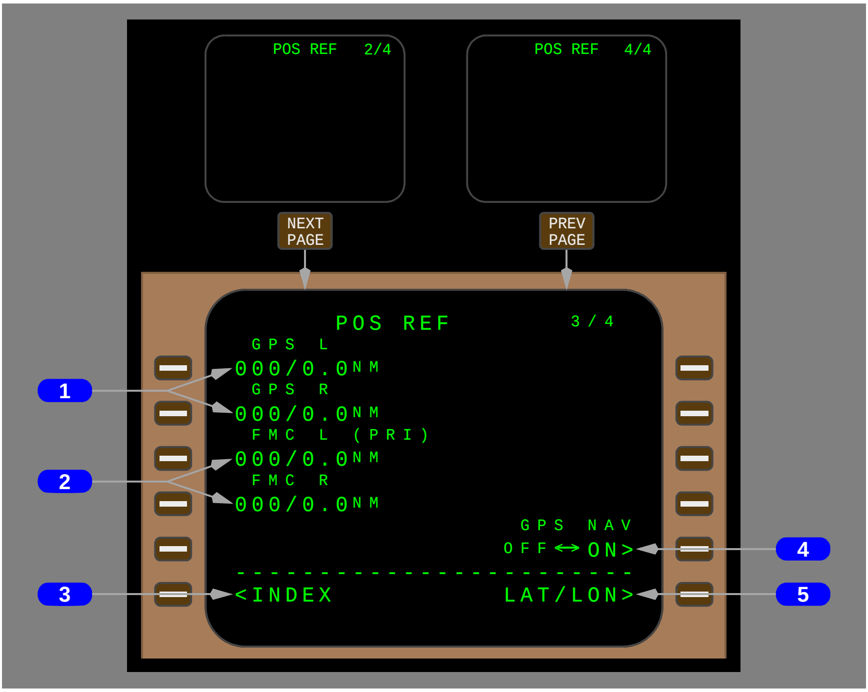
Push – alternates position data format between bearing/distance or latitude/longitude.

The page illustration is shown in the latitude/longitude display format. Latitude/longitude format displays are actual position. Bearing/distance display is relative to the FMC position.

Position Reference Page 3/4

On position reference page 3, the flight crew can observe the calculated positions from the left and right GPS receivers and the left and right FMC calculations. This page also allows the flight crew to enable or disable GPS position updates.

This page can display the bearing/distance or latitude/longitude format. The bearing/distance format displays the positions relative to the active FMC position on the POS REF 2/4 page.



1 **GPS L and GPS R**

Displays the left and right GPS positions.

2 **FMC L and FMC R**

Displays the left and right FMC calculated position.

Primary (PRI) is displayed in line title of the FMC that is the navigation master.

3 **INDEX**

Push – displays the INIT/REF INDEX page.

4 GPS NAV

Push – alternately selects GPS NAV ON (enabled) and OFF (disabled).

OFF – GPS position data is not available to the FMC. OFF displays in large letters; ON displays in small letters.

ON – GPS position data is available to the FMC. ON displays in large letters; OFF displays in small letters.

Note: When the engines are shut down after flight GPS NAV is set to ON.

5 Latitude/Longitude (LAT/LON) or Bearing/Distance (BRG/DIST)

Push – alternately changes the display of position data on POS REF 2/4, 3/4, and 4/4 to latitude/longitude format or bearing/distance format.

The page illustration is shown in the bearing/distance display mode.

Position Reference Page 4/4

On position reference page 4, the calculated positions and ground speeds from the left, center and right IRS are displayed. Positions can be displayed in the bearing/distance or latitude/longitude format.

1 IRS L, C, and R

Displays the position of the Left, Center, and Right IRS. Positions can be displayed in latitude longitude or as bearing and distances from the FMC position.

2 INDEX

Push – displays the INIT/REF INDEX page.

3 Ground Speed (GS)

Displays the ground speed calculated by each IRS. The displayed values are frozen when the engines are shut down after flight until power is removed.

4 Latitude/Longitude (LAT/LON) or Bearing/Distance (BRG/DIST)

Push – alternately changes the displayed position between latitude/longitude format and bearing/distance format. When the display is in the bearing/distance format the prompt shows LAT/LON>.

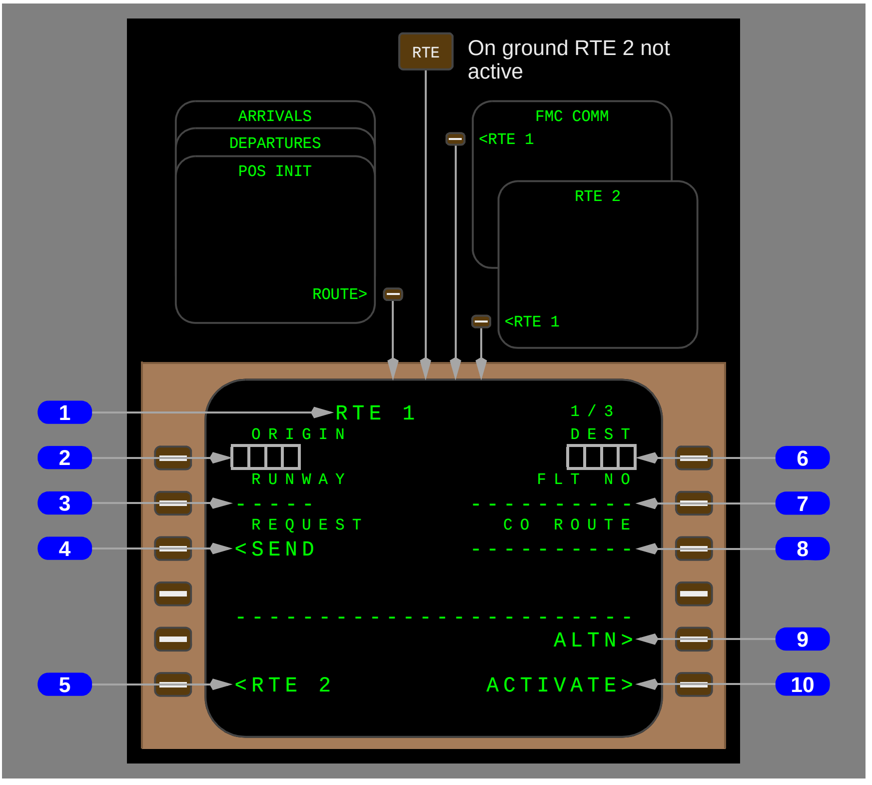
Route Page

Two routes (RTE 1 and RTE 2) can be stored and displayed in air traffic control format. The first route page displays origin and destination data. Subsequent route pages display route segments between waypoints or fixes. Having two routes allows management of alternate or future routes while leaving the active route unmodified. RTE 2 has an identical page structure as RTE 1.

N422LA through N526LA
Routes can be entered by the flight crew or uplinked through data link.

Route Page 1/X

N422LA through N526LA



1 Page Title

Preceded by ACT when the route is active, and by MOD when the route is modified and the change is not executed.

Multiple route pages are indicated by the page sequence number to the right of the title. The minimum number of route pages is 2.

2 ORIGIN

Entry:

- must be a valid ICAO identifier in the navigation database
- made automatically when a company route is entered
- enables direct selection of departure and arrival procedures
- required for route activation
- inhibited in–flight for active route.

Entry on the ground deletes existing route.

3 RUNWAY

Enter the applicable runway for the origin airport. Runway must be in the navigation database.

Entry:

- is optional
- causes MOD to display in the title if route is active
- can be selected on the DEPARTURES page
- can be included in company route.

The runway is deleted after the first waypoint is crossed.

4 REQUEST SEND

Push – transmits a data link request for a flight plan route uplink.

Flight crew can optionally fill in origin, destination, runway, flight number, company route name, or route definition to be included in the request.

5 Route (RTE) 2

Push – displays the RTE 2 page 1/X.

Allows access to an inactive route for entry, modification or activation.

Inactive route modifications:

- do not alter the active route
- do not change the inactive RTE page title.

Prompt changes to RTE 1 when RTE 2 is displayed.

6 Destination (DEST)

Entry:

- must be a valid ICAO identifier in the navigation database
- is made automatically when a company route is entered
- enables direct selection of destination arrival procedures
- is required for route activation
- displays MOD in page title if entered in an active route.

7 Flight Number (FLT NO)

Enter the company flight number.

Entry:

- optional for activation of the route
- limited to 10 characters
- may be entered by the flight crew or uplinked
- included in the PROGRESS page title

- propagated to RTE 2 and the ATC LOGON pages
- deleted at flight completion.

Flight number can also be entered on the ATC LOGON page.

8 Company Route (CO ROUTE)

A company route can be called from the navigation database by entering the route identifier. The data supplied with a company route can include origin and destination airports, departure runway, SID and STAR, and the route of flight. All company route data is automatically entered when the route identifier is entered.

An entry is optional for activation of the route.

Valid entry is any flight crew entered or uplinked company route name. If the name is not contained in the NAV database, the entry is allowed and the scratchpad message NOT IN DATABASE is displayed.

Entry of a new company route replaces the previous route.

In–flight entry is inhibited for the active route.

9 Alternate (ALTN)

Push – displays the ALTN page.

10 ACTIVATE

Push the ACTIVATE key to arm the route and illuminate the EXECUTE light. When the EXECUTE key is pushed, the route becomes the active, ACT is displayed in the title, and the ACTIVATE prompt is replaced with the next required preflight page prompt.

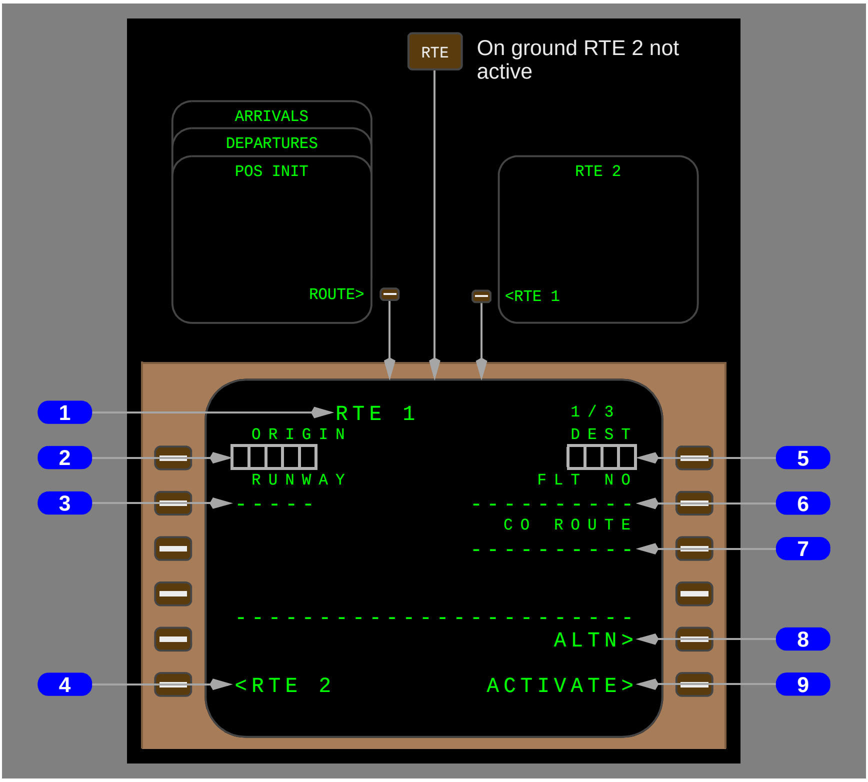
Activation of a route is required for completion of the preflight.

ACTIVATE is always displayed on the inactive route pages.

After route activation, the ACTIVATE prompt is replaced by:

- PERF INIT, when the required performance data is incomplete, or
- TAKEOFF when the required performance data is complete.

N316LA



1 Page Title

Preceded by ACT when the route is active, and by MOD when the route is modified and the change is not executed.

Multiple route pages are indicated by the page sequence number to the right of the title. The minimum number of route pages is 2.

2 ORIGIN

Entry:

- must be a valid ICAO identifier in the navigation database
- made automatically when a company route is entered
- enables direct selection of departure and arrival procedures
- required for route activation
- inhibited in–flight for active route.

Entry on the ground deletes existing route.

3 RUNWAY

Enter the applicable runway for the origin airport. Runway must be in the navigation database.

Entry:

- is optional
- causes MOD to display in the title if route is active
- can be selected on the DEPARTURES page
- can be included in company route.

The runway is deleted after the first waypoint is crossed.

4 Route (RTE) 2

Push – displays the RTE 2 page 1/x.

Allows access to an inactive route for entry, modification or activation.

Inactive route modifications:

- do not alter the active route
- do not change the inactive RTE page title.

Prompt changes to RTE 1 when RTE 2 is displayed.

5 Destination (DEST)

Entry:

- must be a valid ICAO identifier in the navigation database
- made automatically when a company route is entered
- enables direct selection of destination arrival procedures
- required for route activation
- displays MOD in page title if entered in an active route.

6 Flight Number (FLT NO)

Enter the company flight number.

Entry:

- optional for activation of the route
- limited to 10 characters
- may be entered by the flight crew or uplinked
- included in the PROGRESS page title
- propagated to RTE 2 page
- deleted at flight completion.

7 Company Route (CO ROUTE)

A company route can be called from the navigation database by entering the route identifier. The data supplied with a company route can include origin and destination airports, departure runway, SID and STAR, and the route of flight. All company route data is automatically entered when the route identifier is entered.

An entry is optional for activation of the route.

Valid entry is any flight crew entered or uplinked company route name. If the name is not contained in the navigation database, the entry is allowed and the scratchpad message NOT IN DATABASE is displayed.

Entry of a new company route replaces the previous route.

In–flight entry is inhibited for the active route.

8 Alternate (ALTN)

Push – displays the ALTN page.

9 ACTIVATE

Push the ACTIVATE key to arm the route and illuminate the execute light. When the EXEC key is pushed, the route becomes active, ACT is displayed in the title, and the ACTIVATE prompt is replaced with the next required preflight page prompt.

Activation of a route is required for completion of the preflight.

ACTIVATE is always displayed on the inactive route pages.

After route activation, the ACTIVATE prompt is replaced by:

- PERF INIT, when the required performance data is incomplete, or
- TAKEOFF when the required performance data is complete.

More Route Page Prompts for an Active Route

Additional prompts are displayed on the route page once it becomes active.

N422LA through N526LA

1 REPORT SEND

Push – transmits the active route to the company via data link downlink.

2 Route Copy (RTE COPY)

Push – copies the entire active route (RTE x) into the inactive route (RTE y).

Displayed only on the active route page.

Displays COMPLETE after the route is copied.

N316LA

1 Route Copy (RTE COPY)

Push – copies the entire active route (RTE x) into the inactive route (RTE y).

Displayed only on the active route page.

Displays COMPLETE after the route is copied.

Route Page After Ground Station Uplink

N422LA through N526LA

When a valid route uplink is received, the message ROUTE X UPLINK READY is displayed in the scratchpad.

The EICAS communications message FMC is displayed and a chime sounds.

1 ROUTE UPLINK

Displays ROUTE UPLINK when flight plan uplink received.

2 LOAD

Displays LOAD when an uplinked route received.

Push –

- loads uplinked flight plan
- in flight, when uplinked flight plan applies to active route, EXECUTE light illuminates and ERASE displays at 6L
- when route inactive, blanks PURGE at 4R
- displays scratchpad message ROUTE 1 UPLINK LOADING.

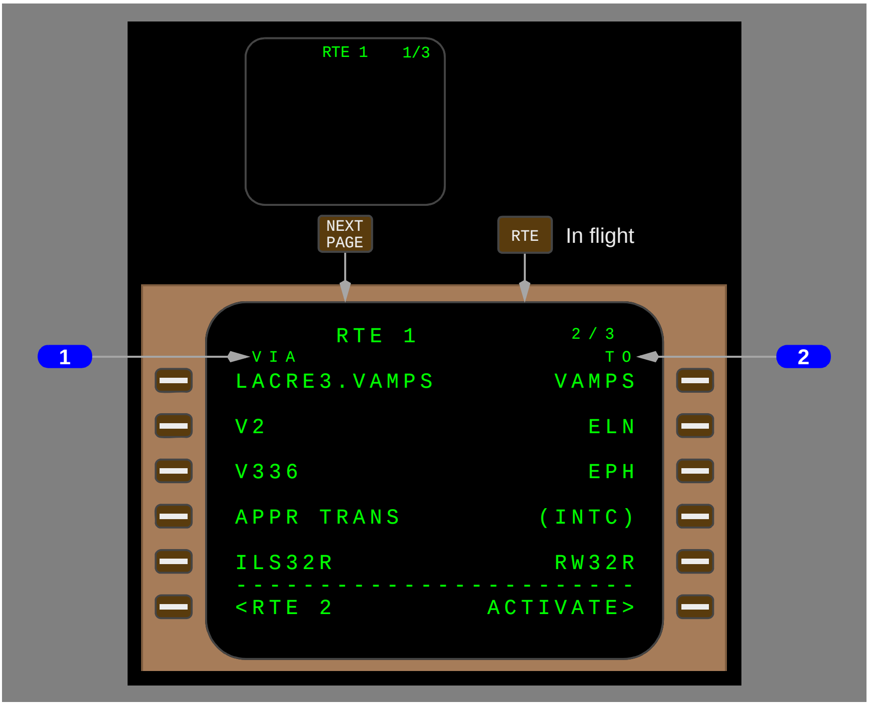
3 PURGE

Displays PURGE when an uplink that applies to an inactive route has been received.

Push – rejects uplinked flight plan data.

Route Page 2/X

The subsequent route pages 2/X through X/X, display route segments in air traffic control format. Route segments are defined as direct routing, airways, or procedures with start and end points such as waypoints, fixes, navaids, airports, or runways. More waypoints for each route segment are shown on the RTE LEGS page.



1 VIA

The VIA column displays the route segment to the waypoint or termination in the TO column. Enter the path which describes the route segment between the previous waypoint and the segment termination.

Enter an airway in the VIA column and boxes display in the TO column.

Valid entries can also include procedures or DIRECT. Procedures are usually entered through selections on DEPARTURES and ARRIVALS pages. DIRECT is usually entered as a result of entering a TO waypoint first.

Valid airways must:

- contain the fix entered in the TO waypoint, and
- contain the previous TO waypoint, or
- intersect the previous VIA route segment.

Dashes change to DIRECT if the TO waypoint is entered first.

Dashes display for the first VIA beyond the end of the route.

Invalid VIA entries result in the scratchpad message INVALID ENTRY.

Invalid VIA entries are:

- airways and company routes which do not contain the TO waypoint of the previous line
- airways that do not intersect the previous airway
- airways or company routes that are not in the navigation database.

The start and end waypoints determine whether the entered airway is valid. The route segment must contain the waypoint entered in the TO position. The TO waypoint of the previous route segment must be the same as the start point of the next route segment or a route discontinuity is created between the segments.

Entry of a SID or transition enters the VIA and TO data for the route segments of the SID. A SID links to the next route segment when the final SID waypoint is part of the route segment.

When no SID is used, entering an airway on the first line of page 2 initiates an airway intercept from the runway heading and:

- replaces the airway with dashes in the first line VIA
- shows boxes in the first line TO waypoint
- moves the airway to line 2 after the TO waypoint is entered
- enters the first fix on the airway nearest to being abeam of the departure heading in the airway line TO waypoint.

A route can contain segments formed by the intersection of two airways. Entering two intersecting airways in successive VIA lines without a TO waypoint causes the FMC to create an airway intersection waypoint to change from one segment to the next. The FMC created waypoint intersection (INTC) displays in the first airway segment TO waypoint.

LACRE3.VAMPS is an example of a SID selection made on the DEPARTURES page.

V2 and V336 are examples of airway entries.

APP TRANS is an example of a STAR selection made on the APPROACH page.

ILS32R is an example of an approach selection made on the APPROACH page.

2 **TO**

Enter the end point of the route segment specified by the VIA entry.

Entry of a waypoint in the TO column without first entering a VIA airway shows DIRECT in the VIA column.

Data input is mandatory when boxes are displayed.

Valid waypoint entries for a DIRECT route segment are any valid waypoint, fix, navaid, airport, or runway.

Valid waypoint entries for airways are waypoints or fixes on the airway.

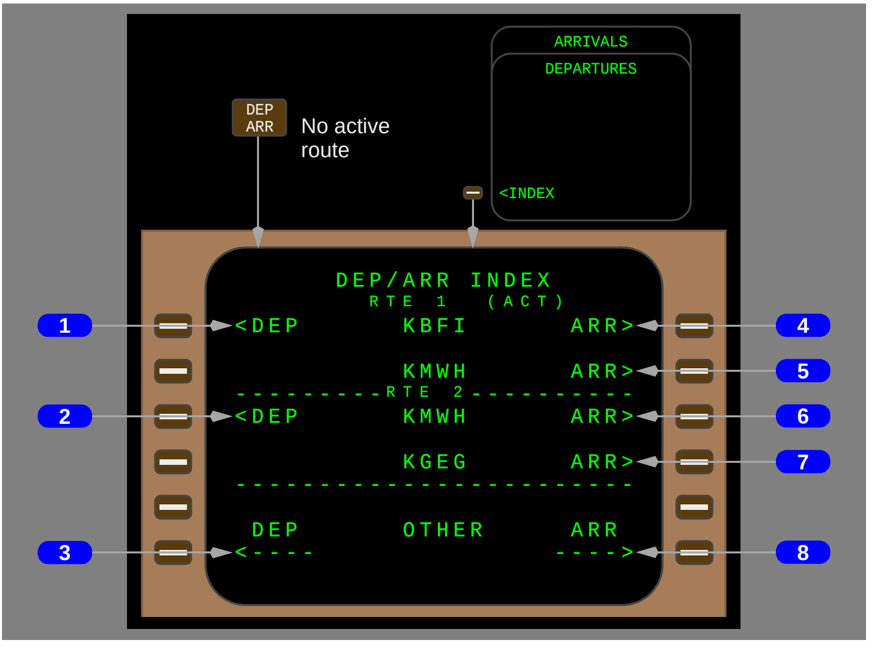
Dashes display on the first TO waypoint after the end of the route.

Preflight Pages – Part 2

Departure/Arrival Index Page

The departure and arrival index page is used to select the departure or arrival page for the origin and destination airports for each route. The index also allows reference to departure or arrival data for any other airport in the navigation database.

Departure and arrival prompts are available for the origin airport. Destination airports have only arrival prompts.



1 Departure (DEP) – Route 1

Push – displays the departure page for route 1 origin airport.

2 Departure (DEP) – Route 2

Push – displays the departure page for route 2 origin airport.

3 Departure (DEP) – Other

Displays the departure page for the airport entered into this line through the scratchpad.

DEP prompt for OTHER allow display of departure data about airports that are not the origin or destination for route 1 or 2. The data can be viewed but cannot be selected because the airport is not on the route.

4 Arrival (ARR) – Route 1 Origin

Push – displays the arrival page for route 1 origin airport. Origin airport arrivals selection is used during a turn–back situation.

5 Arrival (ARR) – Route 1 Destination

Push – displays the arrival page for route 1 destination airport.

6 Arrival (ARR) – Route 2 Origin

Push – displays the arrival page for route 2 origin airport. Origin airport arrivals selection is used during a turn–back situation.

7 Arrival (ARR) – Route 2 Destination

Push – displays the arrival page for route 2 destination airport.

8 Arrival (ARR) – Other

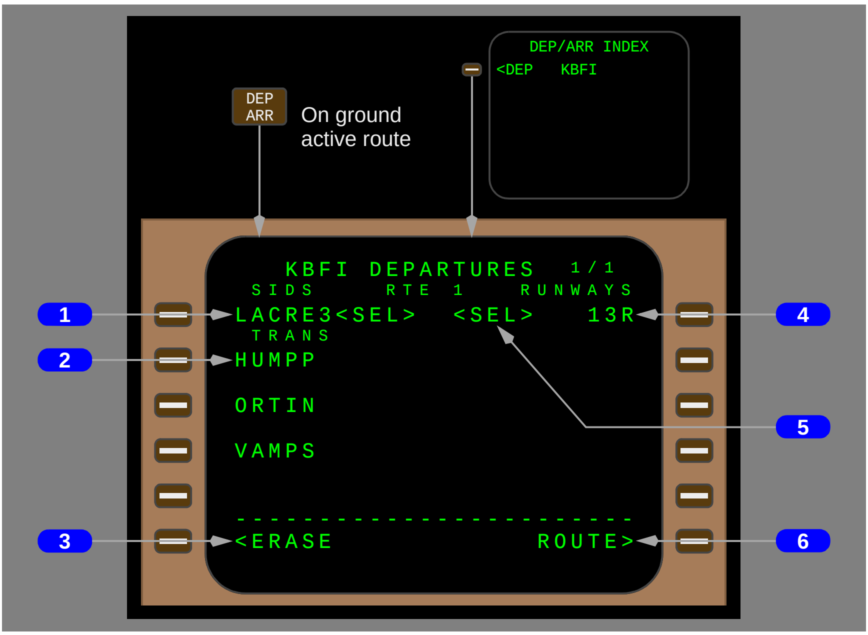
Displays the arrival page for the airport entered in this line through the scratchpad.

ARR prompt for OTHER allows display of arrival data about airports that are not the origin or destination for route 1 or 2. The data can be viewed but cannot be selected because the airport is not on the route.

Departures Page

The departures page is used to select the departure runway, SID, and transition for the route origin airport.

The departures page for the inactive route displays when the DEP ARR function key is pushed with an inactive RTE or RTE LEGS page is displayed.



1 Standard Instrument Departures (SIDS)

Displays a list of SIDS for the airport.

Push –

- selects SID for use in the route
- other SIDs are no longer displayed and the transitions for the selected SID are displayed
- runways for selected SID remain and others are no longer displayed.

2 Transitions (TRANS)

Displays transitions compatible with the selected SID.

Push –

- selects transition for entry in the route
- other transitions no longer display.

3 ERASE or INDEX

Erase displays when a route modification is pending. INDEX displays when no route modification is pending.

ERASE push – removes route modifications not executed and displays the original route.

INDEX push – displays the DEP/ARR INDEX page.

4 RUNWAYS

Displays a list of runways for the selected airport.

The runway selected on the RTE 1/X page displays as <SEL> or <ACT>.

Push –

- selects runway for use in the route. All other runways no longer display
- SIDs associated with selected runway remain, all others no longer display
- subsequent change of a runway deletes departure procedures previously selected.

5 <SEL>, <ACT>

Selecting an option displays <SEL> inboard of the option and creates a route modification. After executing the modification, <SEL> becomes <ACT>. Executing a modification or leaving the page and returning displays all options and the <SEL> or <ACT> prompts.

6 ROUTE

Push – displays the related RTE page.

7 Engine Out Standard Instrument Departure (EO SID)

EO SIDs are airline designed procedures for specific runways. When a runway is selected the EO SID is listed after the other SIDs associated with that runway. If no EO SID exists for the selected runway, NONE is displayed.

PUSH – on the ground, selects the EO SID as a route modification for review. The modification should be erased after the review is complete.

If an engine failure occurs after takeoff before the flaps are retracted, the EO SID will be automatically loaded as a route modification to be executed or erased.

Navigation Radio Page

VOR navigation radios are normally autotuned by the FMC. The NAV RADIO page displays the tuned VOR frequencies, identifiers, tuning status and current radial for both VOR receivers. The VORs can be remotely tuned from this page.

1 VOR Frequency and Tune Status

Displays the frequency and identifier of the tuned navaids and allows input of frequencies or identifiers to remote tune the VORs. Dashes are displayed if the VOR is not tuned.

The tuning status is displayed adjacent to left and right VOR frequencies. Entry of a frequency or identifier remotely tunes a VOR. The FMC autotunes VORs and their related DMEs for procedure flying and radio positions. The tuning status displays are:

- A (autotuning) – FMC selects a navaid for best position orientation
- P (procedure autotuning) – FMC selects navaids for approach or departure procedure guidance
- R (remote tuning) – VOR frequency or identifier has been entered by the flight crew on the NAV RADIO page
- M (manual) – VOR is manual–tuned using the VOR control panels on the glareshield. Manual–tuning takes priority over FMC autotuning.

Valid entries:

- VOR, non–ILS DME, or ILS DME identifier
- VOR frequency (XXX.X or XXX.XX).

2 RADIAL

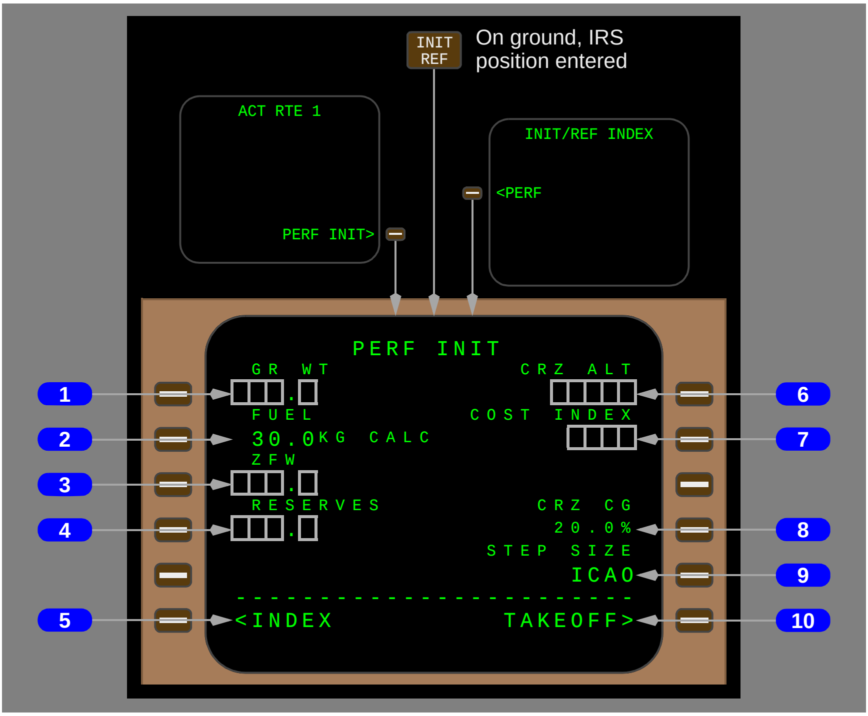
Displays the current radial from the left and right VOR stations to the airplane.

Performance Initialization Page

The performance initialization page allows the entry of airplane and route data to initialize performance calculations. This data is required for VNAV operation.

Performance Initialization Page

N316LA



1 Gross Weight (GR WT)

Airplane gross weight can be entered by the flight crew or calculated by the FMC after entry of zero fuel weight.

Valid entry is thousands of kilograms with a decimal (hundreds) optional.

Entering the zero fuel weight first displays calculated gross weight.

Entry of a value after takeoff speeds are selected removes the speeds and displays the scratchpad message TAKEOFF SPEEDS DELETED.

2 FUEL

Fuel on board displays when the fuel totalizer calculations are valid. The source for the display is included in the line:

- SENSED – fuel quantity is from the totalizer.
- CALC (calculated) – fuel quantity is from FMC calculations. Manual entry is possible
- MANUAL – fuel quantity has been manually entered. Manual entries blank totalizer on PROGRESS page 2/3.

Valid entry is thousands of kilograms with a decimal (hundreds) optional.

Only manual entries can be deleted. The display returns to the sensed (totalizer) value when a manual entry is deleted.

3 Zero Fuel Weight (ZFW)

Normally, ZFW is entered from the airplane dispatch papers and the FMC calculates the airplane gross weight.

Valid entry is thousands of kilograms with a decimal (hundreds) optional.

Calculated zero fuel weight displays when airplane gross weight is entered first and fuel on board is valid.

Entry of a value after takeoff speeds are selected removes the speeds and displays the scratchpad message TAKEOFF SPEEDS DELETED.

ZFW may be manually entered or uplinked. When a performance uplink is pending, uplinked values (small font) display beside the entered values (large font).

4 RESERVES

Valid entry is thousands of kilograms with a decimal (hundreds) optional.

Can be manually entered or uplinked. When a performance uplink is pending, uplinked values (small font) display beside the entered values (large font).

5 INDEX

Push – displays the INIT/REF INDEX page.

6 Cruise Altitude (CRZ ALT)

Cruise altitude can be entered by the flight crew or from a company route or uplink.

Entered value is displayed on the CLB and CRZ pages.

7 COST INDEX

Cost index is used to calculate ECON climb, cruise, and descent speeds. Larger values increase the ECON cruise speed. Entering zero results in maximum range airspeed and minimum trip fuel. Cost index can be entered by the flight crew or from a company route or uplink.

Valid entries are 0 to 9999.

8 Cruise Center of Gravity (CRZ CG)

Used by FMC to compute maximum altitude and maneuver margin to buffet.

Displays default center of gravity.

Can be manually entered or uplinked.

Default value displays in small font.

A flight crew entered or unlinked value displays in large font.

9 STEP SIZE

Displays the climb altitude increment used for planning the optimum climb profile.

Default value is ICAO which provides a 2000 foot step below FL290 and a 4000 foot step above FL290.

Valid manual entries are 0 to 9000 in 1000 foot increments.

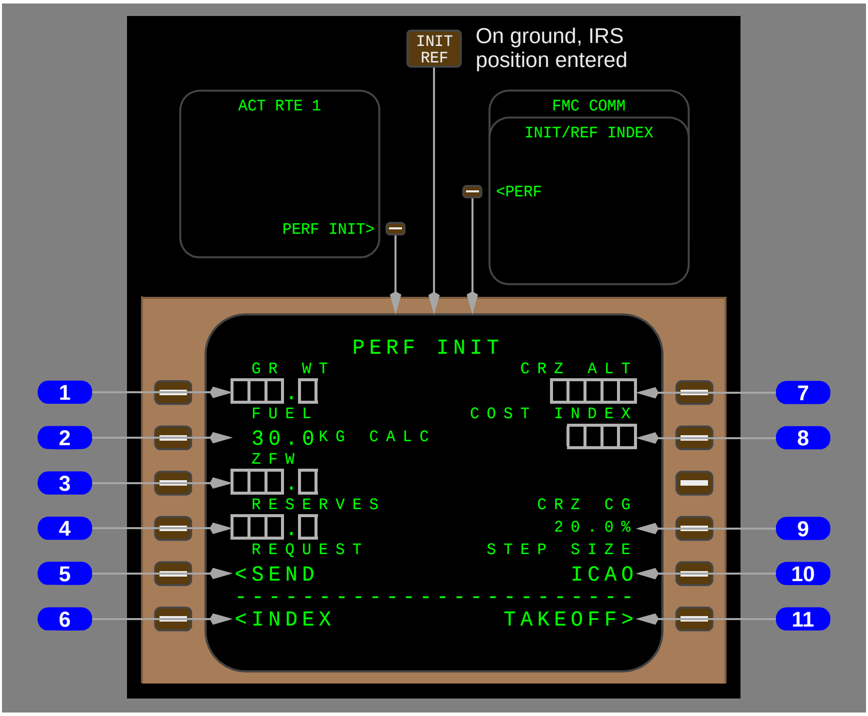
In–flight entries are inhibited. In–flight step size changes are made on the CRZ page.

For a non–zero entry, performance predictions are based on step climbs at optimum points. For a zero entry, performance predictions are based on a constant CRZ ALT.

10 TAKEOFF

Push – displays the TAKEOFF REF page.

N422LA through N526LA



1 Gross Weight (GR WT)

Airplane gross weight can be entered by the flight crew or calculated by the FMC after entry of zero fuel weight.

Valid entry is thousands of kilograms with a decimal (hundreds) optional.

Entering the zero fuel weight first displays calculated gross weight.

Entry of a value after takeoff speeds are selected removes the speeds and displays the scratchpad message TAKEOFF SPEEDS DELETED.

2 FUEL

Fuel on board displays when the fuel totalizer calculations are valid. The source for the display is included in the line:

- SENSED – fuel quantity is from the totalizer.
- CALC (calculated) – fuel quantity is from FMC calculations. Manual entry is possible
- MANUAL – fuel quantity has been manually entered. Manual entries blank totalizer on PROGRESS page 2/3.

Valid entry is thousands of kilograms with a decimal (hundreds) optional.

Only manual entries can be deleted. The display returns to the sensed (totalizer) value when a manual entry is deleted.

3 Zero Fuel Weight (ZFW)

Normally, ZFW is entered from the airplane dispatch papers and the FMC calculates the airplane gross weight.

Valid entry is thousands of kilograms with a decimal (hundreds) optional.

Calculated zero fuel weight displays when airplane gross weight is entered first and fuel on board is valid.

Entry of a value after takeoff speeds are selected removes the speeds and displays the scratchpad message TAKEOFF SPEEDS DELETED.

ZFW may be manually entered or uplinked. When a performance uplink is pending, uplinked values (small font) display beside the entered values (large font).

4 RESERVES

Valid entry is thousands of kilograms with a decimal (hundreds) optional.

Can be manually entered or uplinked. When a performance uplink is pending, uplinked values (small font) display beside the entered values (large font).

5 Performance Initialization Request (REQUEST SEND)

Push – transmits a data link request for performance data uplink.

Flight crew can fill in ZFW, CG, cruise altitude, reserves or cost index to qualify request.

6 INDEX

Push – displays the INIT/REF INDEX page.

7 Cruise Altitude (CRZ ALT)

Cruise altitude can be entered by the flight crew or from a company route or uplink.

Entered value is displayed on the CLB and CRZ pages.

8 COST INDEX

Cost index is used to calculate ECON climb, cruise, and descent speeds. Larger values increase the ECON cruise speed. Entering zero results in maximum range airspeed and minimum trip fuel. Cost index can be entered by the flight crew or from a company route or uplink.

Valid entries are 0 to 9999.

9 **Cruise Center of Gravity (CRZ CG)**

Used by FMC to compute maximum altitude and maneuver margin to buffet.

Displays default center of gravity.

Can be manually entered or uplinked.

Default value displays in small font.

A flight crew entered or unlinked value displays in large font.

10 **STEP SIZE**

Displays the climb altitude increment used for planning the optimum climb profile.

Default value is ICAO which provides a 2000 foot step below FL290 and a 4000 foot step above FL290.

Valid manual entries are 0 to 9000 in 1000 foot increments.

In–flight entries are inhibited. In–flight step size changes are made on the CRZ page.

For a non–zero entry, performance predictions are based on step climbs at optimum points. For a zero entry, performance predictions are based on a constant CRZ ALT.

11 **TAKEOFF**

Push – displays the TAKEOFF REF page.

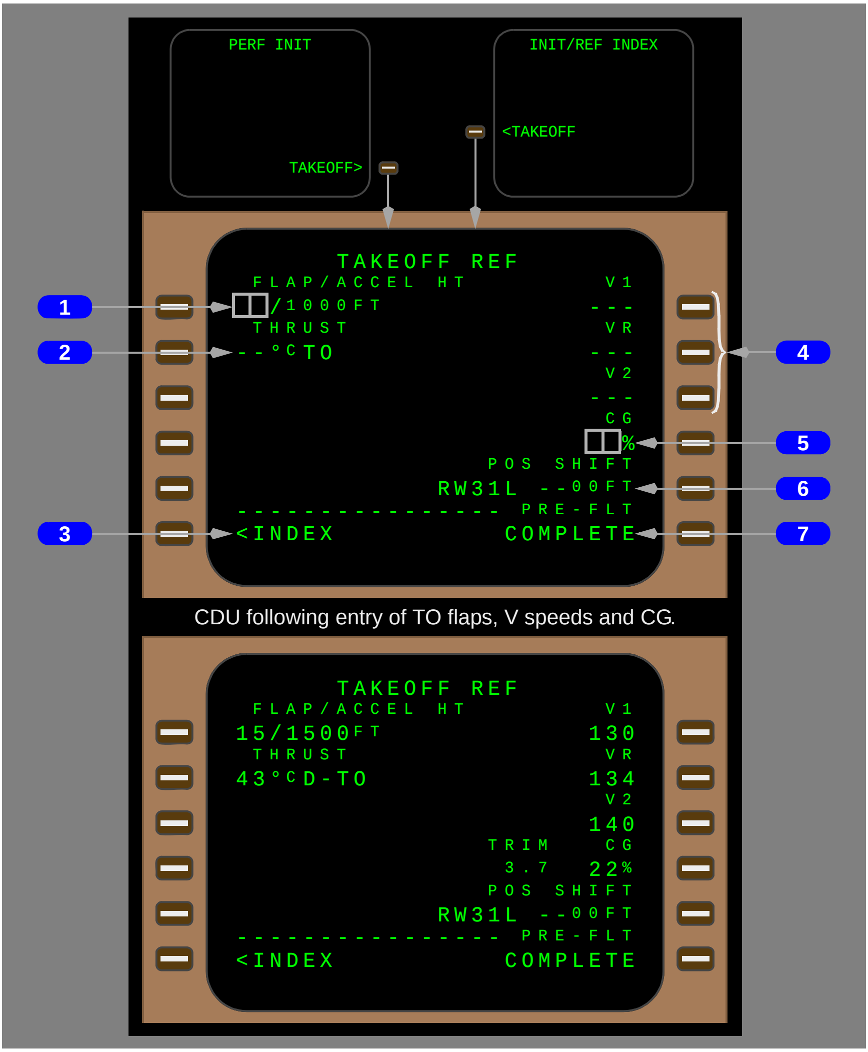
Takeoff Reference Page

The takeoff reference page allows the input of the final performance data required for takeoff. Entries on the takeoff reference page complete the normal FMC preflight. If any required preflight data has been omitted, a prompt is displayed to access the page where data is missing.

N422LA through N526LA
Takeoff reference page entries can be made manually or uplinked.

Takeoff Reference Page

N316LA



1 Flap/Acceleration Height (FLAP/ACCEL HT)

Enter a valid takeoff flap setting: 5, 15, or 20.

Entry of a value after takeoff speeds are entered removes the speeds and displays the scratchpad message TAKEOFF SPEEDS DELETED.

ACCEL HT displays the acceleration height in feet above the origin airport. VNAV commands acceleration at this altitude or at first flap retraction.

Default value is from the AMI.

Valid flight crew entries are from 400 to 9999 feet above the origin airport elevation.

2 THRUST

Initially displays dashes and the thrust reference mode.

If an assumed temperature value is entered on the thrust management select panel, the entered temperature is displayed here.

Allows entry of an assumed temperature which is used by the TMC. Entries can be made in degrees Celsius or Fahrenheit. Fahrenheit entries must be suffixed with an F. The entered value is displayed on EICAS.

Entry of a value after takeoff speeds are entered removes the speeds and displays the scratchpad message TAKEOFF SPEEDS DELETED.

3 INDEX

Push – displays the INIT/REF INDEX page.

4 V Speeds

Dashes are displayed before speeds are entered and when speeds have been deleted.

Flight crew entered speeds are displayed in large font. "V1" and "VR" are displayed on the ADI speed tape.

If performance data is changed or a new thrust rating is set on the TMSP after takeoff speeds are entered, the takeoff speeds are deleted, dashes are displayed, and the scratchpad message TAKEOFF SPEEDS DELETED is displayed.

5 TRIM, Center of Gravity (CG)

Valid entry is CG within the valid range.

After the CG is entered, the FMC calculates and displays the stabilizer takeoff trim setting to the left of the CG entry.

6 Position Shift (POS SHIFT)

Displays the departure runway from the active RTE page and allows entry of a distance between departure runway threshold and where the autothrottle will be engaged for takeoff.

The FMC updates its position to the departure runway threshold when the autothrottle is engaged for takeoff. If a position shift distance is entered, upon autothrottle engagement the FMC updates its position to that entered distance from the departure runway threshold.

If an intersection takeoff is planned, the intersection identifier or a positive value should be entered. If a displaced threshold takeoff is planned a negative value should be entered.

Valid position shift entries are from 99 to – 99 in hundreds of feet.

Entry of a value after takeoff speeds are selected removes the speeds and displays the scratchpad message TAKEOFF SPEEDS DELETED.

POS SHIFT update is inhibited when GPS is primary FMC navigation source (i.e GPS NAV is ON).

7 Pre-Flight (PRE–FLT) Status

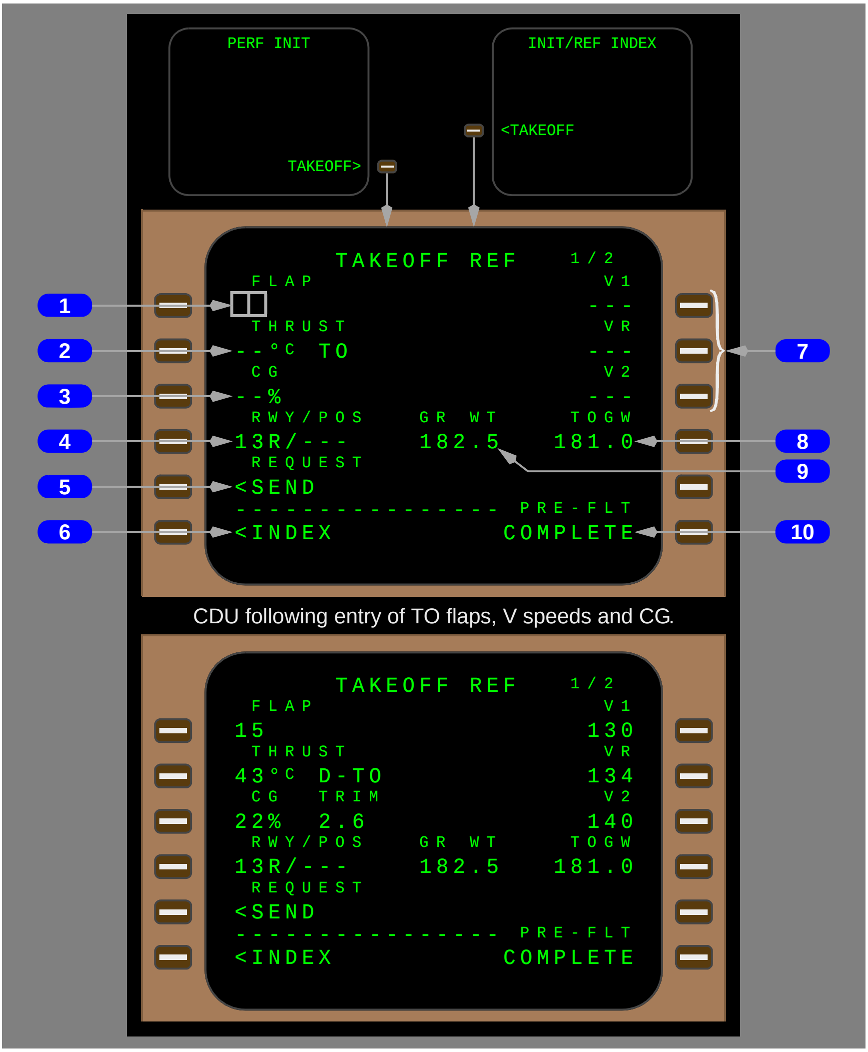
Displays COMPLETE if all required pre–flight entries have been made.

Displays a prompt to access a pre–flight page where further entries are required if pre–flight is not complete.

N422LA through N526LA

Note: Data entered on this page does not change the same data entered on previous preflight pages (i.e. entry of a runway in the RWY/POS line does not change the runway entered on the RTE page). Values entered by the flight crew on this page and downlinked is a request for takeoff data for the entered values.

N422LA through N526LA



1 Flap

Enter a valid takeoff flap setting: 5, 15, or 20.

Entry of a value after takeoff speeds are entered removes the speeds and displays the scratchpad message TAKEOFF SPEEDS DELETED.

2 THRUST

Initially displays dashes and the thrust reference mode.

If an assumed temperature value is entered on the thrust management select panel, the entered temperature is displayed here.

When dashes are displayed, allows entry of an assumed temperature which is used by the TMC. Entries can be made in degrees Celsius or Fahrenheit. Fahrenheit entries must be suffixed with an F. The entered value is displayed on EICAS.

Entry of a value after takeoff speeds are entered removes the speeds and displays the scratchpad message TAKEOFF SPEEDS DELETED.

3 Center of Gravity (CG), TRIM

Valid entry is CG within the valid range.

After the CG is entered, the FMC calculates and displays the stabilizer trim setting for takeoff.

4 Runway/Position Shift (RWY/POS)

Displays the departure runway from the active RTE page and allows entry of an offset distance between departure runway threshold and where the autothrottle will be engaged for takeoff.

If GPS navigation is not enabled (GPS NAV selected OFF), the FMC updates its position to the departure runway threshold when the autothrottle is engaged for takeoff. If a position shift distance is entered, upon autothrottle engagement the FMC updates its position to that entered distance from the departure runway threshold.

If an intersection takeoff is planned, the intersection identifier or a positive value should be entered. If a displaced threshold takeoff is planned a negative value should be entered.

Valid position shift entries are from 9900 to – 9900 in feet. The last two digits must be zeros.

Entry of a value after takeoff speeds are selected removes the speeds and displays the scratchpad message TAKEOFF SPEEDS DELETED.

5 Takeoff Data Request (REQUEST SEND)

Push – transmits a data link request for takeoff data uplink.

Flight crew entered data is included with the request.

6 INDEX

Push – displays the INIT/REF INDEX page.

7 V Speeds

Dashes are displayed before speeds are entered and when speeds have been deleted.

Flight crew entered speeds are displayed in large font. "V1" and "VR" are displayed on the ADI speed tape.

If performance data is changed or a new thrust rating is set on the TMSP after takeoff speeds are entered, the takeoff speeds are deleted, dashes are displayed, and the scratchpad message TAKEOFF SPEEDS DELETED is displayed.

8 Takeoff Gross Weight

Entry is included with the takeoff datalink request.

9 Gross Weight

Displays the airplane gross weight value from the PERF INIT page.

10 Pre-Flight (PRE–FLT) Status

Displays COMPLETE if all required pre–flight entries have been made.

Displays a prompt to access a pre–flight page where further entries are required if pre–flight is not complete.

Takeoff Reference Page 2

N422LA through N526LA

1 WIND

Valid entry is the takeoff wind.

Entry of a value after takeoff speeds are entered removes the speeds and displays the scratchpad message TAKEOFF SPEEDS DELETED.

2 Runway (RWY) WIND

Displays the takeoff runway wind components in knots once the wind is entered and a runway is entered on TAKEOFF REF page 1. The headwind is displayed with an H or T and the crosswind is displayed with an L or R.

3 Acceleration Height (ACCEL HT)

Displays the height that VNAV will begin an acceleration for flap retraction after takeoff. Default value from the navigation database is displayed in small font. Valid entry is 400 to 9999 feet. Pilot entered values are displayed in large font.

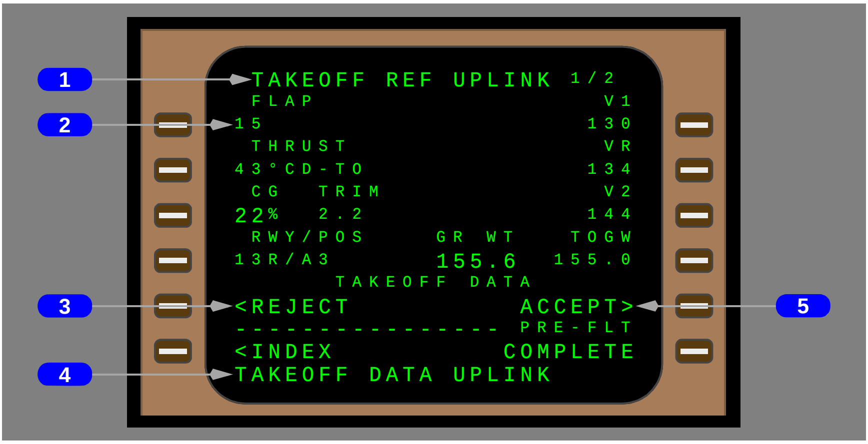
4 Reference Outside Air Temperature (REF OAT)

Allows entry of an outside air temperature. Entered value is used in V speed calculations and is included in the takeoff data request downlink.

Entry can be made in degrees Celsius or Fahrenheit. Fahrenheit entries must be include an F.

Takeoff Reference Uplink

N422LA through N526LA



1 TAKEOFF REF UPLINK

The page title changes to indicate UPLINK data is displayed.

2 Uplinked Data

Uplinked data is displayed in small font until it is accepted.

3 REJECT

PUSH – deletes uplinked data and returns pre–uplink data to display.

4 Scratchpad Message

The TAKEOFF DATA UPLINK message appears in the scratchpad when the uplink is received. The message is cleared when ACCEPT or REJECT is selected.

5 ACCEPT

Push – loads uplinked data and changes the small font displays to large font.

1 Alternate Takeoff Data (ALTN THR/FLAP)

Provides access to alternate takeoff data which is included in the takeoff uplink. Shows the thrust and flap setting used to calculate the alternate data.

PUSH – selects the alternate takeoff data and replaces all pending (small font) data on page 1 and 2 with the alternate data.The line title changes to STD THR/FLAP and the data line shows the thrust and flap setting used to calculate the standard takeoff uplink data.

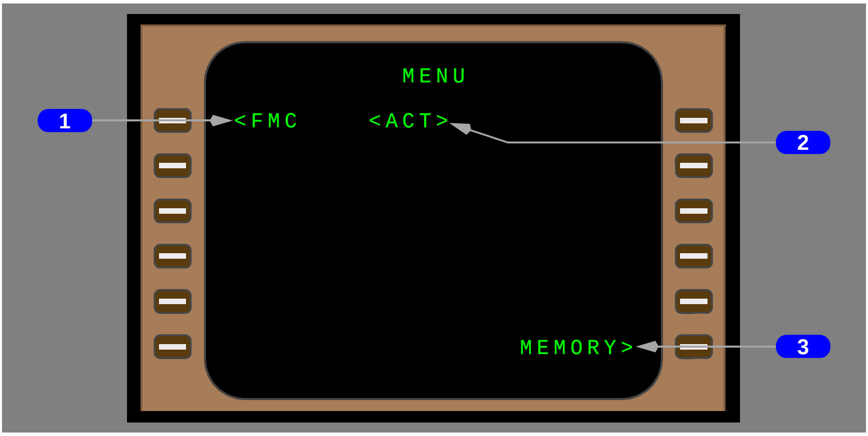
2 Standard Limit Takeoff Gross Weight (STD LIM TOGW)

Displays the limit takeoff gross weight used to calculate the standard uplink takeoff data. If alternate data is selected the line title displays ALT LIM TOGW.

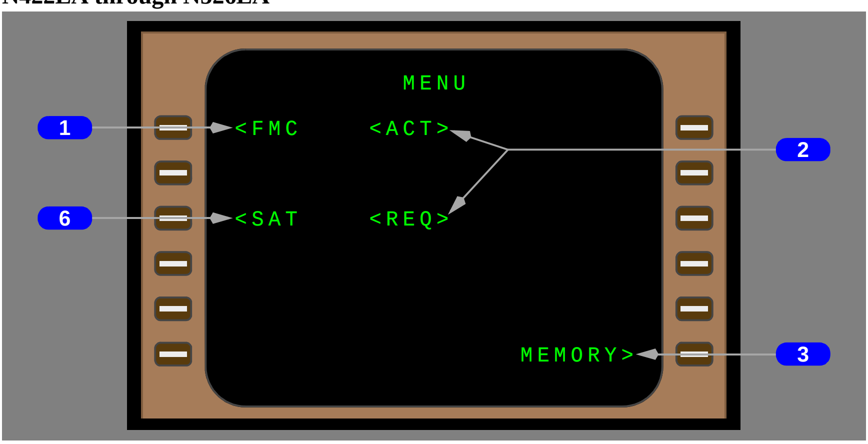
Menu Page

The MENU page allows access to other airplane systems which are controlled with the CDU.

N316LA



N422LA through N526LA



1 FMC

Push – connects FMC to CDU

2 CDU Status

- <ACT> – indicates system currently controlling CDU
- <REQ> – indicates inactive CDU function requiring pilot action
- blank – indicates function is not selected or requiring action.

3 **MEMORY (not displayed while airborne)**

Push – displays maintenance memory page, providing access to computer memory for maintenance while the airplane is on the ground

N422LA through N526LA

6 **SAT (Satellite Communications)**

Push –

- activates CDU control of SATCOM
- Displays SATCOM MAIN MENU page.

See Chapter 5, Communications.

Intentionally
Blank

Introduction

The takeoff phase of flight starts with the selection of takeoff thrust at the start of the takeoff roll.

If GPS navigation is not available the FMC position is updated to the takeoff runway position when the autothrottle is engaged for takeoff.

The takeoff mode of the autoflight system provides flight director guidance until LNAV and VNAV are engaged after takeoff. Preparation for this phase starts in the preflight phase and includes entry of the TAKEOFF REF page data.

The takeoff phase changes to the climb phase when climb thrust and VNAV are engaged. The climb phase continues to the top of climb point, where the cruise phase starts.

Takeoff Phase

When changes are made to the departure runway and SID, the DEPARTURES and TAKEOFF REF pages must be modified to agree. The modified data is entered the same as during preflight.

During takeoff, the autothrottle commands the selected thrust and the autoflight system provides pitch and roll commands through the flight director.

When armed before takeoff, LNAV engages at 50 feet radio altitude. When engaged, FMC roll commands fly the active route leg.

Climb Phase

When climb thrust and VNAV are engaged the FMC provides pitch commands to maintain the climb speed until the acceleration height is reached. At the acceleration height the FMC provides pitch commands to accelerate.

The VNAV commanded speed is limited by the airplane configuration. At acceleration height, VNAV commands a speed 5 knots below the flap placard speed.

Passing 10,000 feet, VNAV commands an acceleration to the economy climb speed, which is maintained until reaching the cruise altitude unless the climb profile contains other constraints.

During the climb, VNAV complies with the LEGS page waypoint altitude and speed constraints. A temporary level–off for a crossing altitude restriction is accomplished at the commanded speed.

If the climb speed profile results in a climb angle that will cause the airplane to miss a waypoint altitude constraint, the CDU scratchpad message UNABLE NEXT ALTITUDE is displayed. A different speed profile that gives a steeper climb angle must be selected.

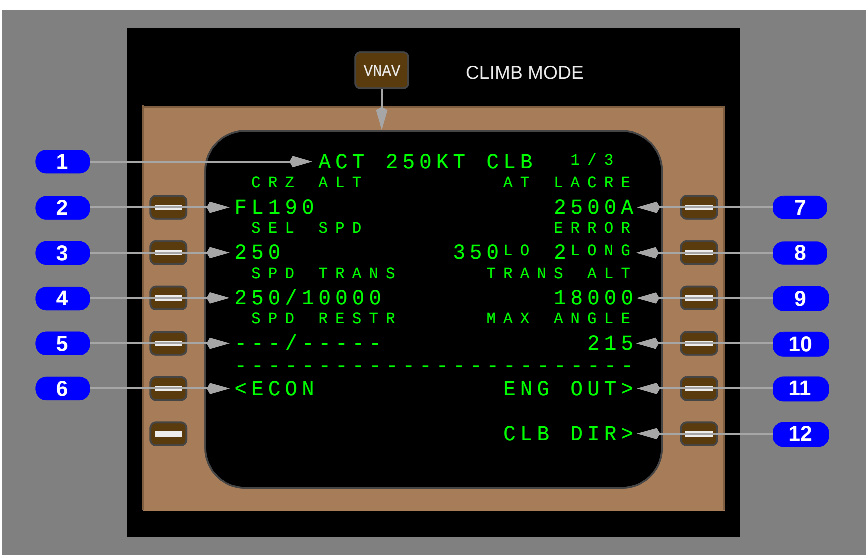
A decrease in airspeed may be observed during VNAV level off to cruise altitude if the rate of climb is high at the level off capture point. VNAV will continue a smooth level off and eventually accelerate to the selected cruise speed. During level off under these conditions, VNAV will not allow the airspeed to decrease below the best hold speed for that altitude, which is above the minimum maneuvering speed.

Climb Page

The climb page is selected by pushing the CDU VNAV function key while on the ground, during takeoff, or in climb.

The climb page is used to evaluate, monitor, and modify the climb path. The data on the climb page comes from preflight entries made on the route and performance pages, and from the FMC data bases.

The FMC manages the climb to comply with the active route. The climb mode is indicated by the CLB page title. The mode can be economy, selected speed, or engine out. In each mode, the same type of data is shown on the page.



1 Page Title

ACT is displayed when the climb phase is active.

The page title displays the type of climb:

- ECON – speed based on the cost index
- LIM SPD – speed based on airplane configuration limiting speed
- MCP SPD – MCP speed intervention selected
- EO – engine out mode selected
- XXXKT – fixed CAS climb speed profile
- M.XXX – fixed Mach climb speed profile.

Fixed climb speeds are for:

- climb segment constraints
- waypoint speed constraints
- an altitude constraint associated with a speed constraint
- a speed transition
- a flight crew selected speed.

2 Cruise Altitude (CRZ ALT)

Displays cruise altitude entered on PERF INIT page.

Valid entries are: XXX, XXXX, XXXXX, or FLXXX. Altitude displays in feet or flight level depending on transition altitude.

3 Economy Speed (ECON SPD), Selected Speed (SEL SPD)

ECON SPD

- economy speed based on cost index
- displays CAS and Mach values.

SEL SPD

- displayed when intermediate level off required below an existing speed constraint
- displayed when flight crew enters speed
- CAS or Mach value may be entered.

4 Speed Transition (SPD TRANS)

Displays the transition speed/altitude from one of these sources:

- the navigation database value for the origin airport
- a default speed of 250 knots and 10,000 feet.

Not displayed above the transition altitude.

Can be deleted.

5 Speed Restriction (SPD RESTR)

Speed restrictions not associated with specific waypoints are manually entered on this line.

Displays dashes before entry by flight crew.

Valid entry is a CAS and altitude (example 240/8000).

6 Economy (ECON)

Push – changes climb speed to ECON. Must be executed.

Prompt is shown on line 5L when the climb mode is not ECON.

7 Waypoint Constraint (AT XXXXX)

Displays next airspeed and/or altitude constraint at waypoint XXXXX.

FMC commands the slower of constraint speed or performance speed.

Constraints are entered on RTE LEGS page or are inserted as part of a SID.

Delete here or on RTE LEGS page.

Blank if no constraint exists.

8 ERROR at Waypoint

Displays altitude discrepancy and distance past waypoint where altitude will be reached.

Blank if no error exists.

9 Transition Altitude (TRANS ALT)

Transition altitude for origin airport contained in navigation database. FMC uses 18,000 feet if transition altitude is not available.

Manually change transition altitude here or on DESCENT FORECAST page.

Valid entries are XXX, XXXX, XXXXX, or FLXXX.

Altitude information displayed on the CDU changes from altitudes to flight levels above the transition altitude.

10 Maximum Angle (MAX ANGLE)

Maximum angle of climb speed.

Entry not allowed.

11 Engine Out (ENG OUT)

Push – modifies page to show engine out (ENG OUT) performance data.

12 Climb Direct (CLB DIR)

Push – deletes all waypoint altitude constraints between the airplane altitude and the MCP altitude. FMC cruise altitude is not affected.

Blank if no constraints exist.

Engine Out Climb

Engine out VNAV climb guidance is displayed on the EO CLB page. The EO CLB page must be selected and executed by the flight crew. Engine out data is available with all engines operating. Engine out climb (EO CLB) changes to engine out cruise (EO CRZ) at the top of climb.

Engine Out CLB Page

The modified page displays engine out performance limitations. Manual entries are allowed. After the modification is executed VNAV gives engine out guidance in the climb.

1 **Cruise Altitude (CRZ ALT)**

Displays cruise altitude if less than MAX ALT.

Displays MAX ALT if less than cruise altitude.

Manual entry is allowed.

2 **Speed Line**

Displays engine out best gradient climb speed (EO SPD) when page first selected. Any valid speed can be entered.

Valid entry is XXX for CAS.

Valid entry is 0.XXX for Mach. Trailing zeros can be omitted.

A manual entry changes the line heading to SEL SPD and may cause MAX ALT to change.

3 Engine Out Speed (EO SPD)

Push – resets command speed to best gradient speed. Blank when EO SPD is displayed on the speed line.

4 Maximum Altitude (MAX ALT)

Lower of maximum altitude at engine out climb speed or cruise speed.

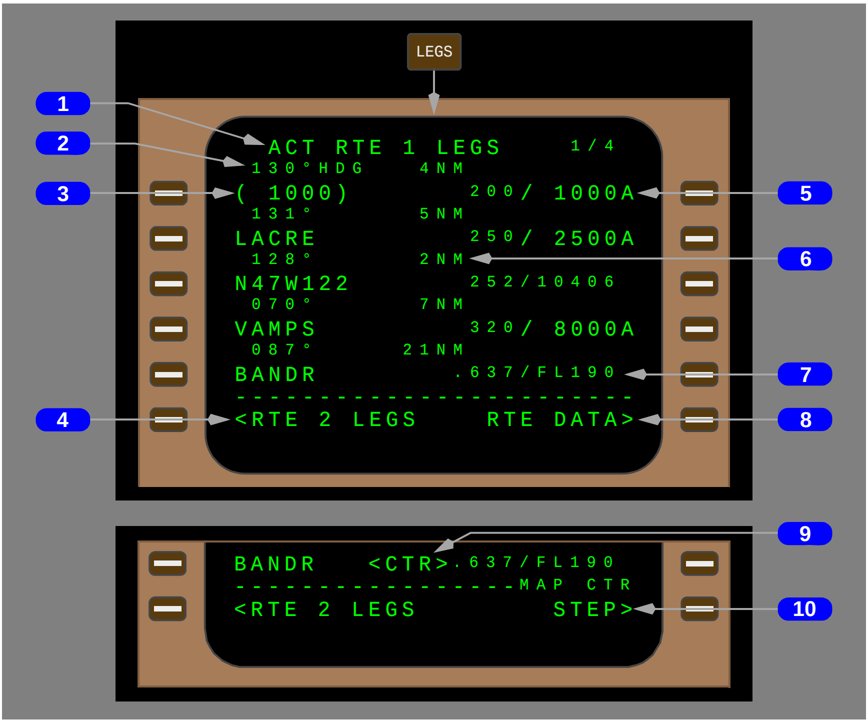
Entry not allowed.

5 All Engine (ALL ENG)

Push – modifies page to display all engine (ALL ENG) performance data.

Route Legs Page

The legs page is used to evaluate and modify the planned route of flight during the climb and to add or delete waypoint constraints to comply with the ATC clearance. The data on the climb page comes from preflight entries made on the route and departure pages, and from the FMC data bases.



1 Page Title

Title format shows route status:

- RTE X LEGS – inactive route
- ACT RTE X LEGS – active route
- MOD RTE X LEGS – modified active route.

2 Leg Direction

Leg segment data in line title:

- courses – magnetic (xxx°) or true (xxx° T)
- arcs – distance in miles, ARC, turn direction (example: 24 ARC L)
- heading leg segments – xxx° HDG

- track leg segments – xxx° TRK
- special procedural instructions from database – HOLD AT, PROC TURN.

Calculated great circle route leg directions may be different than chart values.

Dashes are shown for an undefined course.

3 Waypoint Identifier

Displays waypoints by name or condition.

Active leg is always the first line of the first active RTE X LEGS page.

All route waypoints are shown in flight sequence.

Waypoints can be modified. Examples:

- add waypoints
- delete waypoints
- change waypoint sequence
- connect route discontinuities.

Boxes are shown for route discontinuities.

Dashes are in the line after the end of the route.

4 Route 2 Legs (RTE 2 LEGS)

Push –

- displays the RTE 2 LEGS
- when RTE 2 LEGS page is shown, prompt changes to RTE 1 LEGS.

5 Waypoint Speed/Altitude Constraints

Waypoint speed or altitude constraint in large font.

Manual entry allowed in climb or descent phase. Entered by FMC when constraints are part of a procedure.

Speed constraint is assumed to be at or below the displayed speed.

Valid entries are:

- speed in airspeed or Mach
- altitude in thousands of feet or flight level (19000, 190)
- XXX/XXXXX – airspeed/altitude entered simultaneously
- XXX/ – airspeed only (requires an existing altitude constraint)
- XXXXX or /XXXXX – altitude only.

Altitude constraint suffixes:

- blank – cross at altitude
- A – cross at or above altitude
- B – cross at or below altitude

- both – altitude block. Example: 220A240B
- S – planned step climb (refer to Flight Management, Navigation, Cruise).

6 Distance to Waypoint

Distance from airplane to active waypoint or from waypoint to waypoint.

The first line displays the distance from the airplane to the active waypoint.

7 Waypoint Speed/Altitude Predictions

Waypoint speed and altitude predictions are displayed in small font.

Dashes are displayed in the descent region prior to descent path calculation. Descent path calculation requires altitude constraint below cruise altitude.

8 ACTIVATE, Route Data (RTE DATA)

Push – three possible prompts

- ACTIVATE – activates inactive flight plan; shows RTE DATA prompt
- RTE DATA (route data) – shows route data page
- CTR – see below

9 Center (<CTR>)

Displayed when PLAN mode selected.

Displayed adjacent to the waypoint around which plan mode is centered.

10 MAP Center (CTR) STEP

Replaces ACTIVATE or RTE DATA when PLAN mode selected.

Push – steps <CTR> to next waypoint. Plan mode recenters.

Engine Out Departure

1 Engine Out Standard Instrument Departure (EO SID)

Engine out SIDs can be created by the airline for specific runways. If there is an EO SID in the database for the departure runway it will be listed on the departures page after the runway is selected.

The FMC puts the EO SID into the route as a modification if:

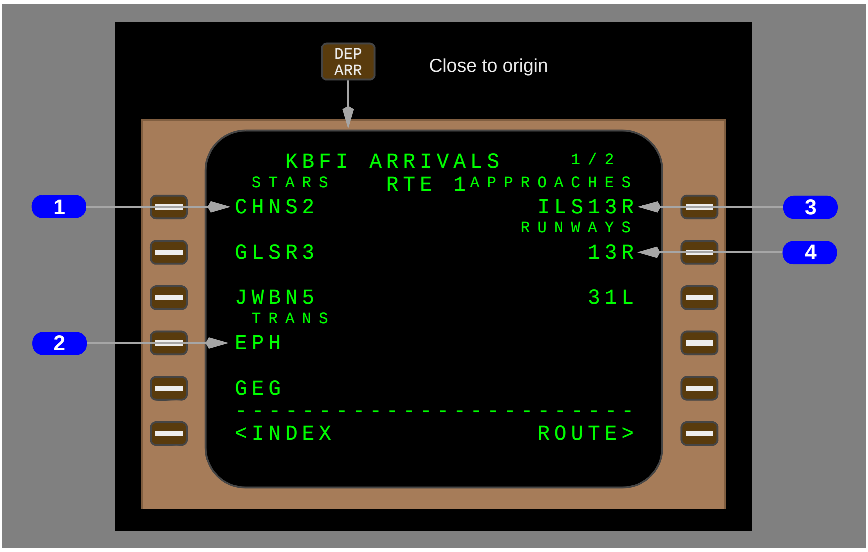
- an engine failure is sensed
- flaps are extended
- and the navigation database has an EO SID for the departure runway.

The modification can be executed or erased.

Air Turn–Back
Arrivals Page

During a turn–back situation, the flight crew requires quick access to the arrivals data for the origin airport. The arrivals page allows access without changing the destination on the route page.

During climb if the airplane is less than 400 miles from the origin and less that half way to the destination, push the DEP ARR key to show the ARRIVALS page for the origin airport.



1 Standard Terminal Arrivals (STARS)

Displays STARS for origin airport.

2 Transitions (TRANS)

Displays transitions for origin airport.

3 APPROACHES

Displays approaches for origin airport.

4 RUNWAYS

Displays runways for origin airport.

Intentionally
Blank

Introduction

The cruise phase starts at the top of climb.

During cruise, the primary FMC pages are:

- RTE X LEGS
- CRZ
- PROGRESS.

The RTE LEGS pages are used to modify the route. The CRZ pages display VNAV related data. The PROGRESS pages display flight progress data. During cruise, the specific page listed below is used to:

- POS REF page – verify the FMC position
- RTE DATA page – display progress data for each waypoint on the RTE LEGS page
- REF NAV DATA page – display data about waypoints, navaids, airports, or runways, and can be used to inhibit navaids
- RTE X page – select a route offset
- FIX INFO page – display data about waypoints. Page data can be transferred to other pages to create new waypoints and fixes
- SELECT DESIRED WAYPOINT page – shows a list of duplicate waypoints from the navigation database. The flight crew selects the correct waypoint from the list
- POS REPORT page – display data for a position report.
- WINDS page – enter forecast wind and temperature

The CLB page changes to CRZ at the top of climb. The CRZ CLB and CRZ DES pages change to CRZ at the new cruise altitude. The CRZ page changes to DES at top of descent.

LNAV Modifications

This section shows typical techniques to modify the route. The modifications include:

- add and delete waypoints
- change waypoint’s sequence
- connect discontinuities
- intercept a course.

RTE LEGS Page Modifications

Modifications to the LNAV route are usually made on the RTE LEGS page. When the route is modified, MOD is displayed in the title and the execute light is illuminated.

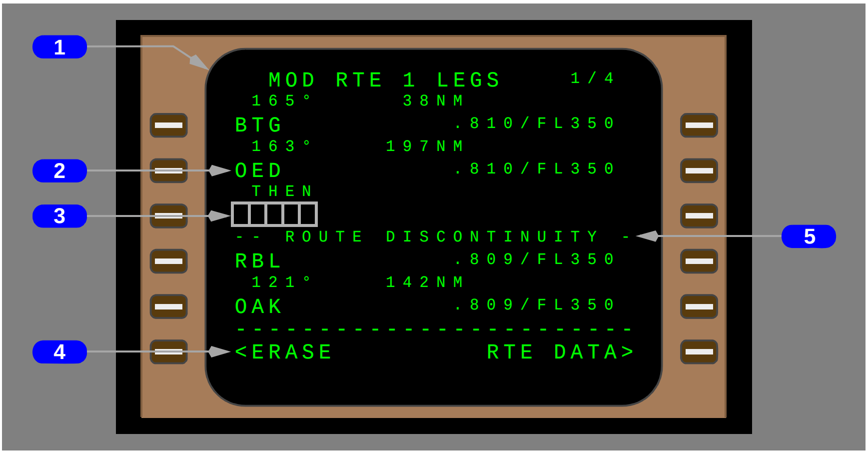
Add Waypoints

Waypoints can be added to the route at any point. Added waypoints are followed by route discontinuities.

First, enter the waypoint name in the scratchpad.

Second, locate the correct line in the flight plan and push the adjacent line select key. The scratchpad waypoint name is put into the selected line. The entered waypoint is connected to the waypoint above it via a direct route. A route discontinuity follows the waypoint.

For example, OED is typed into the scratchpad. Push line select key 2L to put OED into line 2. The FMC assumes BTG direct OED. RBL and the rest of the flight plan are kept but, are put after the route discontinuity.



1 Page Title

MOD – replaces ACT when modification is in progress.

ACT – replaces MOD when ERASE is selected or execute key is pushed.

2 Modified Waypoint

OED waypoint entered into the route after BTG. Modification creates a route discontinuity because OED was not in the active route. The FMC now requires routing beyond OED.

3 Discontinuity Waypoint

Discontinuity is corrected when applicable waypoint is entered in boxes.

4 ERASE

Push – removes all modifications and shows active data.

Displayed when the FMC contains modified data.

Removed when selected or the modifications are executed.

5 ROUTE DISCONTINUITY

Line title separates route segments when there is a discontinuity.

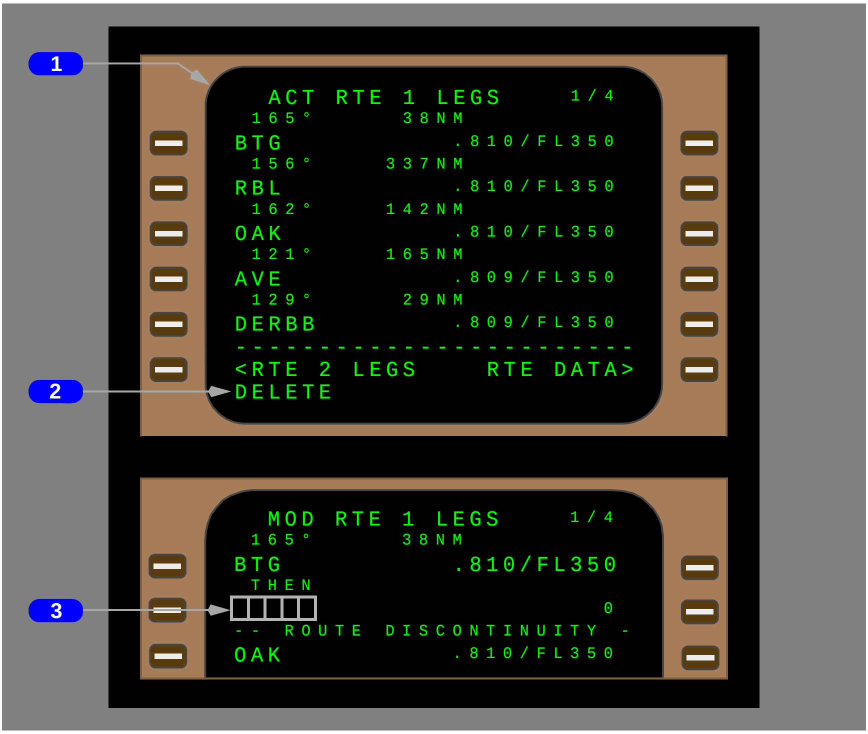
Note: Performance predictions to destination on the PROGRESS page are calculated assuming the route of flight is direct between waypoints on either side of a route discontinuity.

Delete Waypoints

Use the RTE LEGS page to remove waypoints from the route. The active waypoint can not be deleted. Two methods to remove a waypoint are:

- delete the waypoint with the DEL function key
- change the waypoint's sequence.

The data in the route before the deleted waypoint does not change. A discontinuity is put in the route when the DEL function key is used to remove a waypoint.



1 **Active Route**

The active route shows RBL followed by OAK and AVE.

2 **DELETE Entry**

Pushing the DEL function key arms the delete function and selects DELETE to the scratchpad.

3 **Route Discontinuity**

With DELETE in the scratchpad, pushing the line select key for RBL deletes the waypoint. Boxes replace RBL and a route discontinuity is displayed.

Change Waypoint Sequence

Waypoints moved from one position in the flight plan to another do not cause route discontinuities.

The waypoint may be manually typed or copied from any of the RTE LEGS pages. To copy the waypoint, push the line select key adjacent to the waypoint.

The example below shows the flight plan being modified to fly from BTG direct OAK. Push the line select key adjacent to OAK to put OAK in the scratchpad. Push the line select key adjacent to RBL. RBL is removed from the flight plan and the routing is direct from BTG to OAK to AVE. The modification does not cause a route discontinuity. Several waypoints can be removed from the flight plan at a time with this method.

1 Active Route

The active route shows RBL followed by OAK and AVE. The clearance is to fly from BTG direct OAK. The OAK waypoint is selected to the scratchpad.

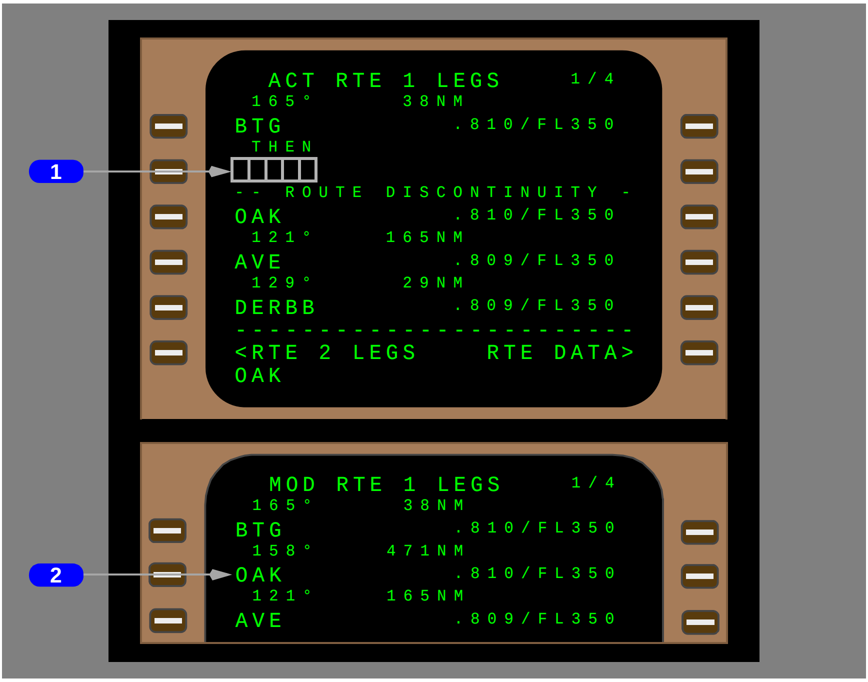
2 Change OAK’s Sequence

OAK is selected to the waypoint after BTG. RBL is removed with no discontinuity.

Remove Discontinuities

A discontinuity exists when two waypoints are not connected by a route segment.

To remove a discontinuity, copy the subsequent waypoint from the route into the scratchpad and enter it into the discontinuity.



1 Route Discontinuity

The active route has a discontinuity after BTG. The example shows how to fly direct from BTG to OAK. Copy OAK to the scratchpad. Any subsequent waypoint in the route can be selected to the scratchpad to remove the discontinuity.

2 Continuous Route

Select OAK to the boxes to remove the discontinuity.

If a waypoint which does not already exist on the route is entered into the boxes the discontinuity moves one waypoint further down the route.

Direct To And Intercept Course To

If the airplane is not on the active leg segment, LNAV may deactivate or it may not activate when armed. This happens after the airplane crosses a discontinuity, or is not on an intercept heading to the active leg segment. Here are three ways to arm or activate LNAV:

- When the airplane is within 2.5 miles of the active leg, push the LNAV switch. LNAV activates and intercepts the active route leg
- When more than 2.5 miles from the active leg, push the LNAV switch when the airplane is on an intercept heading to the active route leg. Initially, LNAV arms and then activates as the airplane approaches the active leg. An intercept heading must intersect the active leg inbound before the active waypoint
- Fly direct to a waypoint or intercept a course to a waypoint. Enter a waypoint in the RTE LEGS page active waypoint line to fly direct. Use the INTC CRS prompt in line 6R to create an intercept course to the waypoint. When the modification has been executed, push the LNAV switch and LNAV arms or activates, depending on the distance from the active leg.

Modification of the Active Waypoint

The following example shows a modification to go direct to a waypoint using the RTE LEGS page. After vectors off the original route a clearance is received to proceed direct to BTG.

1 Course to Active Waypoint

Prior to execution, displays direct–to inbound course at waypoint; changed by entry in INTC CRS line or by selecting intercept course.

After execution, displays current required track to fly inbound course to waypoint.

2 Active Waypoint

Displays crew entered direct/intercept waypoint. If entered waypoint is not part of the active route it will be followed by a discontinuity.

3 ABEAM Points (PTS)

Push –

- creates abeam points on new route to indicate waypoints bypassed by direct to function
- abeam points are perpendicular to the waypoints bypassed
- line title displays ABEAM PTS, line data displays SELECTED
- subsequent route modifications remove ABEAM PTS prompt.

4 Route (RTE) COPY

Push –

- copies active unmodified route into inactive route
- erases previous inactive route
- line title displays RTE COPY, line data displays COMPLETE
- subsequent route modifications remove RTE COPY prompt.

5 Intercept Course (INTC CRS) TO

Displays boxes if entered waypoint not in the active route.

Displays current route course and prompt caret if the entered waypoint is in the active route. Allows entry of a different inbound course via the scratchpad.

When boxes displayed, valid entry is intercept course from 000 to 360.

Push –

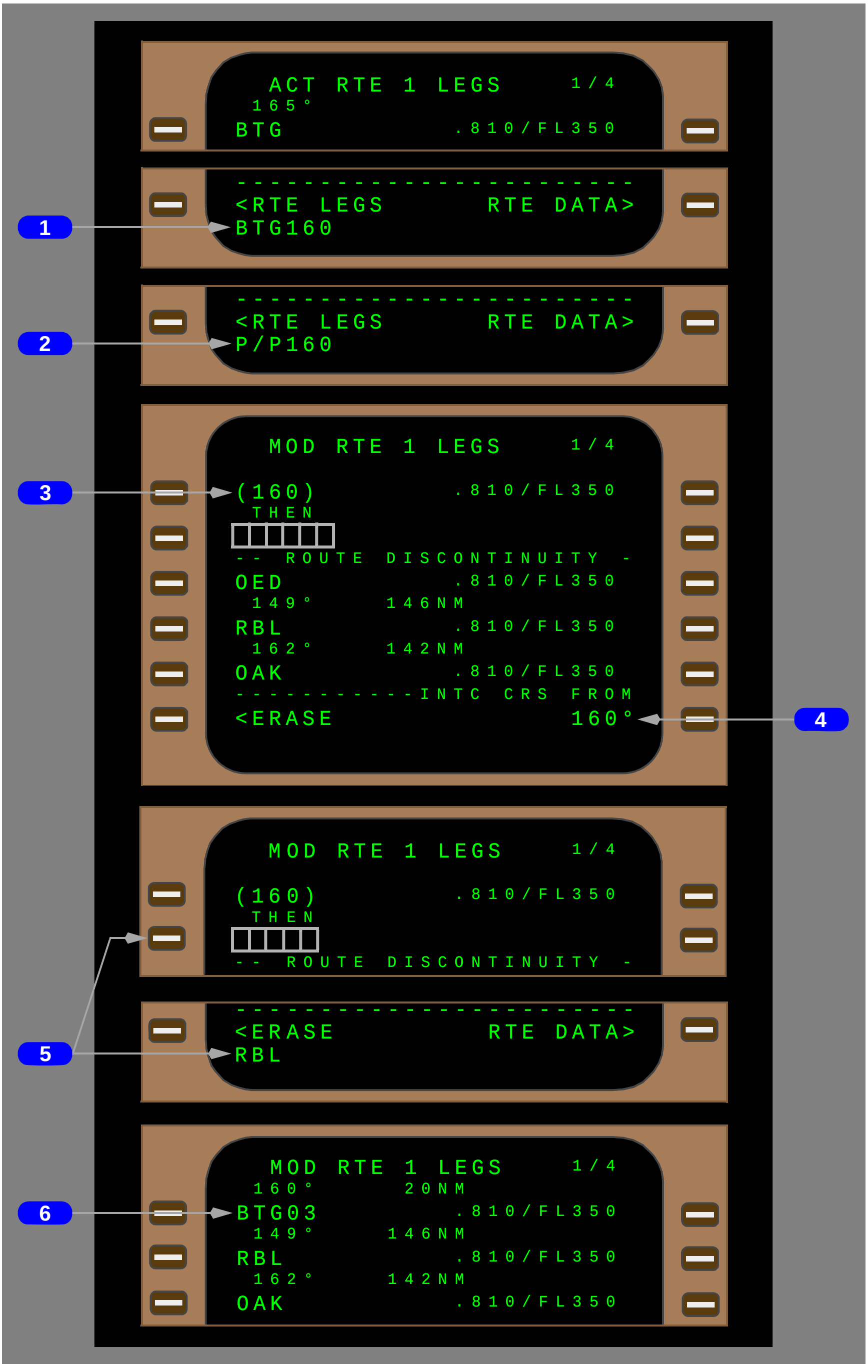
- when course displayed, selects current route course as intercept course to active waypoint
- when course is displayed and a different course has been entered in the scratchpad, the scratchpad value is entered as the intercept course to the active waypoint
- selection or entry is displayed as the course to the active waypoint
- selection or entry removes ABEAM PTS and RTE COPY prompts.

Intercept Course From

The steps to create an intercept course from a waypoint are nearly the same as the steps for an intercept course to. The waypoint name in the scratchpad is suffixed with the outbound course.

An intercept course can be created outbound from a waypoint in the navigation data base or from present position. The waypoint does not have to be in the route. Entering a waypoint and course pair in the active waypoint line displays the INTC CRS FROM prompt. The FMC calculates a route leg with the waypoint as the origin of the entered course.

The following example demonstrates entering a 160° course from BTG. BTG160 is entered in the scratchpad. When this entry is line selected to the active waypoint line, the entered course is displayed as a conditional waypoint.


ACT RTE 1 LEGS 1/4
165°
BTG .810/FL350
<RTE LEGS RTE DATA>
BTG160
<RTE LEGS RTE DATA>
P/P160
MOD RTE 1 LEGS 1/4
(160) .810/FL350
THEN
-- ROUTE DISCONTINUITY -
OED .810/FL350
149° 146NM
RBL .810/FL350
162° 142NM
OAK .810/FL350
-----------INTC CRS FROM
<ERASE 160°
MOD RTE 1 LEGS 1/4
(160) .810/FL350
THEN
-- ROUTE DISCONTINUITY -
<ERASE RTE DATA>
RBL
MOD RTE 1 LEGS 1/4
160° 20NM
BTG03 .810/FL350
149° 146NM
RBL .810/FL350
162° 142NM
OAK .810/FL350
1
2
3
4
5
6

1 Waypoint and Outbound Course

Enter the waypoint name and outbound course in the scratchpad.

2 Present Position and Outbound Course

Enter P/P and outbound course in the scratchpad.

3 Active Outbound Course Entry

After the active waypoint line is selected, the outbound course is displayed. The waypoint name is not used.

For example, BTG160 is entered into the active waypoint line. The FMC calculates a new route leg with BTG as the origin on a outbound course of 160°.

4 Intercept Course From (INTC CRS FROM)

Displays outbound course from the entered waypoint. Allows input of a different outbound course until the modification is executed.

Valid entry is any course from 000° through 360°.

5 Next Waypoint

Enter a down track waypoint into the boxes. To resolve the discontinuity the waypoint must be part of the active route and the inbound course to that waypoint must be intersected by the entered course.

6 Created Waypoint

If the 160° course intercepts the course inbound to the entered waypoint, a new waypoint is created at the intercept point. Line selecting the new waypoint results in a place, bearing, distance format in the scratchpad.

SELECT DESIRED Waypoint (WPT) Page

The SELECT DESIRED WPT page is displayed when a waypoint identifier or name is entered and the navigation database contains more than one location for that name. Selection of a waypoint returns the display to the previous page.

1 Identifier

Displays a list of the waypoints in the navigation database that have the same identifier as entered.

Up to 48 waypoints (8 pages) can be listed.

Waypoints are sorted as follows:

- when page is accessed as a result of a flight plan entry or modification, sort is based on proximity to the waypoint preceding the entered waypoint
- when page is accessed as a result of a DIR/INTC, FIX INFO, or REF NAV DATA entry, sort is based on proximity to current aircraft position.

Select the desired waypoint by pushing either the left or right line select key adjacent to the waypoint. The CDU page where the waypoint identifier was entered is redisplayed with the selected waypoint inserted.

2 Frequency

Displays frequency of the waypoint if it is a navaid. Blank if the waypoint is not a navaid.

3 Type

Displays the type of waypoint for each duplicate name.

4 Latitude/Longitude

Displays the latitude/longitude for each duplicate name.

Airway Intercept

Just as in intercept to, LNAV can be used to intercept an airway. An airway intercept changes the active waypoint on the RTE and LEGS pages.

Enter the airway identifier under VIA on line 1 of the RTE page. Boxes display under TO. Enter the desired airway exit waypoint in the boxes. For this open–ended airway intercept, the FMC selects the waypoint preceding the closest abeam location as the starting waypoint of the airway. This waypoint is displayed on line 1. The entered airway and the desired exit point are displayed on line 2. When the modification is executed the leg inbound to the FMC selected starting waypoint becomes the active leg.

If the clearance heading intercepts the active leg segment, LNAV can be armed and the intercept will occur. In most airway intercept situations, the commanded heading will not intercept the active leg.

If the clearance heading does not intercept the active leg segment, use the intercept–course–to procedure to make the course inbound to the waypoint after the crossing location the active leg segment.

Example

The active route is direct to EPH, then direct to MWH. ATC clears the airplane to:

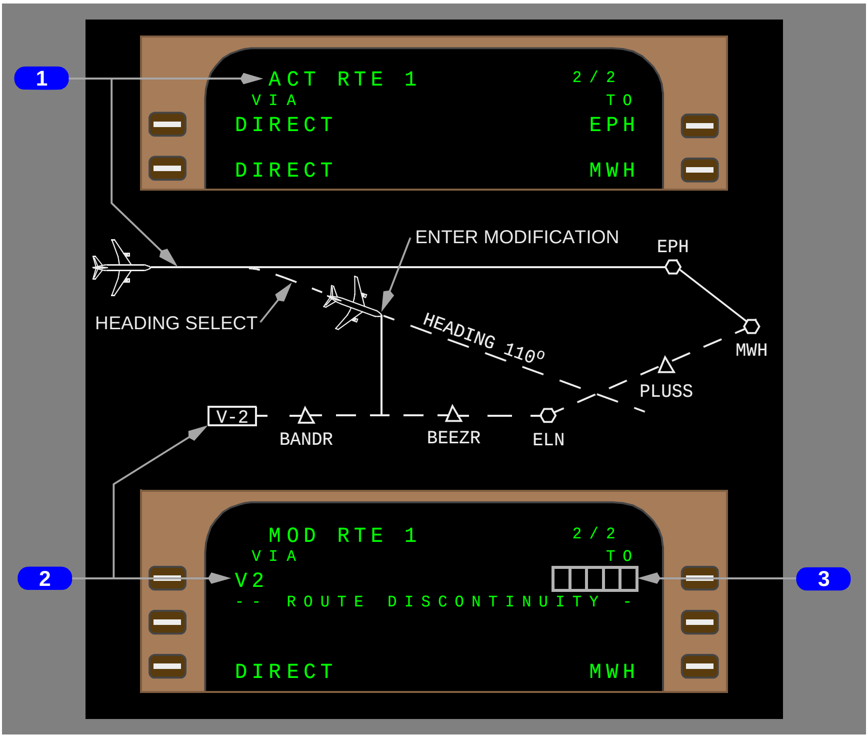
- turn right heading 110°
- intercept V2 to MWH.

Following the V2 modification to MWH and execution, the LEGS page displays this waypoint sequence:

- BANDR
- BEEZR
- ELN
- PLUSS
- MWH.

Modify the LEGS page using a course intercept to the waypoint after the crossing location. In this case, it would be PLUSS. PLUSS becomes the active waypoint on the V2 airway. The LEGS page now displays:

- PLUSS
- MWH.



1 **Active RTE 1 Page**

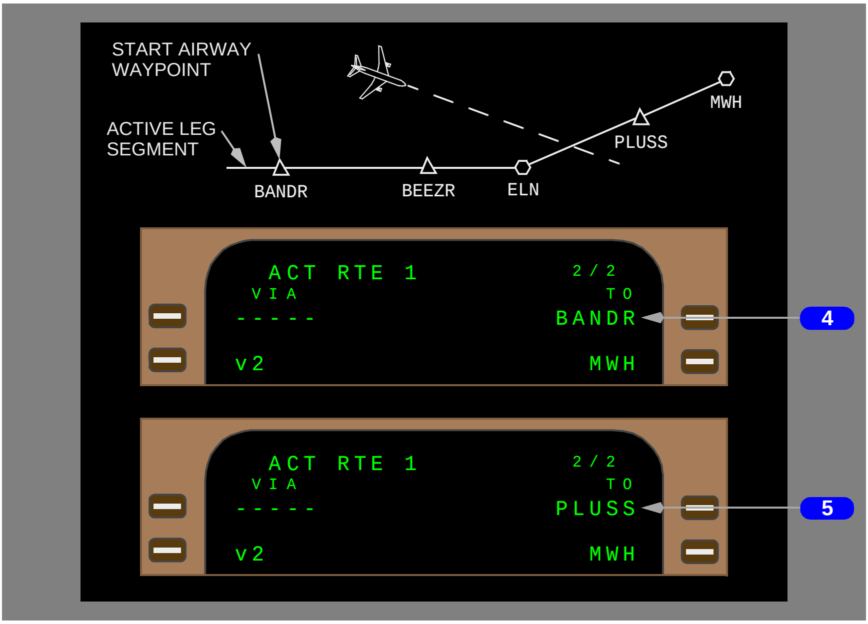
The route page before the ATC clearance.

2 **Input Airway**

Enter the airway in the first VIA position on the RTE page. Boxes display in the TO position. A route discontinuity follows on the next line.

3 **Airway Exit**

Enter desired airway exit point in the boxes.



4 Start Airway Waypoint

After entering MWH in the boxes:

- the FMC selects BANDR as the airway start waypoint
- the airway line moves down one line
- dashes are shown in the VIA to the start airway waypoint.

5 New Active Waypoint

Following modification and execution of the course intercept procedure to PLUSS, the LEGS page displays PLUSS as the active waypoint. LNAV can be armed and the airway intercept can be completed.

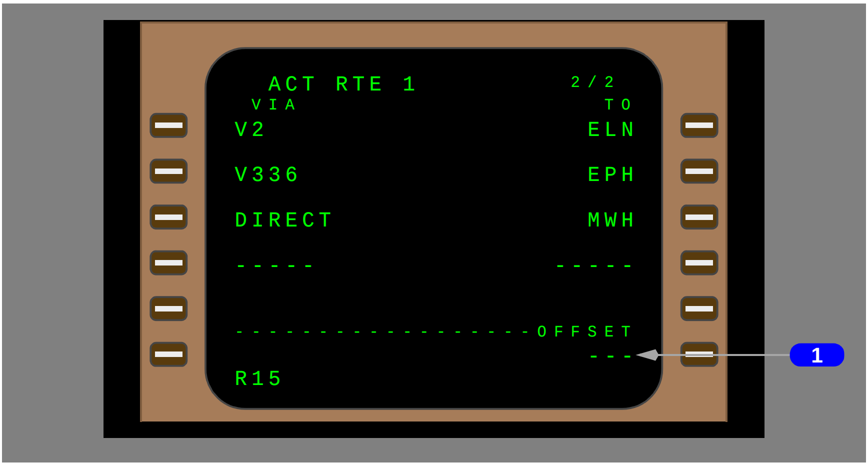
Route Offset

Route offsets are selected on the RTE page. The OFFSET prompt is displayed on the RTE page when the airplane is airborne and not on a SID, STAR, or transition. Entering a distance value into the OFFSET dashes creates the selected offset. An offset propagates along the route from the active waypoint until a discontinuity, approach, approach transition, holding pattern, course change of greater than 135°, or end of route is reached. An offset can be removed by deleting the offset, proceeding direct, or entering an offset value of zero.

The offset is shown as a white dashed line on the map display until the offset modification is executed or erased.

After execution, the offset route is shown as a dashed magenta line on the map display. The original route remains a solid magenta line.

If LNAV is engaged when the offset is executed, the airplane turns to an intercept heading and captures the offset course.



1 OFFSET

Enter the necessary offset. When executed, the CDU offset (OFST) light illuminates.

Valid entries are L (left) or R (right) followed by a distance from 0 to 99 in nautical miles.

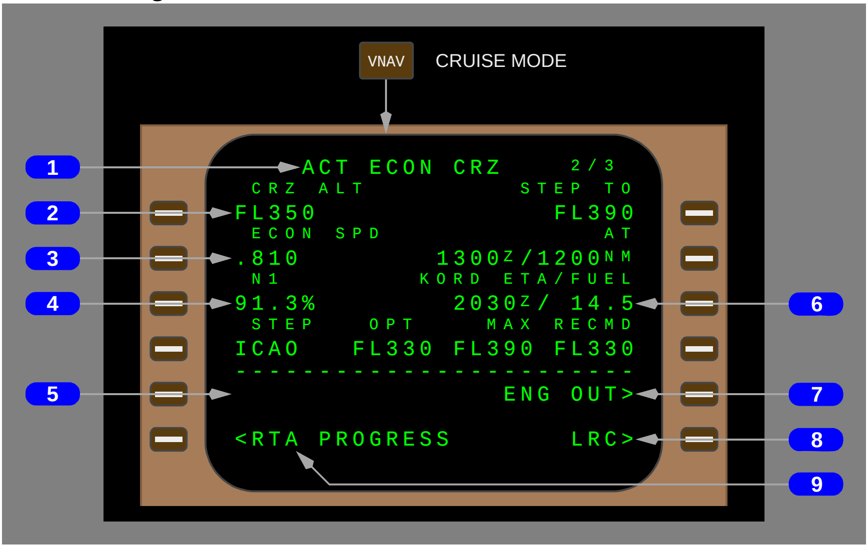
Cruise Page

All Engine Cruise

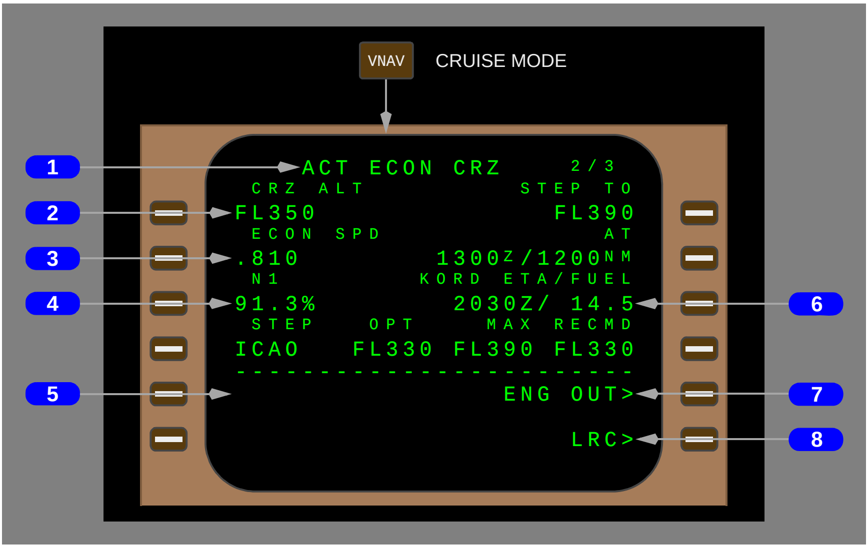
The cruise page is used to monitor and change cruise altitude and speed. Speed changes can be manually selected or automatically selected with the selection of other VNAV modes. Cruise climbs, cruise descents, and step climbs can be accomplished from the cruise page.

When using the economy mode, page data is based on operating at ECON SPD. Economy cruise speed is based on cost index. When the flight crew enters a selected speed, page data changes. When the FMC is in the engine out mode, the data changes to include the airplane capabilities with one engine inoperative. The long range cruise (LRC) mode calculates speeds to maximize airplane range.

N422LA through N526LA



N316LA



1 Page Title

The page title displays active (ACT) or modified (MOD) cruise. Usually, the title contains ECON for economy cruise. Fixed speed, engine out, and long range cruise modify the title.

Page titles include:

- CO – engine out mode and company speed selected
- CRZ CLB or CRZ DES – cruise climb or descent
- ECON – speed based on cost index
- EO – engine out mode selected
- EO D/D – engine out drift down displays when EO selected and the airplane altitude is above the maximum altitude for engine out performance
- LIM SPD – based on an airplane configuration limiting speed
- LRC – long range cruise selected
- MCP SPD – speed intervention applied from the MCP
- M.XXX – fixed Mach cruise speed
- XXXKT – fixed CAS cruise speed.

Fixed cruise speeds are for:

- waypoint speed constraints
- an altitude constraint associated with a speed constraint
- a flight crew selected speed (SEL SPD).

2 Cruise Altitude (CRZ ALT)

Displays cruise altitude entered on PERF INIT page.

Valid entries are: XXX, XXXX, XXXXX, OR FLXXX. Altitude displays in feet or flight level depending on the transition altitude. Changing the MCP altitude enters the new altitude in the scratchpad for entry. Entry creates a modification.

When the modification is executed the page title changes to CRZ CLB or CRZ DES.

N422LA through N526LA
Changing the MCP altitude and pushing the altitude selector enters the MCP altitude as the active cruise altitude, without creating a modification.

3 Economy Speed (ECON SPD), Selected Speed (SEL SPD)

Displays target speed or Mach.

Allows entry of any valid speed or mach number. MOD displays in the page title until the modification is erased or executed.

A manually entered speed changes the line title to SEL SPD.

ECON can be replaced with LRC or company speed (CO SPD), depending on the VNAV mode.

4 N1

Displays N1 necessary for level flight at the target airspeed.

5 Economy (ECON)

Push – selects economy cruise speed.

Displayed when speed or Mach is not ECON.

6 Destination ETA/FUEL

Estimated time of arrival and calculated fuel remaining at the destination.

Displays the same data for the alternate airport when a DIVERT NOW modification is selected from the ALTN page.

Calculations are based on optimum step climbs and cruise altitudes.

7 Engine Out (ENG OUT)

Push –

- displays engine out cruise page
- commands engine out performance calculations
- changes CRZ ALT if above maximum engine out altitude

- changes target speed to engine out speed
- upon execution, thrust reference mode changes to CON.

8 Long Range Cruise (LRC)

Push – displays long range cruise page.

N422LA through N526LA

9 Required Time Of Arrival (RTA) PROGRESS

Push – displays RTA PROGRESS 3/3.

Engine Out Cruise

Engine out VNAV cruise guidance displays on the EO CRZ page. Engine out data is also available with both engines operating.

The initial page data includes engine out performance limitations. Manual entries are allowed. When above the maximum engine out cruise altitude, VNAV calculates engine out (EO) guidance for drift down (D/D). The EO D/D page changes to the EO CRZ page when reaching the engine out cruise altitude. Subsequent engine out cruise climb or descent is accomplished the same as two engine cruise climb or descent.

As the airplane gross weight decreases, maximum altitude increases. A step climb may be possible under these conditions.

The example is based on a cruise altitude above the maximum engine out altitude. When ENG OUT is first selected, the default speed is EO SPD.

1 Page Title

Displays EO D/D (for this example, airplane is above MAX altitude).

Displays MCP SPD D/D when controlling to a manually entered speed during the driftdown.

Displays EO LRC (long range cruise) D/D when LRC selected during driftdown.

Displays EO LRC when in level cruise flight and the LRC speed is selected.

Displays EO CRZ CLB or EO CRZ DES during engine out cruise climbs or descents and the airplane is below the engine out maximum altitude.

2 Cruise Altitude (CRZ ALT)

Displays altitude from MAX ALT line when current CRZ ALT above MAX ALT.

Manual entry of an altitude above maximum engine out altitude results in the scratchpad message, "MAX ALT FLXXX".

Valid entries are the same as all engine cruise page.

3 Engine Out Speed (EO SPD)

Displays the target speed or Mach.

Manual entry is allowed.

Valid entries are the same as all engine cruise page.

A manually entered speed changes the line title to SEL SPD.

ECON can be replaced with long range cruise (LRC), company (CO SPD), or engine out (EO SPD) speed using prompts at the bottom of the page.

Selecting any speed shows engine out speed (EO SPD) as a select prompt at 6L.

Manual entries may change MAX altitude.

4 Company Speed (CO SPD)

Push – Modifies the page with company speed, engine out data from the Airline Policy page.

5 Engine Out (EO SPD)

Push – enables execution of engine out minimum drag speed profile.

Display when EO LRC, EO SEL SPD, or CO SPD is the active speed mode.

6 Optimum, Maximum and Recommended Altitude (OPT MAX RECMD)

OPT – displays the most economical altitude based on airplane gross weight.

MAX – displays the maximum cruise altitude based on:

- engine out operation
- selected speed option
- without any altitude or speed constraints, and
- capable of a 100 feet per minute climb rate.

RECMD – displays the most economical altitude based on airplane performance and winds.

7 ALL Engine (ENG)

Push – displays a MOD XXX CRZ page with performance based on both engines operating.

Selection and execution allows subsequent selection of two engine economy VNAV modes.

8 Long Range Cruise (LRC)

Push – enables execution of engine out long range cruise.

Displayed when EO or SEL SPD is the active mode.

VNAV Modifications

During the cruise phase, VNAV can calculate two types of climbs: cruise and step climbs. Cruise and planned climbs can be entered by the flight crew. Optimum step climbs are calculated by the FMC. In all cases, the new climb altitude must be selected in the MCP altitude window before VNAV commands the climb.

Cruise Climb

N422LA through N526LA
Select a higher MCP altitude and push the MCP altitude selector to start a cruise climb. The FMC CRZ ALT changes to the MCP altitude. VNAV starts a climb with CLB as the thrust limit and VNAV SPD as the pitch flight mode annunciation.

N422LA through N526LA
Another method to start a cruise climb: select a higher MCP altitude, enter the altitude into the CRZ ALT line, then execute.

N316LA
To initiate a cruise climb set the higher altitude on the MCP, then enter the altitude in the CRZ ALT line and execute. When the CRZ page is displayed, the new MCP altitude is automatically copied to the scratchpad to be line selected to the CRZ ALT line.

1 During Cruise Climb

VNAV page title displays ACT ECON CRZ CLB in a climb to a new cruise altitude. ECON is replaced by an indication of the selected speed if other than ECON.

2 End of Cruise Climb

VNAV page title displays ECON CRZ after level off at cruise altitude.

Planned Step Climb

When a step climb is planned to start at a waypoint, the data can be entered on the RTE LEGS page. The FMC performance predictions assume the airplane will start the climb at the identified waypoint.

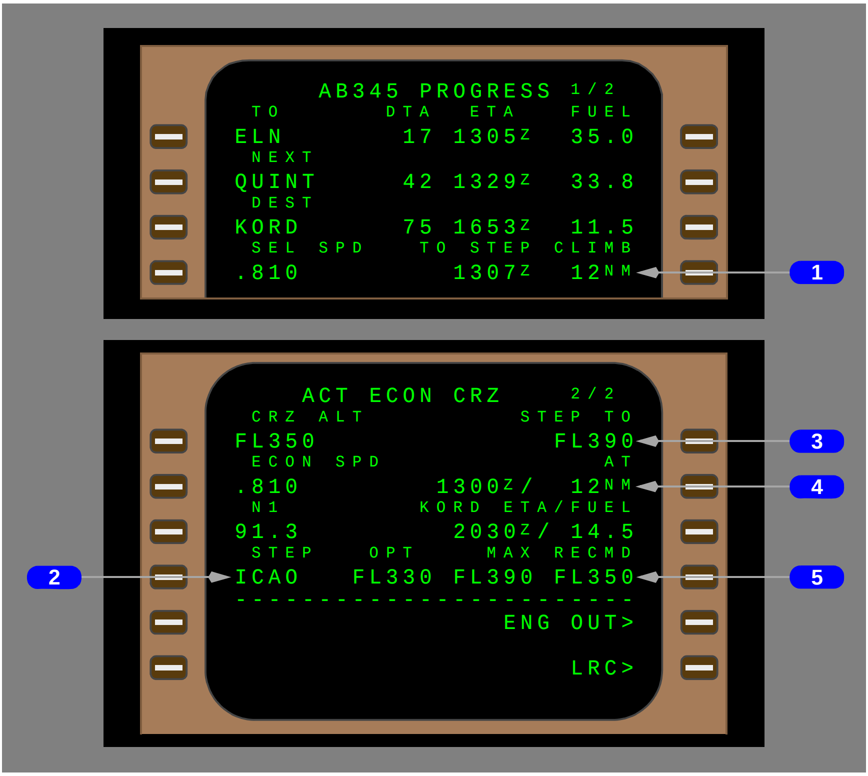
The FMC displays the distance and ETA to the step point on the CRZ and PROGRESS page. The corresponding altitude profile point and identifier are shown on the map display.

1 Step Climb Altitude

Enter the cruise altitude as an altitude constraint and the letter S. The FMC assumes the step climb starts at the waypoint. Accomplish the step climb at the waypoint with the steps described in cruise climb.

Calculated Step Climb

When a non–zero value is entered into the STEP SIZE line on the PERF INIT or CRZ page, the FMC calculates optimum points for step climbs as the airplane performance permits. The climb altitude is determined by the value in STEP SIZE. Multiple step climbs are possible based on performance and route length. VNAV commands the step climbs, if the MCP altitude and the FMC CRZ ALT are set to the new altitude.



1 TO STEP CLIMB

When the step climb start point is the next VNAV event, the line title changes to TO STEP CLIMB.

Displays the ETA and DTG to the point where the step climb starts.

If the airplane passes the step climb point and has not started to climb, the ETA and DTG are replaced with the word NOW.

When the FMC calculates that a step climb is not advised, the ETA and DTG are replaced with the word NONE.

2 STEP SIZE

Displays the default step climb size of ICAO.

Valid entries are altitudes from 0 to 9000 in 1000 foot increments.

Used for calculation of optimum step point and step climb predictions.

Deletion of a manual entry defaults back to ICAO.

3 STEP TO

An altitude can be entered for a step climb evaluation. The FMC calculates the predicted step climb data and displays the results on this page and the PROGRESS page.

Entering a zero value for STEP SIZE causes the FMC to calculate performance based on a constant altitude flight at the CRZ ALT. Entering a valid, non–zero increment or ICAO step size causes the FMC to calculate performance based on accomplishing step climbs at calculated step climb points.

Step climb altitudes entered on the RTE LEGS page can be higher or lower than the CRZ ALT. These step climb altitudes cannot be overwritten on the CRZ page.

When using the ICAO step size, the STEP TO altitude is the next higher altitude above the OPT altitude corresponding to the direction of flight, based on the CRZ ALT entered before takeoff. Changes to CRZ ALT while in flight do not affect calculation of STEP TO altitudes using ICAO step sizes. However, if an alternate route (for example, Route 2) is activated in flight, the hemispheric altitude will be calculated using the current CRZ ALT.

When using an altitude increment step size, the STEP TO altitude is the next higher altitude above OPT calculated by adding the STEP SIZE increment to the FMC CRZ ALT.

When entering a cruise altitude above maximum altitude, the scratchpad message MAX ALT FLXXX is displayed.

Displays:

- the STEP TO altitude from the RTE LEGS page
- a calculated step climb altitude based on the step size.

Manual entry is allowed.

Blank when:

- there is no active flight plan
- within 200 NM of the T/D point or 500 miles from the destination
- the step size is zero
- in the EO D/D phase.

4 AT

Displays the ETA and DTG to the step climb point.

Displays NOW when past the calculated step climb point.

Line title changes to AVAIL AT when the climb is restricted by thrust or buffet.

Line title displays AT XXXXX where XXXXX is the waypoint where a planned step climb has been entered on the RTE LEGS page.

Line title changes to TO T/D when within 200 NM of the top of descent point. ETA and DTG are relative to the T/D point.

The data is the same as displayed on the PROGRESS page.

5 Optimum, Maximum and Recommended Altitude (OPT MAX RECMD)

OPT – displays the most economical altitude based on gross weight and the active cruise speed.

MAX – displays the two engine maximum altitude based on gross weight, climb and cruise speeds within the speed envelope, and sufficient excess thrust to provide a specified residual rate of climb capability.

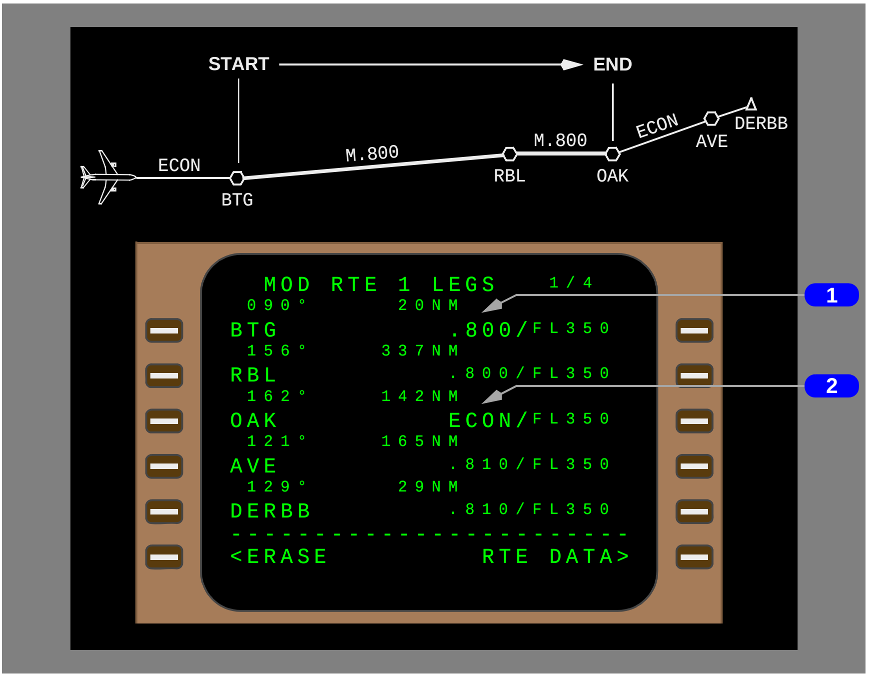
RECMD – displays the most economical altitude based on winds and airplane performance.

Constant Speed Cruise

N422LA through N526LA

A speed for a cruise segment can be specified. A cruise segment has a start waypoint and an end waypoint. The airplane maintains a constant speed between the two waypoints. The waypoints must be in the cruise phase. The FMC controls the speed after the end waypoint or top of descent.

Modification must be executed.



1 Start Waypoint for Constant Speed Cruise

The constant speed cruise starts at BTG at .800 Mach. Entry is in Mach.

2 End Waypoint for Constant Speed Cruise

The constant speed cruise ends at OAK then ECON speed is used.

Entry can be a Mach number, ECON/ or E/, LRC/ or L/.

If no end waypoint is specified, the constant speed terminates at top of descent.

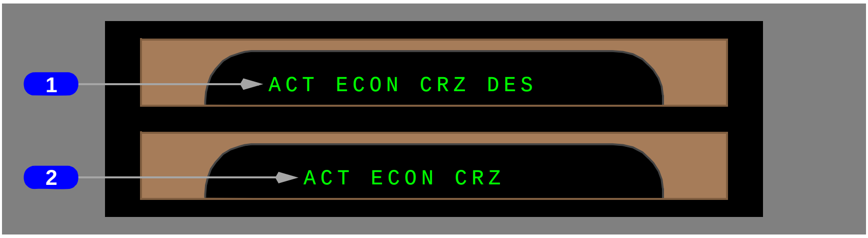
Cruise Descent

Cruise descents can be started in the cruise phase when more than 50 miles from the T/D point.

N422LA through N526LA
A cruise descent can be started by selecting a lower altitude on the MCP and pushing the altitude selector. A VNAV cruise descent is commanded at the current cruise speed and approximately 1250 feet per minute rate of descent. The FMC cruise altitude is automatically changed to the new altitude.

N316LA
A cruise descent can be started by selecting a lower altitude on the MCP, entering the new altitude in the CRZ ALT line and executing. A VNAV cruise descent is commanded at the current cruise speed and approximately 1250 feet per minute rate of descent.

The autothrottles adjust thrust to maintain the target descent rate; pitch maintains the commanded speed. Thrust levers can be manually positioned to adjust the descent rate.



1 During Cruise Descent

VNAV page title shows cruise phase in a descent to a new cruise altitude.

2 End of Cruise Descent

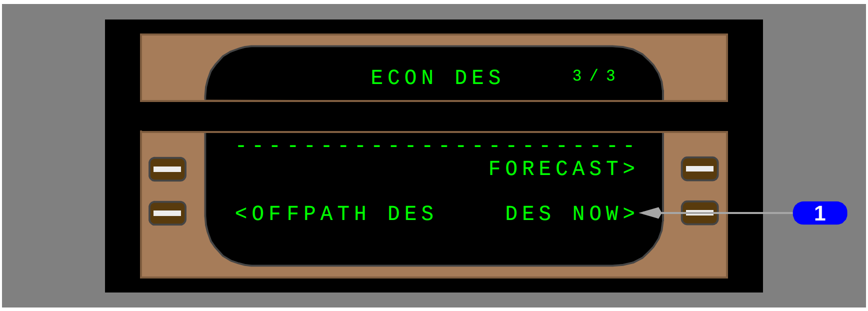
VNAV page title shows cruise phase after level off at new cruise altitude.

Early Descent

An early descent starts when the descent for landing is commenced prior to the top of descent point. Early descents should not be started when the distance to the top of descent point is greater than 50 nautical miles. When further from the top of descent point, the cruise descent function should be used.

Early descents are started on the DES page. Once an early descent is started, VNAV changes to the descent phase and cruise features are no longer available.

The autothrottle adjusts thrust to maintain the target descent rate; pitch maintains the commanded speed. Thrust levers can be manually positioned to adjust the descent rate.



1 Descend Now (DES NOW)

The DES NOW prompt is shown on the descent page when the cruise phase is active. Reset the MCP altitude and select the DES NOW prompt and execute to start an early descent. The descent page becomes active and the airplane starts a VNAV ECON descent of approximately 1250 feet per minute at ECON descent speed.

Once the descent is established the autothrottle mode changes to THR HOLD to allow the pilot to adjust the rate of descent with power changes.

Upon reaching the planned descent path, VNAV commands pitch to maintain the planned descent path and ECON speed.

Navigation Data

Reference Navigation Data Page

The reference navigation data page displays data about waypoints, navaids, airports, and runways. Use this page to inhibit FMC position updates from radio navaids.

1 Identification (IDENT)

Valid entries are any waypoint, navaid, airport, or runway from the navigation database. Only runways at the destination airport can be entered.

Dashes are displayed when the page is first selected. Entry changes to dashes when the page is exited and then reselected.

2 LATITUDE

Displays latitude of entered identifier. When the identifier is a runway the latitude displayed is for the threshold of the runway.

3 Magnetic Variation (MAG VAR), LENGTH

MAG VAR - displays magnetic variation when entered identifier is a navaid.

LENGTH - displays runway length when entered identifier is a runway.

4 NAVAID INHIBIT

When a navigation radio is known to provide erroneous position information, the FMC must be inhibited from automatically tuning that navaid.

Enter the identifier of up to two VOR, VOR/DME, VORTAC, or DME stations that must not be used for FMC position updates.

Entries are blanked at flight completion. Deleting or overwriting removes a previous inhibit.

5 VOR ONLY INHIBIT

Use this line when only the VOR portion of a VOR/DME or VORTAC navaid must be inhibited. ALL is displayed if the VOR/DME NAV prompt is selected to OFF.

Enter the identifier of up to two VORs that must not be used for FMC position updates. Only the VOR portion of the navaid is inhibited, the FMC will still tune the DME for DME–DME updating.

Entries are blanked at flight completion. Deleting or overwriting removes a previous inhibit.

6 INDEX

Push – displays the INIT/REF INDEX page.

7 Frequency (FREQ)

Displays frequency of entered identifier when it is a navaid.

8 LONGITUDE

Displays longitude of entered identifier. When the identifier is a runway the longitude displayed is for the threshold of the runway.

9 ELEVATION

Displays elevation of entered identifier when it is a navaid, airport, or runway.

10 VOR/DME NAV

Alternately switches VOR/DME NAV updating between OFF and ON

Push – when ON is displayed in large font

- changes OFF to large font and ON to small font
- inhibits VOR/DME updates to the FMC by inhibiting all VORs. DME-DME updating is not inhibited.
- displays ALL in both locations of the VOR ONLY INHIBIT line.

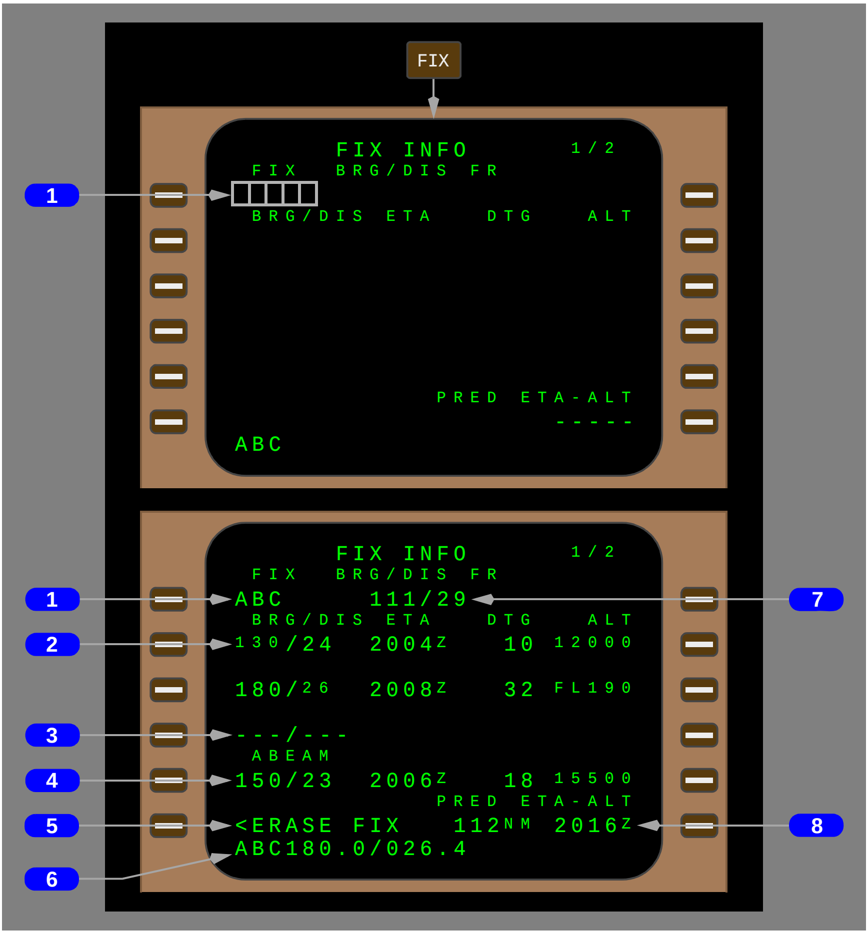
Push – when OFF is displayed in large font

- changes ON to large font and OFF to small font
- enables VOR/DME updating to the FMC
- deletes the ALL from the VOR ONLY INHIBIT line.

Fix Information Page

Two identical fix information pages are used to create waypoint fixes and waypoints for the map display. Some of the created waypoints can be copied into the route.

Magnetic or true fix bearings depend on the position of the heading reference switch or airplane location. Refer to FMC Polar Operations, Flight Management Navigation, section 31.



1 FIX

Before entry of a name or identifier, boxes displayed and most data lines are blank.

Valid entries are airports, navaids, and waypoints from the navigation database. The selected fix appears on the map display highlighted by a green circle.

2 Bearing/Distance (BRG/DIS), ETA, DTG, ALT

Valid entries are XXX/YYY.Y:

- decimal values can be omitted
- leading zeros can be omitted for distance entries
- distance only entries must start with a slash (/).

Distances from the fix appear on the map display as a circle around the fix.

When the circle intersects the active route, the ETA, DTG, and predicted altitude at the intersection display for the closest of the two intersections.

Bearings from the fix appear on the map display as radial lines from the fix.

When the bearing intersects the active route, the ETA, DTG, and predicted altitude at the intersection display.

ETA – displays the estimated time if arrival to the intersection point.

DTG – displays the distance to go to the intersection point.

ALT – displays the predicted altitude at the intersection point.

Push - copies the fix place/bearing/distance into the scratchpad. This fix can be placed in the route on a LEGS or RTE page as a waypoint.

3 Bearing/Distance (BRG/DIS) – Dashes

Enter a bearing, distance, or both bearing and distance from the fix. A bearing and distance from the fix appear on the map display as a waypoint fix point. ETA, DTG, and predicted do not display.

4 ABEAM

Displays ABEAM prompt.

Push - displays bearing and distance from the fix perpendicular to the nearest segment of the flight plan path, and ETA, DTG, and altitude at the intersection point.

Second push - copies the fix place/bearing/distance into the scratchpad. This fix can be placed in the route on a LEGS or RTE page as a waypoint.

5 ERASE FIX

Push – removes all fix data from the page and the map display.

6 **Route Intersection Point Copied**

Pushing the line select key for one of the BRG/DIS entries copies the fix place/bearing/distance definition into the scratchpad. This fix can be placed into the route on a LEGS page as a waypoint.

7 **Bearing/Distance From (BRG/DIS FR)**

Displays the bearing and distance of the airplane from the fix.

8 **Predicted Distance to ETA or Altitude (PRED ETA-ALT)**

Valid entry is altitude, flight level, or time. Time entry must be followed by "Z".

Entering an altitude or flight level displays the predicted along track distance and altitude or flight level on this line. The predicted airplane position appears on the map as a green circle with the entered altitude/flight level or time.

In–Flight Position Update

FMC position update can be accomplished on the POS REF 2/4 page in flight.

1 **UPDATE ARMED**

Pushing the ARM prompt arms the position update function. ARM changes to ARMED. Each of the position update sources have a NOW prompt.

2 NOW

Push – to update the FMC position from the desired source. The FMC position is momentarily changed to the position of the selected system. If other valid sensor position exist, it returns to the most reliable sensor position.

Route and Waypoint Data
Route Data Page

The route data page displays progress data for each waypoint on the ACT RTE X LEGS page. This page also allows access to the WIND page. This page is available only for the active route.

One page shows data for five waypoints.

The ETA and calculated fuel remaining at the waypoint display for each waypoint. Manual entry is not possible.

N422LA through N526LA

1 Waypoint (WPT)

Displays identifier for waypoint.

2 ETA

Displays ETA for waypoint.

3 LEGS

Push – displays RTE LEGS page.

4 FUEL

Displays the FMC calculated fuel remaining at the waypoint.

Note: ETA and estimated fuel calculations assume a direct flight across route discontinuities.

5 WIND Page Prompt

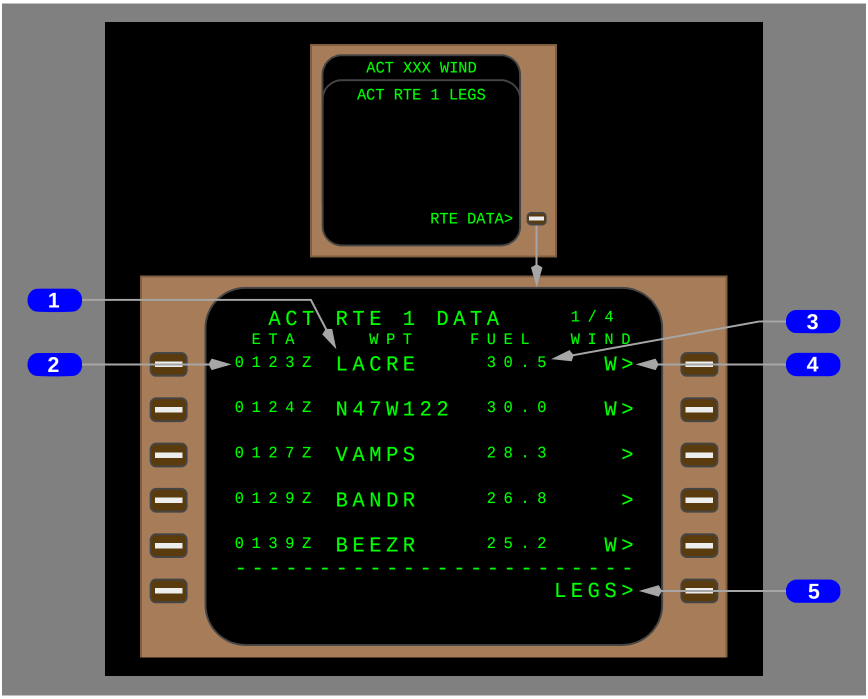
Push – selects WIND page for the selected waypoint.

A "W" next to the prompt indicates that wind data has been entered on the wind page for that waypoint.

6 WIND DATA REQUEST

Push – transmits a data link request for wind and descent forecast data.

Flight crew may enter up to four altitudes on any wind page to qualify the request.



1 Waypoint (WPT)

Displays identifier for waypoint.

2 ETA

Displays ETA for waypoint.

3 FUEL

Displays the FMC calculated fuel remaining at the waypoint.

Note: ETA and estimated fuel calculations assume a direct flight across route discontinuities.

4 WIND Page Prompts

Push – selects WIND page for the selected waypoint.

A "W" next to the prompt indicates that wind data has been entered on the wind page for that waypoint.

5 LEGS

Push – displays RTE LEGS page.

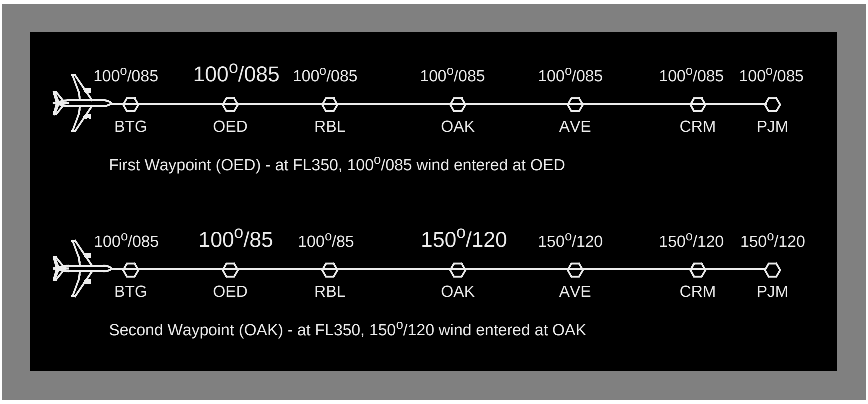
Wind Data

The FMC uses wind data to improve performance prediction accuracy.

The FMC applies the first entered wind data to all waypoints in the flight plan. Wind data includes altitude and direction/speed.

Wind data entered at another waypoint (at the same altitude) changes wind data down track from the second entered waypoint either to the end of the track, or to the next entered wind. The wind data before the second entered waypoint does not change. Therefore, enter wind data for waypoints closest to the airplane, then enter wind data for waypoints down track from the airplane.

For example: at FL 350, 100°/085 is entered at waypoint OED. All waypoints in the route have the OED wind data. Then, additional wind data entered at OAK changes the wind data at OAK and through the end of the route.



Entered wind data are mixed with sensed wind data for performance predictions. The FMC uses entered winds for predictions far ahead of the airplane and sensed winds close to the airplane. The FMC mixes these winds for predictions in between.

Sensed winds are displayed on the HSI and on progress page 2.

Wind Page

The wind page is used to enter forecast winds and temperatures at specific altitudes for specific waypoints to enhance VNAV performance. The FMC calculates step climb points based on the wind effect.

The wind page displays waypoint wind data for one to four altitudes per waypoint. This data can be uplinked or manually entered.

The altitudes are entered first. The altitudes can be entered in any order and are sorted and displayed in ascending order.

Wind speed and direction are entered for the specific altitudes.

OAT can be entered for any one altitude. The FMC calculates the temperature for the entered altitudes using the standard lapse rate.

1 Page Title

Displays ACT XXXXX WIND, where XXXXX is the waypoint for which the wind page was selected.

When a route is being modified, MOD is shown in the page title. If ACT is displayed when the wind page is first accessed, entry of wind data caused MOD to be displayed. Wind entries must be executed.

2 Altitude (ALT)

Enter altitude or flight level for wind entries. Altitude data entry is possible only on line 1L.

After altitude entry, data is sorted in ascending order in lines 1 through 4. Dashes display on right side of line for wind direction and speed entry.

When all four lines have data, one must be deleted before new data can be entered.

Entered altitudes are propagated to all wind pages.

3 Altitude/Flight Level Data

Displays the altitude or flight level for wind entries. Data entered on 1L is displayed on lines 1 through 4 in ascending order. Altitude entry is not possible in lines 2L through 4L.

Calculated OAT based on standard lapse rate from the entry made on the ALT/OAT line are display in small font.

4 ERASE

Push – removes modified data.

5 Direction and Speed (DIR/SPD)

Displays dashes after altitude/flight level entry in the ALT line. Enter predicted wind direction and speed for the altitude.

Values propagate to other waypoint winds. Propagated values display in small font.

Manual entries display in large font.

6 Altitude/Outside Air Temperature (ALT/OAT)

Enter altitude and OAT. The altitude for OAT does not have to be one of the wind altitudes. The FMC uses standard lapse rate to calculate the temperature at the other altitudes.

Entries must be executed.

7 Route Data (RTE DATA)

Push – displays the RTE DATA page.

Progress Pages

The progress page displays general flight progress data.

The position report page is accessed from the progress page.

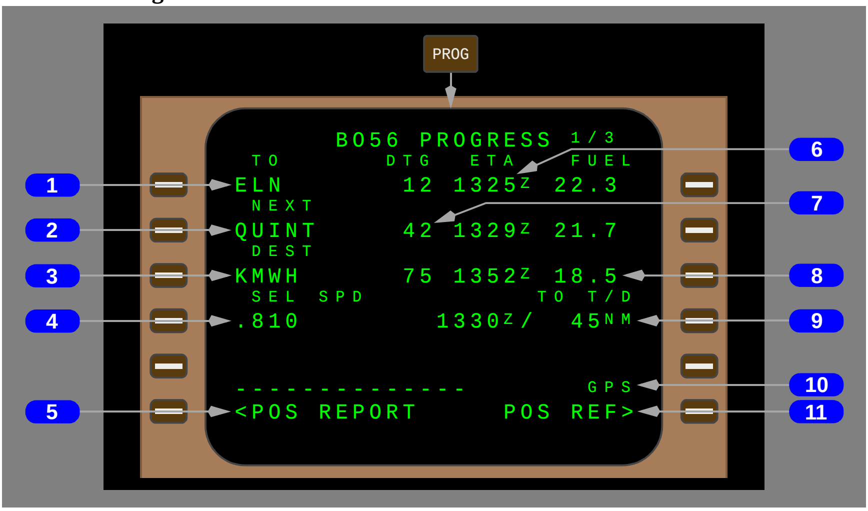
Progress Page 1

The page title displays the company flight number entered on the RTE page.

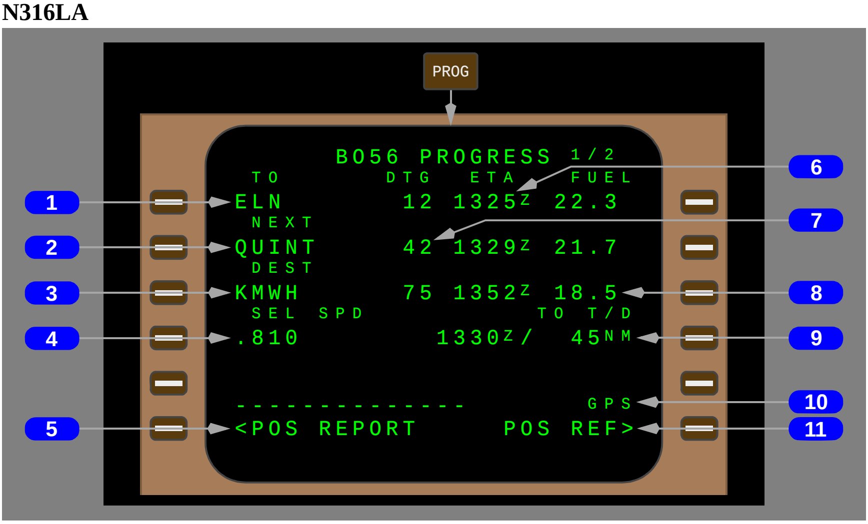
Page one of the progress pages displays general data about:

- waypoints (active and next)
- destination
- FMC speed
- next VNAV profile point.

N422LA through N526LA



N316LA



1 TO

Active waypoint is displayed.

Can not be modified.

2 NEXT

Waypoint after TO waypoint is displayed.

Can not be modified

3 Destination (DEST)

When the page is selected the active route destination is displayed. Any waypoint or airport in navigation database can be entered over the destination.

The line titles are:

- DEST – performance predictions to destination. Default display.
- DIR TO FIX – when entered waypoint is not in flight plan. Data is based on flying present position direct to overhead the waypoint.
- EN ROUTE WPT – when entered waypoint is in flight plan. Line data are based on flying the flight plan route to the waypoint.
- MOD – a modification has been made on another page. Performance predictions include modification.

Entries do not modify the active route and are deleted when all CDUs are changed to a different page.

4 Selected Speed (SEL SPD)

Displays the FMC active command speed.

The active speed mode is the same as on the performance page, unless changed by the MCP or a limit. The speed modes are:

- LRC SPD – long range cruise speed
- ECON SPD – economy speed
- SEL SPD – selected speed manually entered on the CDU
- LIM SPD – speed is limited by VMO, MMO, flap limit, or buffet limit
- MCP SPD – MCP speed entered on the MCP IAS/MACH indicator
- EO SPD – engine out speed
- CO SPD – engine out operations at airline specified engine out company speed

5 Position Report (POS REPORT)

Push – displays the POS REPORT page.

6 ETA

Estimated time of arrival at waypoint or destination.

7 Distance To Go (DTG)

Distance to go to waypoint or destination.

8 FUEL

Estimated fuel remaining at waypoint or destination.

9 TO Top Of Descent (T/D)

ETA and DTG to next VNAV profile point.

The line title and data change for other phases of flight. Other line titles:

- TO T/C – top of climb data
- TO STEP CLIMB – step climb data
- TO E/D – end of descent data
- LEVEL AT – time and distance to level off in engine out mode.

10 Navigation Updating Mode

Displays the current FMC position updating source. Possible displays are:

- GPS
- RADIO
- IRS
- LOC–GPS
- LOC–RADIO
- LOC

11 Position Reference (POS REF)

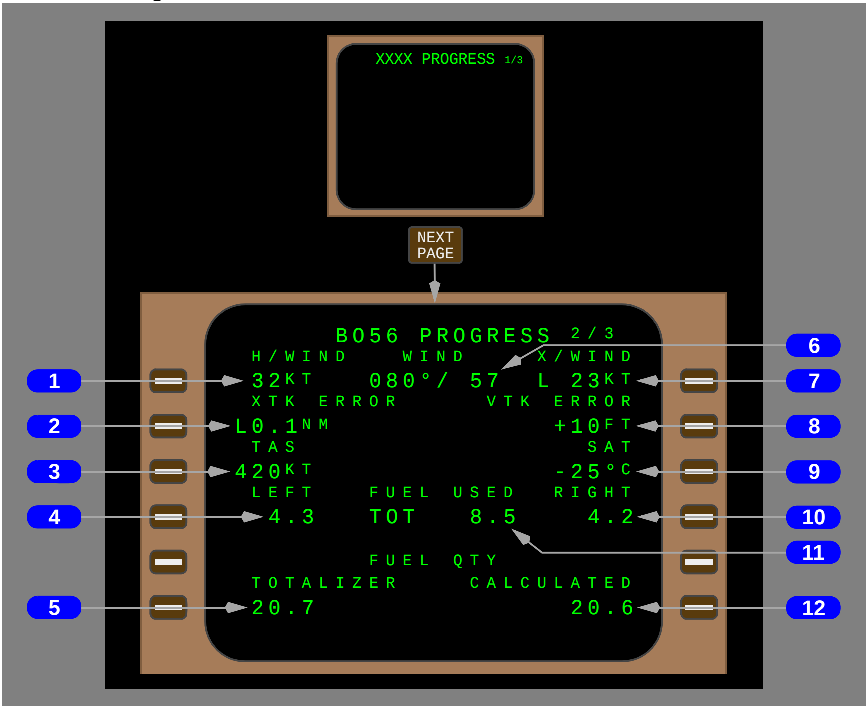
Push – displays position reference page.

Progress Page 2

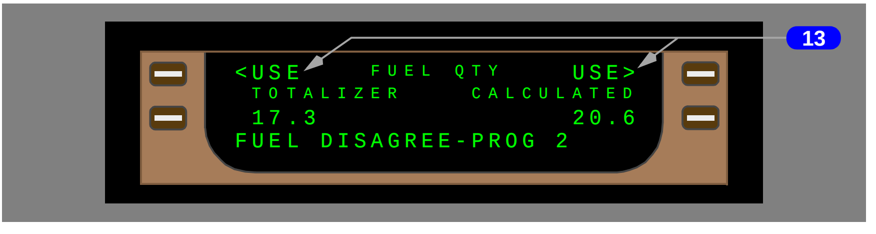
Progress page two contains:

- wind data
- true airspeed
- fuel data
- track error data.
- static air temperature

N422LA through N526LA



N316LA



1 Headwind (H/WIND), Tailwind (T/WIND)

Displays headwind (H/WIND) or tailwind (T/WIND) component relative to the airplane heading.

2 Crosstrack Error (XTK ERROR)

Displays crosstrack (XTK) error in nautical miles left or right of the active route.

3 TAS

Displays airplane true airspeed.

4 LEFT FUEL USED

Displays fuel used by left engine sensed by fuel flow meters.

5 Fuel Quantity (TOTALIZER)

Displays total fuel quantity from the fuel system quantity processor.

The fuel remaining line displays two independent fuel remaining values, TOTALIZER and CALCULATED. They can be compared to validate FMC calculations.

6 WIND

Displays current wind direction and speed referenced to true north.

7 Crosswind (X/WIND)

Displays left (L) or right (R) crosswind component relative to airplane heading.

8 Vertical Track Error (VTK ERROR)

Displays vertical path (VTK) error above (+) or below (-) vertical path.

9 Static Air Temperature (SAT)

Displays outside static air temperature.

10 RIGHT FUEL USED

Displays fuel used by right engine sensed by fuel flow meters.

11 FUEL USED Total (TOT)

Displays sum of the LEFT and RIGHT fuel used values.

12 FUEL Quantity (QTY) CALCULATED

Displays fuel remaining as calculated by the FMC with these methods:

- before engine start, fuel quantity calculated by fuel quantity system totalizer
- after engine start, fuel quantity at engine start decreased by EICAS engine fuel flow rate
- after fuel dump or after erasing a manually entered fuel quantity, resets to fuel quantity system totalizer
- after all engines are shutdown, resets to fuel quantity system totalizer.

The fuel remaining line displays two independent fuel remaining values, TOTALIZER and CALCULATED. They can be compared to validate FMC calculations.

13 USE

USE prompts display when TOTALIZER and CALCULATED values disagree by a significant amount. The scratchpad message FUEL DISAGREE–PROG 2 is also displayed.

Push – selects method to calculate fuel quantity, either TOTALIZER or CALCULATED.

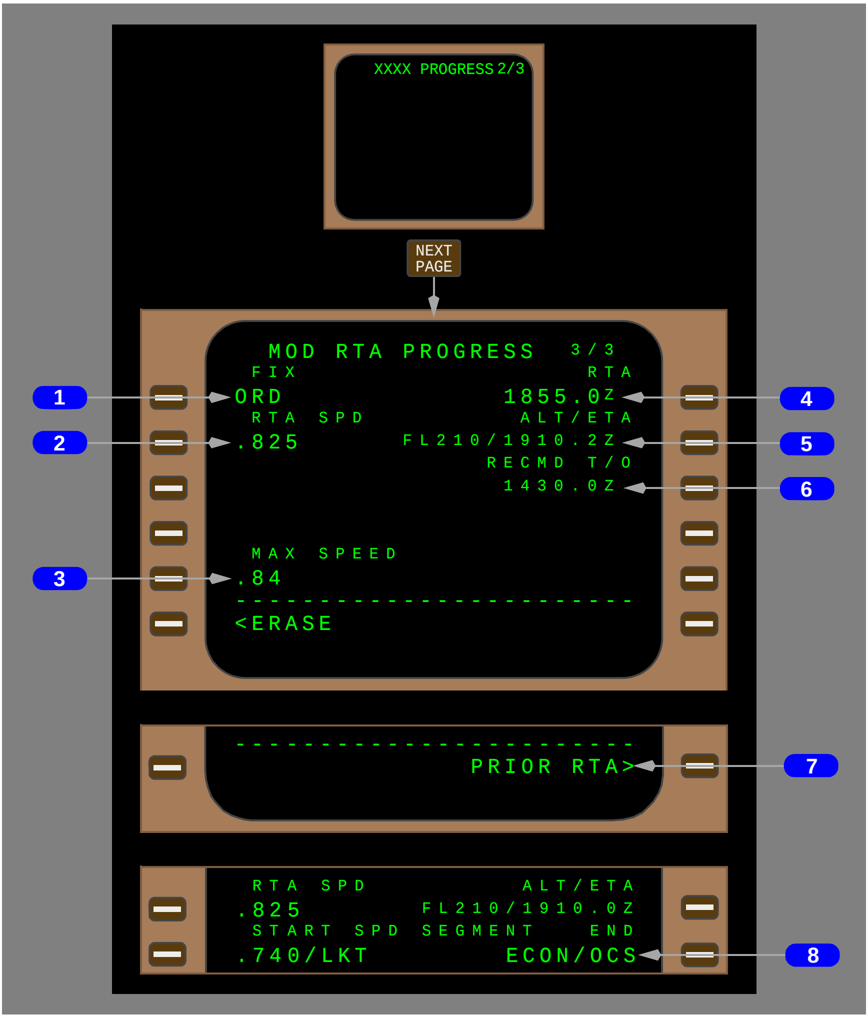
When one is selected:

- it is used for remainder of flight
- the other fuel calculation method blanks
- scratchpad clears.

RTA Progress Page 3

N422LA through N526LA

Progress page three is used to enter data for required time of arrival (RTA). RTA can be entered or changed during preflight or in flight. Creating an RTA changes PROGRESS and CRZ page titles to include RTA. RTA operations only impact speeds in the cruise phase.



1 FIX

Displays boxes prior to RTA fix entry. Displays is blank when an engine-out mode is active or there is no active or pending active route.

Valid entry is a waypoint in the active or pending active route. Waypoints defined by coordinates must be down selected to the scratchpad, then selected to the FIX line.

Entry by flight crew or data link.

ALT/ETA is displayed in line 2R after a valid FIX is entered.

When RTA is active, deletion of FIX terminates RTA and resumes ECON. Display returns to boxes.

When RTA not is active, deletion of FIX erases a pending RTA MOD. Display returns to boxes.

2 Required Time Of Arrival Speed (RTA SPD)

Displays FMC computed cruise speed to accomplish RTA.

Blank if no RTA fix or time entered, or with descent active.

3 Maximum Speed (MAX SPD)

Valid entry is Mach .100M to .990M.

Deletion of entered value displays default Mach.

Default Mach .84M displays in small font.

4 Required Time Of Arrival (RTA)

Boxes display after entry of RTA FIX in 1L.

Valid entry is time from 0000.0 to 2359.9. Decimal entry of .0 is optional.

Suffix to RTA indicates:

- no suffix – arrive at entered time
- A – arrive at or after entered time
- B – arrive at or before entered time.

Entry shows recommended T/O time.

Deletion terminates RTA and returns ECON as cruise mode.

5 Altitude/ETA (ALT/ETA)

Displays predicted altitude and ETA at RTA fix after entry of FIX in 1L.

Blank until performance data is entered.

6 Recommended Takeoff (RECMD T/O)

Displays recommended takeoff time to meet RTA at ECON speed.

Dashes until FIX is entered.

Blanks in flight.

Valid entry is time from 0000.0 to 2359.9. Decimal entry of .0 is optional.

Manual entry recalculates all flight plan time predictions.

Changes to NOW after recommended takeoff time.

When unable to meet the RTA based on a manual takeoff time entry the scratchpad message UNABLE RTA is displayed.

7 PRIOR RTA

Displays when RTA is not active but RTA fix and time previously entered and activated.

Push -

- displays previously active RTA fix and time
- initiates RTA modification.

8 Constant Speed Cruise

Displays constant speed cruise start and end waypoint

Position Report Page

The position report page displays current flight data formatted as a position report. The page contains reference data only. Manual entries are inhibited.

N422LA through N526LA
A data linked position report can be initiated from the page.

N422LA through N526LA

N316LA

1 Position (POS)

Waypoint used to report position. This is the previous active waypoint.

The actual time of arrival (ATA) and altitude (ALT) at the waypoint follow the waypoint name.

2 Estimate (EST)

The active waypoint is displayed with the ETA to that waypoint.

3 NEXT

The waypoint following the active waypoint.

4 Temperature and Wind (TEMP WIND)

TEMP displays the OAT in degrees C.

WIND displays the wind direction and speed. Wind direction is shown in degrees true.

5 Destination ETA (DEST ETA)

The FMC calculated ETA for the destination is displayed.

6 Speed (SPD)

Displays the target FMC speed.

7 Position Fuel (POS FUEL)

Displays the fuel on board at the POS waypoint.

N422LA through N526LA

8 SEND Prompts

Push – sends a position report via datalink to the company or ATC.

Intentionally
Blank

Introduction

The descent phase starts at the top of descent point and continues to the end of descent point. Planning for the descent phase starts during cruise.

The approach phase starts at the end of descent point and continues to touchdown or go–around. When a go–around is accomplished, the FMC enters a modified cruise or approach phase, depending on the route and cruise conditions.

Alternates can be selected at any time. Alternates are available from preflight through all phases of flight and can be updated at any time. Diversion to an alternate can be accomplished during cruise, descent, or approach.

As the airplane passes the top of descent point with VNAV engaged, the descent page becomes active and the CDU automatically changes from the cruise page to the descent page.

Early Descent

Descent for the approach and landing may be commenced before reaching the top of descent point. The description of early descent options and functions is in Section 42, FMC Cruise.

Descent

During descent, LNAV is managed using the RTE LEGS page, as in the cruise phase. VNAV descent management is accomplished primarily on the DES page.

Other pages which support descent are:

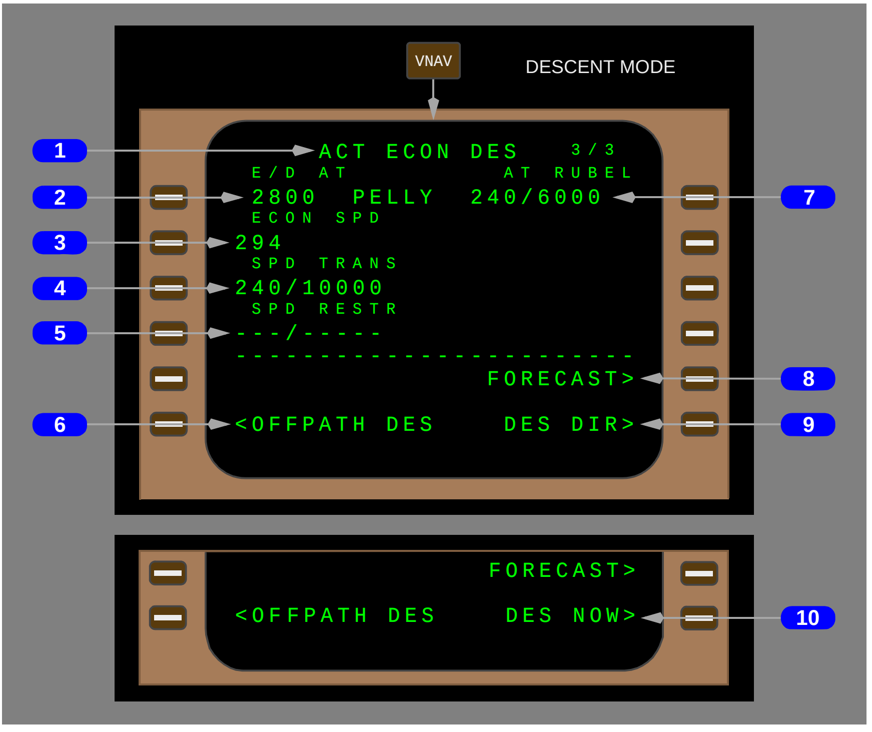
- DESCENT FORECAST page – to enter forecast wind data to aid descent planning
- OFFPATH DES page – to analyze descent performance with and without the use of speedbrakes

Descent Page

The descent page is used to monitor and revise the descent path. Descent speed modes are economy (ECON) and fixed speed (SEL). The default VNAV descent mode is ECON. A fixed speed descent is flown when speed intervention is used or a speed is entered on the DES page. The descent page is no longer available after the end of descent.

The page title includes the VNAV speed mode. The ECON mode controls descent speed at the economy speed until reaching a lower speed restriction. The fixed speed mode controls descent speed until a lower speed restriction is reached.

N316LA



1 Page Title

The title usually shows ECON during descent. Fixed speed descents modify the title.

The page title shows the type of descent:

- ECON – speed based on a cost index
- LIM SPD – speed based on airplane configuration limiting speed
- MCP SPD – MCP speed intervention is selected

- XXXKT – fixed CAS descent speed profile
- M.XXX – fixed Mach descent speed profile
- ACT – prefix shown when descent phase is active
- MOD – prefix shown when descent phase is active and the flight plan is modified.

Reasons for fixed descent speeds are:

- waypoint speed constraints
- an altitude constraint associated with a speed constraint
- a speed transition
- a flight crew entered selected speed (SEL SPD).

2 End Of Descent At (E/D AT)

Shows the end of descent altitude and waypoint.

The end of descent point is a waypoint in the descent phase with the lowest altitude constraint.

Blank if no E/D point exists.

3 Economy Speed (ECON SPD), Selected Speed (SEL SPD)

Shows the current target descent speed.

ECON SPD –

- economy speed based on cost index
- shows CAS or Mach.

SEL SPD –

- shows when intermediate level off required below an existing speed constraint
- shows when flight crew enters speed
- CAS or Mach value may be entered.
- page title changes to ACT XXXKT DES or ACT M.XXX DES
- <ECON prompt appears at line 5L to allow selection of economy descent speed.

4 Speed Transition (SPD TRANS)

The transition speed is usually 10 knots less than the destination airport limiting speed from the navigation database. When no airport limit speed exists, the default speed of 240 knots is shown. The transition altitude is the point that the transition speed is active for the destination airport. When no altitude exists in the navigation database, the default of 10,000 feet is shown.

Blanks when the transition has occurred.

Can be deleted.

5 Speed Restriction (SPD RESTR)

Speed restrictions not associated with specific waypoints are manually entered on this line.

Dashes before entry by flight crew.

Valid entry is a CAS and altitude (example 240/8000).

An entry creates a modification.

6 Off Path Descent (OFFPATH DES)

Push – shows the OFFPATH DES page.

7 AT XXXXX

Shows the next waypoint constraint from the RTE LEGS page.

Line title shows:

- AT XXXXX (the waypoint identifier)
- HOLD AT XXXXX
- AT VECTORS
- AT (INTC).

The constraint is speed/altitude. Blank when no constraint exists.

Can be deleted on this page.

VNAV commands the lesser of constraint speed or present performance speed.

8 FORECAST

Push – shows the DESCENT FORECAST page.

9 Descend Direct (DES DIR)

Push – deletes all waypoint altitude constraints between the airplane altitude and the MCP altitude. FMC cruise altitude is not affected.

Shown in descent phase with altitude constraint between airplane and E/D.

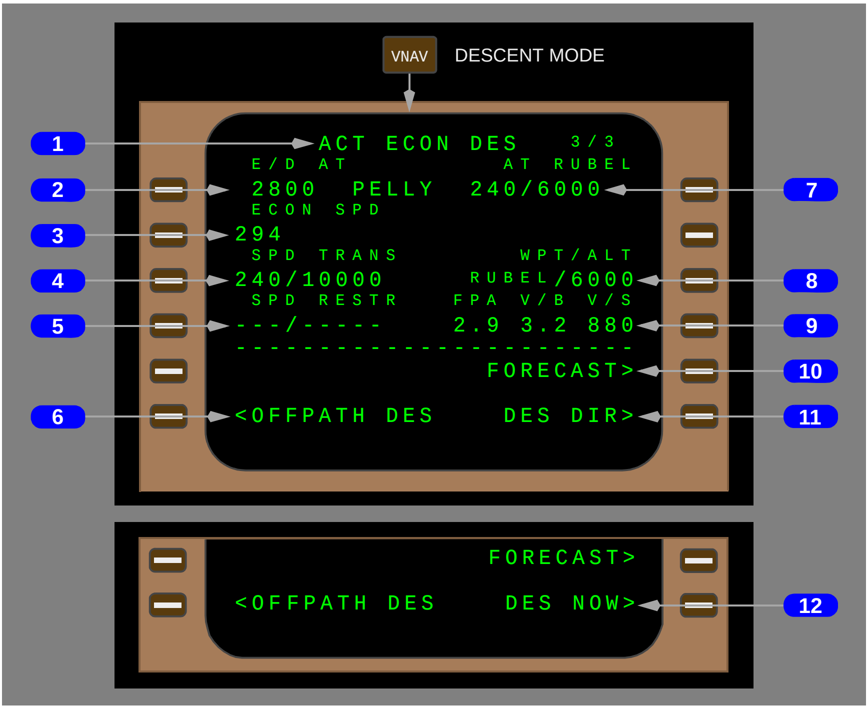
10 Descend Now (DES NOW)

Shown when the descent phase is not active.

Push –

- starts a 1250 feet per minute descent schedule until intercepting the planned descent path
- activates the FMC descent phase.

N422LA through N526LA



1 Page Title

The title usually shows ECON during descent. Fixed speed descents modify the title.

The page title shows the type of descent:

- ECON – speed based on a cost index
- LIM SPD – speed based on airplane configuration limiting speed
- MCP SPD – MCP speed intervention is selected
- XXXKT – fixed CAS descent speed profile
- M.XXX – fixed Mach descent speed profile
- ACT – prefix shown when descent phase is active
- MOD – prefix shown when descent phase is active and the flight plan is modified.

Reasons for fixed descent speeds are:

- waypoint speed constraints
- an altitude constraint associated with a speed constraint
- a speed transition
- a flight crew entered selected speed (SEL SPD).

2 End Of Descent At (E/D AT)

Shows the end of descent altitude and waypoint.

The end of descent point is a waypoint in the descent phase with the lowest altitude constraint.

Blank if no E/D point exists.

3 Economy Speed (ECON SPD), Selected Speed (SEL SPD)

Shows the current target descent speed.

ECON SPD –

- economy speed based on cost index
- shows CAS or Mach.

SEL SPD –

- shows when intermediate level off required below an existing speed constraint
- shows when flight crew enters speed
- CAS or Mach value may be entered.
- page title changes to ACT XXXKT DES or ACT M.XXX DES
- <ECON prompt appears at line 5L to allow selection of economy descent speed.

4 Speed Transition (SPD TRANS)

The transition speed is usually 10 knots less than the destination airport limiting speed from the navigation database. When no airport limit speed exists, the default speed of 240 knots is shown. The transition altitude is the point that the transition speed is active for the destination airport. When no altitude exists in the navigation database, the default of 10,000 feet is shown.

Blanks when the transition has occurred.

Can be deleted.

5 Speed Restriction (SPD RESTR)

Speed restrictions not associated with specific waypoints are manually entered on this line.

Dashes before entry by flight crew.

Valid entry is a CAS and altitude (example 240/8000).

An entry creates a modification.

6 Off Path Descent (OFFPATH DES)

Push – shows the OFFPATH DES page.

7 **AT XXXXX**

Shows the next waypoint constraint from the RTE LEGS page.

Line title shows:

- AT XXXXX (the waypoint identifier)
- HOLD AT XXXXX
- AT VECTORS
- AT (INTC).

The constraint is speed/altitude. Blank when no constraint exists.

Can be deleted on this page.

VNAV commands the lesser of constraint speed or present performance speed.

8 **Waypoint/Altitude (WPT/ALT)**

Line title appears at all times. Data line displays "-----/-----" when a descent profile does not exit in the flight plan. With a descent profile in the flight plan, data line displays the same waypoint/altitude restriction displayed on the AT line (1R). When sequencing the displayed waypoint, the next waypoint, and altitude in the descent profile display. This waypoint may be overwritten by pilot entry. Valid entry is any pilot defined waypoint in the flight plan (e.g. LMT02, PAE53) or any waypoint, navaid, or airport in the navigation database.

9 **Flight Path Angle, Vertical Bearing, and Vertical Speed (FPA, V/B, V/S)**

- FPA - displays the current airplane flight path angle whenever the airplane descends (data blanks if the airplane levels or climbs).
- V/B - displays vertical bearing from current position to the displayed waypoint and altitude (data blank if WPT/ALT line displays "-----/-----").
- V/S - displays required vertical speed to maintain the vertical bearing (data blank if WPT/ALT line displays "-----/-----").

10 **FORECAST**

Push – shows the DESCENT FORECAST page.

11 **Descend Direct (DES DIR)**

Push – deletes all waypoint altitude constraints between the airplane altitude and the MCP altitude. FMC cruise altitude is not affected.

Shown in descent phase with altitude constraint between airplane and E/D.

12 **Descend Now (DES NOW)**

Shown when the descent phase is not active.

Push –

- starts a 1250 feet per minute descent schedule until intercepting the planned descent path
- activates the FMC descent phase.

Descent Forecast Page

The descent forecast page is used to enter wind data for descent, and the altitude at which anti–ice use is anticipated for more accurate descent path calculation.

The primary entries are wind direction and speed for up to four descent altitudes, and the altitude that anti–ice is turned on.

N422LA through N526LA

1 Transition Level (TRANS LVL)

Shows the transition level.

The transition level can be specified by the arrival procedure. The default transition level is FL 180.

Above transition level, altitudes are in flight levels. Below transition level, altitudes are in thousands of feet.

Valid entry is an altitude or flight level.

2 Altitude (ALT)

Enter altitude of forecast wind data.

Altitudes and flight levels can be entered in any order. Entries are not sorted.

Execute not necessary.

3 REQUEST SEND

Push – transmits a data link request for descent wind data.

4 Thermal Anti–Ice On Altitude (TAI/ON ALT)

Enter the altitude where anti–ice is first turned on during the descent. The FMC calculates the descent profile based on the higher thrust caused by thermal anti-ice operation below this altitude.

5 Wind Direction/Speed (WIND DIR/SPD)

Enter the wind direction/speed for the specified altitude. Initial entry must have wind direction and speed, subsequent entries may have one or the other.

Execute not necessary.

6 Descent (DES)

Push – shows the DES page.

N316LA

1 Transition Level (TRANS LVL)

Shows the transition level.

The transition level can be specified by the arrival procedure. The default transition level is FL 180.

Above transition level, altitudes are in flight levels. Below transition level, altitudes are in thousands of feet.

Valid entry is an altitude or flight level.

2 Altitude (ALT)

Enter altitude of forecast wind data.

Altitudes and flight levels can be entered in any order. Entries are not sorted.

Execute not necessary.

3 Thermal Anti–Ice On Altitude (TAI/ON ALT)

Enter the altitude where anti–ice is first turned on during the descent. The FMC calculates the descent profile based on the higher thrust caused by thermal anti-ice operation below this altitude.

4 Wind Direction/Speed (WIND DIR/SPD)

Enter the wind direction/speed for the specified altitude. Initial entry must have wind direction and speed, subsequent entries may have one or the other.

Execute not necessary.

5 Descent (DES)

Push – shows the DES page.

Offpath Descent Page

The offpath descent page allows the analysis of descent performance off the present route of flight, direct to a selected waypoint. Data entered on the page shows clean and drag descent ranges on the page and on the map display. The ranges are based on an entered waypoint and altitude constraint. The range can be used to determine if the altitude constraint can be met in a direct descent to the waypoint.

The FMC puts the last descent waypoint with an altitude constraint into DES TO.

The ECON SPD, SPD TRANS, SPD RESTR, and DES data are the same as the DES page.

1 Descend To (DES TO)

The waypoint for a direct–to descent. Usually, this is the E/D waypoint from the active route. Manual entry of waypoints on or off of the route are allowed. The DTG calculations are for a descent direct to the selected waypoint.

When within 150 feet of the DES TO altitude for a waypoint other than the E/D waypoint, the display automatically changes the DES TO waypoint to the E/D waypoint from the DES page.

A waypoint is entered for direct–to analysis.

2 Distance To Go (DTG)

Shows the straight line distance to the entered waypoint.

3 Speed/Altitude (SPD/ALT)

Shows the speed/altitude constraint for the entered waypoint.

A manual waypoint entry shows boxes for manual speed and altitude entry.

4 TO CLEAN

Distance to the clean descent circle. The distance is negative when a clean descent is no longer possible.

A clean circle assumes no drag devices are used for descent.

A direct descent to the DES TO waypoint at a SPD/ALT constraint is possible when the airplane is outside the clean circle. The clean circle is shown on the map display when the DISPLAY prompt is ON.

5 TO DRAG

Distance to the drag descent circle. The distance is negative when a drag descent is no longer possible.

A drag circle assumes speedbrakes are UP for descent.

A direct descent to the DES TO waypoint at a SPD/ALT constraint is possible when the airplane is outside the drag circle. The drag circle is shown on the map display when the DISPLAY prompt is ON and the airplane is inside the clean circle.

6 DISPLAY

Push – alternates between ON and OFF.

ON – shows the clean and drag circles on the map display. The drag circle is not displayed until the airplane position is inside the clean circle.

OFF – removes the clean and drag circles from the map display.

Selected state is large font.

Automatically changes to OFF within 150 feet of the waypoint constraint altitude.

Engine Out Descent

There are no specific engine out pages for descent. Use the two engine descent planning features and pages.

Approach

During approach, roll and pitch modes usually change to the approach guidance supplied by navigation radios. The FMC continues to calculate and show present position and can supply LNAV and VNAV approach guidance for certain types of approaches when radio navigation is not used.

The RTE LEGS and DESCENT pages are used to manage the airplane until other approach guidance becomes active. Other pages which support approaches are:

- ARRIVALS page – to select arrival and approach procedures
- HOLD page – to manage holding patterns
- APPROACH REF page – to specify approach flap settings and set the approach VREF speed

Holding is described in this section but it can be used during any phase of flight.

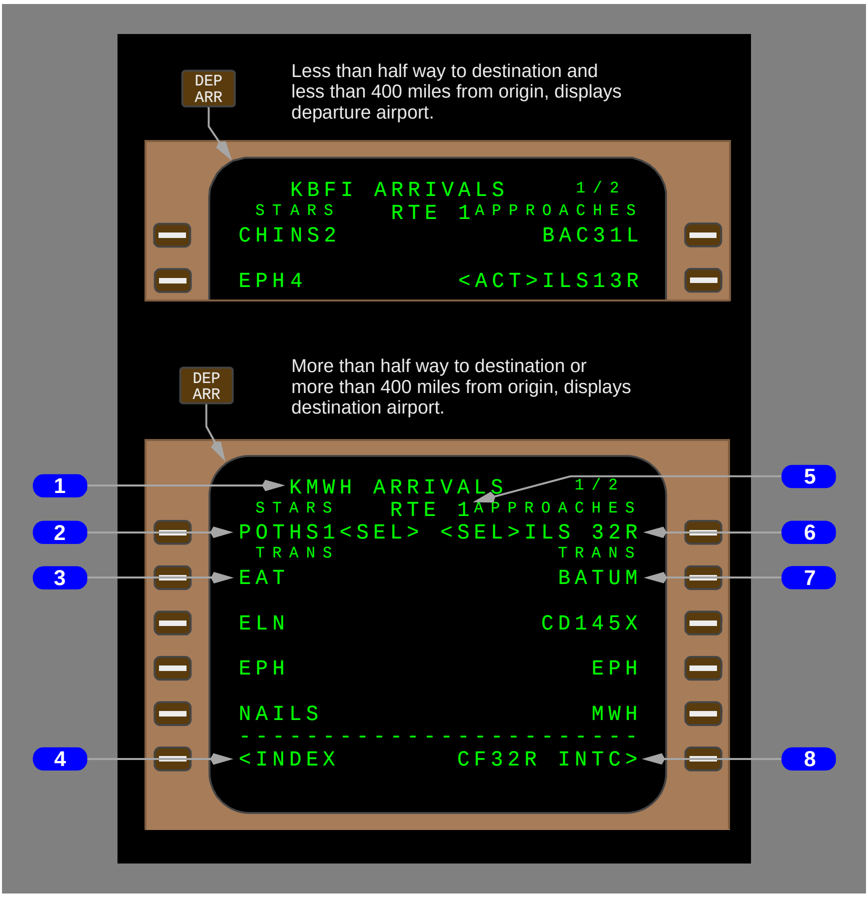
Arrivals Page – IFR Approaches

The arrivals page allows selection of an approach, standard terminal arrival route (STAR), and an arrival transition to the destination airport. This page can also be used to view data about a selected airport that is not the destination. Route 1 and Route 2 have separate arrival pages.

The approaches, STARS/profile descents, and transitions are shown and selected on this page.

Selecting Options

Selecting a runway, approach, approach transition, STAR/profile descent, or descent transition option shows <SEL> inboard of the selection, and makes a route modification. The other options within the same category are removed from the list. When the modification is executed, <SEL> changes to <ACT>. Select another page and return to ARRIVALS to show all options; the applicable <SEL> or <ACT> prompts are shown.



1 Page Title

The destination airport identifier is shown in the title.

Airports with more than 5 runways or STARs produce multiple arrivals pages.

2 Standard Terminal Arrivals (STARS)

Lists the STARS and PROFILE DESCENTS for the airport.

STARS are shown first in a list under the STAR line title. Profile descents are listed after the STARS under the PROF DES line title.

When a selection is made the procedures not selected are removed from the page. The selected procedure is listed with <SEL> and a list of compatible transitions is shown.

3 Standard Terminal Arrivals Transitions (STARS TRANS)

Lists all the transitions for the selected STAR.

When a selection is made the transitions not selected are removed from the page. The selected transition is listed and marked <SEL>.

4 INDEX

Push – shows the DEP/ARR INDEX page.

5 Route 1 (RTE 1)

Shows the active route number (RTE 1 or RTE 2).

6 APPROACHES

Lists all approaches and runways for the destination airport.

When a selection is made, other approaches and runways are removed from the page and compatible transitions are listed. The list of STARS and profile descents is reduced to those compatible with the selected approach.

7 Approach Transitions (APPROACHES TRANS)

Transitions are listed when an approach is selected. Shows a list of available transitions to the selected approach.

Approach transitions include:

- IAF
- feeder fix
- fixes which define routing to the FAF.

Selecting an approach without a transition makes a straight-in approach which starts at:

- a charted fix or CFXXX, where XXX is the runway number
- a waypoint 4–8 miles outside the final approach fix.

8 Final Approach Fix Intercept (XXXXX INTC)

Selecting the prompt shows a modified RTE LEGS page with an intercept course to the approach transition fix (usually the IAF) for the selected approach.

Vertical Angle Display on the Route Legs Page

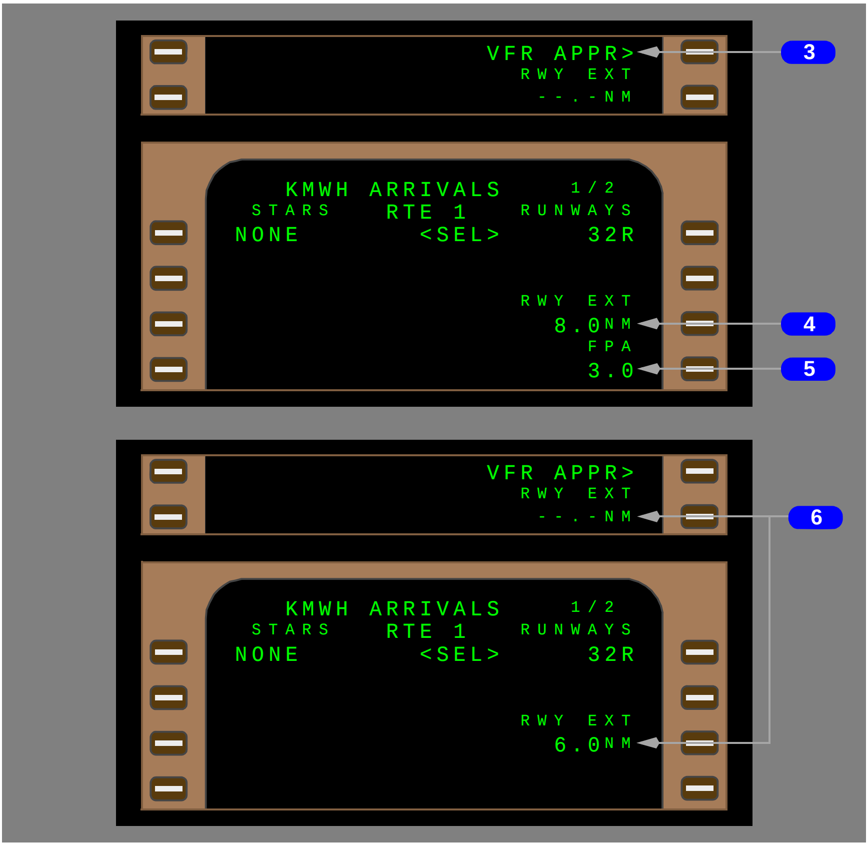
When a runway is selected as part of the active route the vertical angle of the flight path approaching the runway is displayed on the RTE LEGS page.

1 Glide Path (GP) Angle

Displays the vertical angle for use by VNAV on the final approach to the runway. If the runway was selected as part of a published approach, the displayed angle will be close to the published glide path angle but may differ slightly.

Arrivals Page – VFR Approaches

The arrivals page also allows selection of a VFR approach if the navigation database contains a VFR approach for the selected runway.



1 RUNWAYS

Push – removes approach list and other runways. Displays RWY EXT prompt and VFR APPR prompt in line 2 if a VFR approach is in the navigation database.

The RUNWAYS list for other runways is shown if a runway is not selected. Example shows runway 32R selected. Change the CDU to another page and return to the ARRIVALS page to show all arrival procedures.

2 ROUTE

Push – shows the active route page 2/X.

3 VFR Approach (VFR APPR)

Push – makes a transition waypoint, FAXXX at 8 NM and 2000 feet above the runway.

Shown when a VFR approach is in navigation data base for selected runway.

LNAV and VNAV guidance to the runway is available.

4 Runway Extension (RWY EXT)

After VFR APPR is selected, RWY EXT can not be modified.

5 Flight Path Angle (FPA)

Shows flight path angle. Shown only after VFR APPR is selected.

Default is 3.0 degrees. Valid entries are from 2.4 to 3.7 degrees.

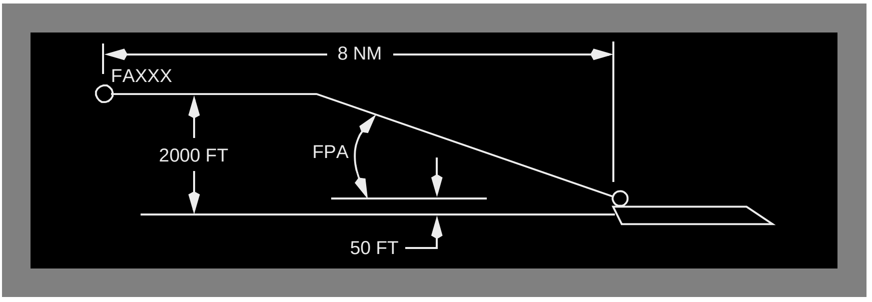
6 Runway Extension (RWY EXT)

Valid entries are from 1.0 to 25.0 miles from the runway threshold.

Entry allowed if VFR APPR is not selected. Entry removes VFR APPR prompt. Example shows 6 NM entered.

Makes waypoint RXYYY, where YYY is the runway; example: RX32R. Makes a route discontinuity before and after the waypoint.

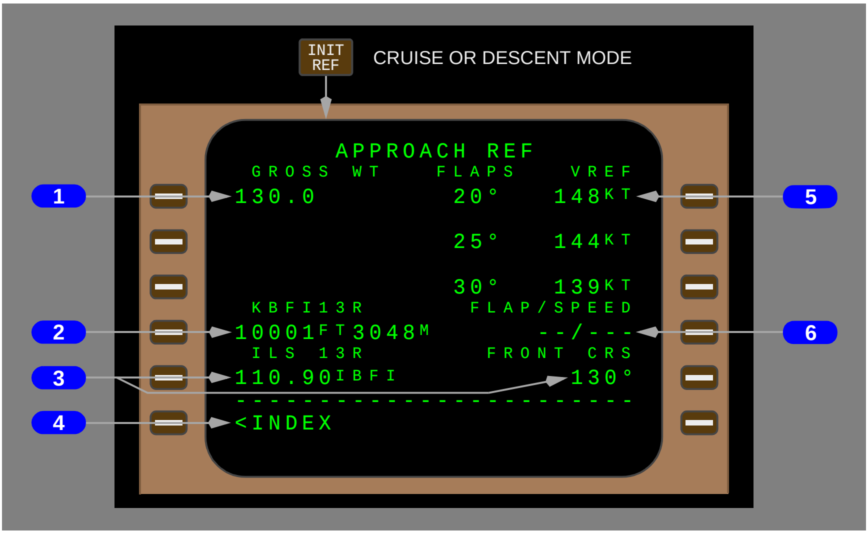
VFR Approach Path



The VFR approach is a level path until the FPA is intercepted. The FPA goes from the FAXXX waypoint altitude to the runway threshold at 50 feet and 170 knots. Default values are shown in RWY EXT and FPA.

Approach Reference Page

The approach reference page shows approach planning data and approach reference speed (VREF) selection.



1 Gross Weight (GROSS WT)

FMC calculated airplane gross weight is usually shown.

Manual entry is allowed in case the FMC calculated gross weight is unavailable or invalid, or to allow previewing recommended approach speeds at other than the calculated FMC gross weight. The manually entered gross weight is for reference only and is deleted when a different page is selected. Permanent changes to gross weight may only be made on the PERF INIT page.

Shows boxes when gross weight is not available from the FMC.

Valid entry is XXX.X.

2 Runway Length

The shown runway reference changes based on route progress. The destination runway is the reference when the present position is more than halfway to the destination or more than 400 NM from the origin airport. The origin airport runway is the reference when less than halfway or less than 400 NM from the origin airport.

Shows the length of the referenced runway in feet and meters.

3 ILS Frequency and FRONT Course (CRS)

Display is blank prior to entering a destination runway in the active route.

Displays the runway, corresponding ILS frequency, facility identifier and FRONT CRS from the navigation database for the runway shown.

4 INDEX

Push – shows the INIT/REF INDEX page.

5 FLAPS VREF

A gross weight is necessary for VREF speed calculation. Push the applicable line select key to select the correct VREF speed. The three VREF speeds are based on landing flap setting.

Shows the calculated reference speed for flaps 20°, 25°, and 30°.

The display is blank until a gross weight is shown.

6 FLAP/SPEED

The flap position and VREF speed is entered for landing.

The VREF speed is shown on the ADI speedtape.

Deletion of the data removes VREF from the ADI.

Alternate Airport Diversions

The ALTN page data helps the flight crew find the best alternate airport. The page has four airports shown in an ETA sequence. Each airport on the list has an ALTN XXXX page with more data. Select the ALTN XXXX page with a caret.

N422LA through N526LA

There are three uplinks messages that provide alternate airport data. The Company Preferred Alternates Uplink provides up to 4 alternate airports that are listed on the ALTN page 1/2. The Alternates Flight List Uplink provides a list of up to twenty alternate airports that are listed on ALTN page 2/2. And the Alternates Inhibit Uplink provides up to two alternate airports that are listed on the inhibit lines of ALTN page 1/2.

Alternate Page

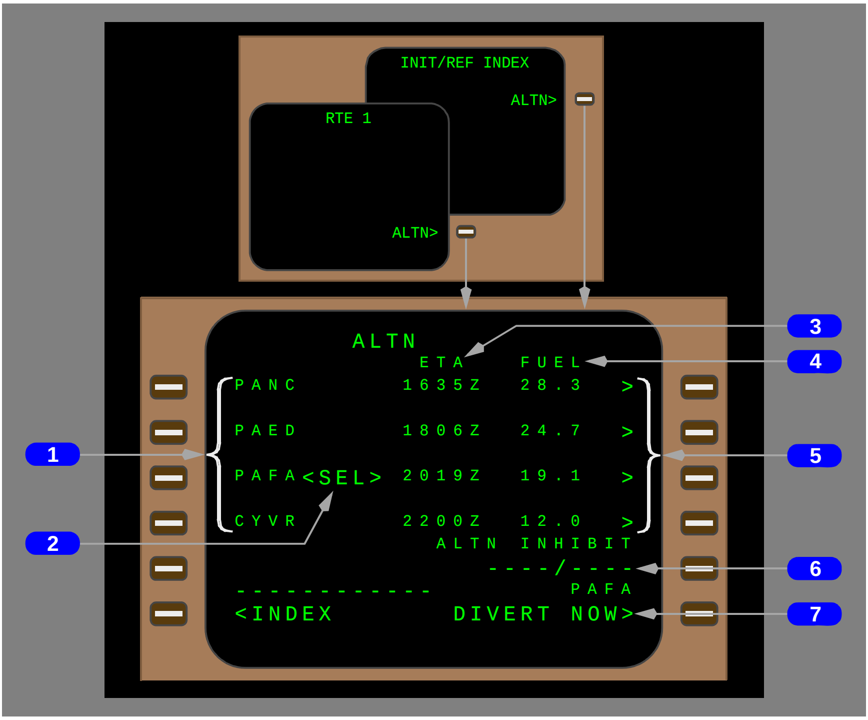
N316LA

The alternate page displays a list of alternate airports. An alternate airport can be selected from this page to change the flight plan destination.

The page displays a list of up to four alternate airports sorted in order of the ETA to the airport while airborne. The source of alternate airports can be:

- automatic selection from the navigation database
- manual entry.

Alternate airports automatically selected from the navigation database are displayed in small font. The presently selected alternate airport is shown on the map display in normal airport symbology. All four alternate airports are shown on the plan mode.



1 Alternate Airports

Displays the identifier of four alternate airports in ETA order when airborne. Displays the identifier of four alternate airports in distance order when on the ground.

Valid manual entry is an airport from the navigation database. A manual entry replaces the alternate where the entry is made and is shown in large font. After entry, the four airports are resequenced according to ETA.

Use the DELETE function to remove manually entered alternate airports from the ALTN page.

2 Selected (<SEL>), Automatically Selected (<A>)

<SEL> indicates a manually selected alternate airport.

A manual selection of an alternate airport is made by pushing the line select key left of the airport identifier with nothing in the scratchpad.

When there is no manually selected alternate the FMC automatically selects the alternate airport with the earliest ETA. Automatically selected alternates are indicated by <A> next to the airport identifier.

The selected alternate identifier is shown in the line title of the DIVERT NOW prompt.

Entering a new airport into the list deletes the last airport in the list and selects the new airport. After entry, the airports are rearranged in ETA sequence. Manually entered airports are shown in large font and can be removed using the DELETE function.

Use the DELETE function to remove the <SEL> from a manually selected alternate. The automatic selection function selects a new alternate.

3 ETA

Displays the alternate airport ETA.

ETA is calculated based on the routing, altitude, and speed shown on the XXXX ALTN page. ETA is blank when the airplane is on the ground.

4 FUEL

Displays the alternate airport predicted arrival fuel.

Predicted arrival fuel is calculated based on the routing, altitude, and speed shown on the XXXX ALTN page and includes a descent direct from a computed T/D to the ALTN airport at idle thrust. The message UNABLE FUEL is shown in the FUEL column if the predicted arrival fuel is less than zero.

Fuel values are blank when the airplane is on the ground.

5 Alternate Select

Selects the XXXX ALTN page, which contains more data about the specific airport.

6 Alternate Inhibit (ALTN INHIBIT)

An airport will not be one of the four alternate airports if entered into the alternate inhibit line.

One or two airports can be manually entered.

Valid entries are airports from the navigation database.

7 DIVERT NOW

The DIVERT NOW selection modifies the route to go from the present position to the selected alternate using the route shown on the XXXX ALTN page.

Push –

- makes an LNAV route modification for a divert to the selected alternate
- automatically displays the MOD XXXX ALTN page for the selected alternate
- displays SELECTED in this position on the CDUs not involved with the modification
- blank on ground
- blank in the air when a diversion is not permitted.

The DIVERT NOW selection changes the display to the XXXX ALTN page for the diversion airport. The details of the route can be confirmed or modified before the diversion is executed.

Execution of the diversion:

- changes the route destination airport
- includes the route modification into the active flight plan
- deletes all parts of the original route that are not part of the diversion
- if a descent path exists, deletes all descent constraints (the scratchpad message DESCENT PATH DELETED is shown when DIVERT NOW is selected).

After a divert is executed the XXXX ALTN page is not updated until all CDUs are selected off of the XXXX ALTN page.

Alternate Page 1/2

N422LA through N526LA

The first alternate page displays alternate airport data. An alternate airport can be selected to change the flight plan destination.

The page displays a list of up to four alternate airports sorted in order of the ETA to the airport while airborne. The source of alternate airports can be:

- an uplink directly to this page
- automatic selection from the ALTN LIST page
- automatic selection from the navigation database
- manual entry.

Alternate airports automatically selected from the alternate list or the navigation database are shown in a small font. The presently selected alternate airport is shown on the map display in normal airport symbology. All four alternate airports are shown on the plan mode.

1 Alternate Airports

Displays the identifier of the four alternate airports in ETA order when airborne. Displays the identifier of the four alternate airports in distance order when on the ground.

Valid manual entry is an airport from the navigation database. A manual entry replaces the alternate where the entry is made and is shown in large font. After entry, the four airports are resequenced according to ETA.

The DELETE function key can be used to remove manually entered alternate airports from the ALTN page.

2 Selected (<SEL>), Automatically Selected (<A>)

<SEL> indicates a manually selected alternate airport.

A manual selection of an alternate airport is made by pushing the line select key left of the airport identifier with nothing in the scratchpad.

When there is no manually selected alternate the FMC automatically selects the alternate airport with the earliest ETA. Automatically selected alternates are indicated by <A> next to the airport identifier.

The selected alternate identifier is shown in the line title of the DIVERT NOW prompt.

Entering a new airport into the list deletes the last airport in the list. After entry, the airports are rearranged in ETA sequence. Manually entered airports are shown in large font and can be removed using the DELETE function.

Use the DELETE function to remove the <SEL> from a manually selected alternate. The automatic selection function selects a new alternate.

3 Alternate Request (REQUEST SEND)

Push – transmits a data link request for company preferred alternates (up to four).

Uplinked airports are shown in ETA order but are assigned a preference number by the transmitting site. The scratchpad displays the message ALTN UPLINK when the alternate airport data arrives.

4 Weather Request (WXR REQUEST SEND)

Push – transmits a data link request for alternate airport weather data.

Uplinked weather is sent to the flight deck printer.

5 ETA

Displays the alternate airport ETA.

ETA is calculated based on the routing, altitude, and speed shown on the XXXX ALTN page. ETA is blank when the airplane is on the ground.

6 FUEL

Displays the alternate airport predicted arrival fuel.

Predicted arrival fuel is calculated based on the routing, altitude, and speed shown on the XXXX ALTN page and includes a descent direct from a computed T/D to the ALTN airport at idle thrust. The message UNABLE FUEL is shown in the FUEL column if the predicted arrival fuel is less than zero.

Fuel values are blank when the airplane is on the ground.

7 Alternate Select

Selects the XXXX ALTN page, which contains more data about the specific airport.

8 Alternate Inhibit (ALTN INHIBIT)

An airport will not be one of the four alternate airports if entered into the alternate inhibit line.

One or two airports can be entered.

Alternate inhibits can be manually entered or uplinked. The inhibited airports may be uplinked with the ALTN UPLINK or separately. If uplinked separately, the scratchpad displays the message ALTN INHIBIT UPLINK.

Valid entries are airports from the navigation database.

9 DIVERT NOW

The DIVERT NOW selection modifies the route to go from the present position to the selected alternate using the route shown on the XXXX ALTN page.

Push –

- makes an LNAV route modification for a divert to the selected alternate
- automatically displays the MOD XXXX ALTN page for the selected alternate
- displays SELECTED in this position on the CDUs not involved with the modification
- blank on ground
- blank in the air when a diversion is not permitted.

The DIVERT NOW selection changes the display to the XXXX ALTN page for the diversion airport. The details of the route can be confirmed or modified before the diversion is executed.

Execution of the diversion:

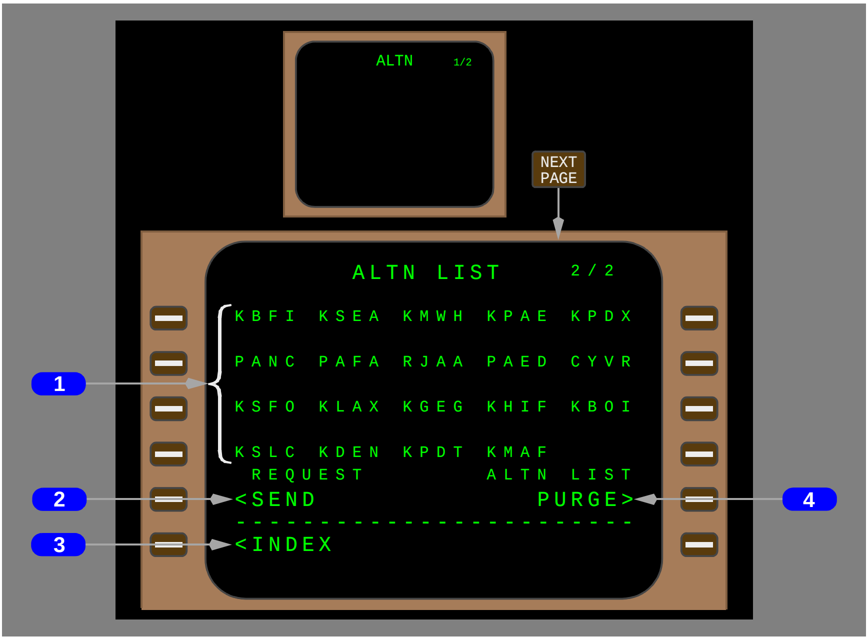
- changes the route destination airport
- includes the route modification into the active flight plan
- deletes all parts of the original route that are not part of the diversion
- if a descent path exists, deletes all descent constraints (the scratchpad message DESCENT PATH DELETED is shown when DIVERT NOW is selected).

After a divert is executed the XXXX ALTN page is not updated until all CDUs are selected off of the XXXX ALTN page.

Alternate List Page 2/2

N422LA through N526LA

The second alternate page displays a list of previously uplinked alternate airports. The alternates shown on the ALTN 1/2 page are automatically selected from this list, or from the navigation database when a list does not exist.



1 Alternate Airports List

The four lines contain up to 20 airports from which the alternates shown on the ALTN page 1/2 are automatically selected.

The alternates shown on the ALTN 1/2 page are selected by the FMC from this list when manually selected and preferred uplinked airports do not use all four selections.

The list is uplinked directly to this page. No manual entry is allowed. Manual airport entries are accomplished on the ALTN 1/2 page.

2 Alternate List Request (ALTN LIST REQUEST SEND)

Push – transmits a data link request for an alternate airport list uplink.

3 INDEX

Push – displays the INIT/REF INDEX page.

4 Alternate List Purge/Confirm (ALTN LIST PURGE/CONFIRM)

The entire alternate list can be deleted. A new list must be uplinked after a purge. When no list exists, the alternate airports are automatically selected from the navigation database.

Selecting PURGE arms the purge function and displays the CONFIRM prompt.

Selecting CONFIRM permanently deletes all airports from the alternate airport list.

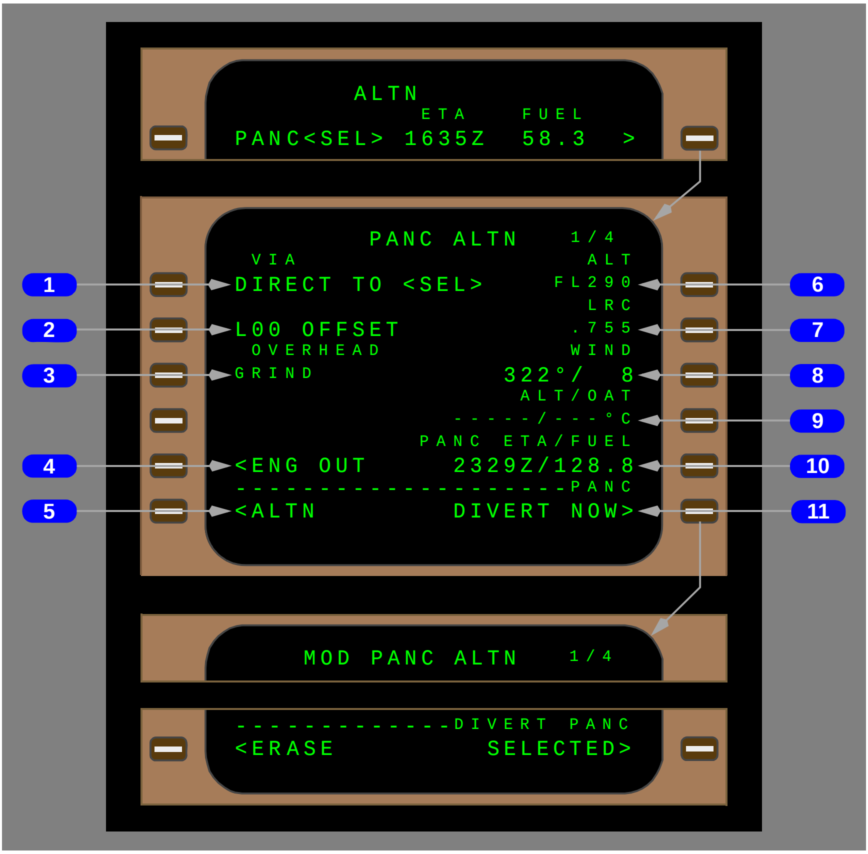
XXXX Alternate Page

Each of the four alternate airports shown on the ALTN page 1/2 have a related XXXX ALTN page. The XXXX ALTN pages show specific data about alternate airports, the route used for a diversion, and the conditions upon which the ETA and fuel calculations are based. All data on the page is related to the alternate airport shown in the page title.

Three route options to the airport can be selected:

- DIRECT TO – direct to alternate
- OFFSET – flight plan route with an offset
- OVERHEAD – flight plan route to a waypoint then direct to alternate.

The selected route option is identified by <SEL>. ETA and fuel remaining are calculated based on the selected option. Selection of a route option for one alternate selects the same route option for the other three alternates.



1 VIA DIRECT TO

Push – selects present position DIRECT TO alternate route option.

All flight plan waypoints are deleted.

2 VIA OFFSET

Push –

- with scratchpad empty, selects OFFSET route option
- with offset data in scratchpad, enters offset data. Does not select option.

Entry and exit to the offset is the same as for the RTE page offset. All flight plan waypoints are kept.

3 VIA OVERHEAD

Push –

- with scratchpad empty, selects OVERHEAD option
- with overhead data in scratchpad, enters overhead data. Does not select route option.

Displays active waypoint in flight plan.

The waypoints up to the selected or entered overhead waypoint are kept, then routing is direct to the alternate airport. All waypoints after overhead waypoint are deleted.

Enter any waypoint in the active or modified route.

4 Engine Out (ENG OUT)

This prompt performs the same function as described on the cruise page in the FMC Cruise section. It can be selected before or after the diversion is selected.

5 Alternate (ALTN)

Push – displays the ALTN 1/2 page.

6 Altitude (ALT)

Entry of any valid altitude or flight level into this line causes a recomputation of ETA and arrival fuel. Altitude entries do not become part of the diversion modification. Altitude entries apply to all four alternates.

Displays the altitude for which ETA and arrival fuel are calculated.

The scratchpad displays the message UNABLE ALT, if the entry is above maximum altitude or the top of climb point for divert is after top of descent point for divert.

7 Speed (SPD)

Entry of speed or Mach number into this line causes a recomputation of ETA and arrival fuel. Speed entries do not become part of the diversion modification. Speed entries apply to all four alternates.

Speed modes available are:

- ECON (economy)
- LRC (long range cruise)
- EO (engine out)
- EO LRC (engine out long range cruise)
- CO (company speed)
- any CAS or Mach.

8 **WIND**

Entry of data into these lines causes a recomputation of ETA and arrival fuel. A separate wind entry may be made for each of the four alternates.

Displays the estimated average wind for the divert route.

Valid entry is a direction in degrees/speed in knots from 1 to 999.

9 **Altitude/Outside Air Temperature (ALT/OAT)**

Entry of data into these lines causes a recomputation of ETA and arrival fuel. A separate ALT/OAT entry may be made for each of the four alternates.

Displays the OAT for a specific altitude.

Valid entry is an altitude/temperature in degrees C.

10 **Alternate Airport ETA/Fuel (XXXX ETA/FUEL)**

Displays the calculated airport ETA and arrival fuel based on the selected route, altitude, and speed shown on this page and includes a descent direct from a computed T/D to the ALTN airport at idle thrust.

11 **XXXX DIVERT NOW**

This prompt performs the same function as described on the ALTN 1/2 page.

Note: After a divert is executed, the XXXX ALTN page data is not updated until all CDUs change to a page other than the XXXX ALTN page.

Holding

The FMC computes holding patterns with constant radius turns based on current wind and FMC commanded airspeed. The pattern size is limited to FAA or ICAO protected airspace. In LNAV, the AFDS tracks the holding pattern using up to a 30 degree bank angle. Strong winds or airspeed in excess of FAA or ICAO entry speeds may result in the airplane flying outside the protected airspace.

Entry to a holding pattern is via the parallel, teardrop, or direct entry methods, dependant upon the airplane’s track to the hold fix. However, to make efficient use of the holding airspace, the airplane may begin the initial turn to the holding entry maneuver, parallel, teardrop or direct, just prior to crossing the hold fix ("fly-by"). In all entry maneuvers the airplane will "fly-over" or "fly-by" the holding fix as appropriate to remain on the holding side of the inbound hold course. Teardrop and parallel entry flight maneuvers are flown within the confines of the displayed holding pattern. Direct entry maneuvers may extend slightly beyond the end of the hold pattern.

Note: The holding pattern entry flight path is shown when the selected display range is 40 NM or less, and the holding fix is the active waypoint.

Hold Page (First Hold)

The hold page is used to enter a holding pattern into the route.

When the flight plan does not have a holding pattern, push the HOLD function key to show the RTE X LEGS page with the HOLD AT line.

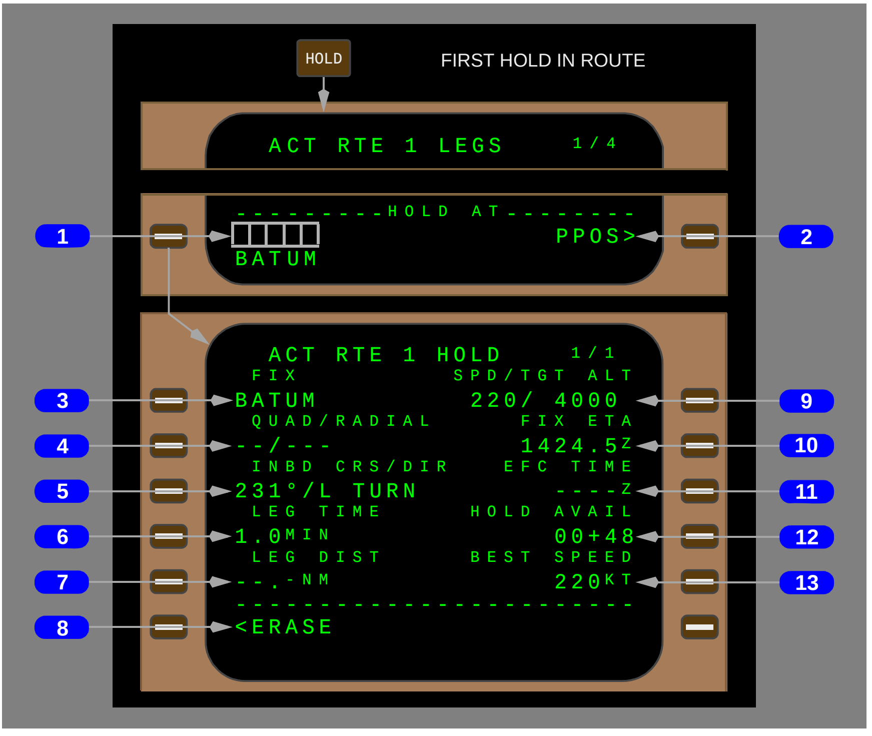
Two versions of the hold page are possible:

- an airway or procedure holding pattern
- a flight crew–entered holding pattern.

The holding page displays actual or default data about the holding pattern.

Entries make route modifications, which can be erased or executed.

Active holding patterns are displayed in magenta.



1 HOLD AT

When the HOLD function key is pushed and no holding pattern exists in the route, the RTE LEGS page displays prompts to enter the holding fix. Enter the holding fix to show the RTE X HOLD page.

Normally a route waypoint is entered as the holding fix. If a waypoint that is not part of the active route is entered the scratchpad message HOLD AT XXX appears where XXX is the entered waypoint. The holding fix can then be inserted in the route in the proper sequence.

2 HOLD AT Present Position (PPOS)

Selects the airplane present position as the holding fix.

3 Holding FIX

Displays the holding fix.

4 Quadrant/Radial (QUAD/RADIAL)

The holding quadrant and radial are entered.

Valid entry is X/XXX, XX/XXX, or /XXX (example NE/040).

Automatically changes INBD CRS/DIR to agree.

5 Inbound Course/Direction (INBD CRS/DIR)

Displays the holding inbound course and turn direction.

Valid entry is XXX (inbound course), XXX/X (inbound course/turn direction), /X or X (turn direction).

Automatically changes QUAD/RADIAL to agree.

6 LEG TIME

Default display is 1.0 MIN (minute) at or below 14,000 feet or 1.5 MIN above 14,000 feet.

Displays –.– if a LEG DIST is entered.

Valid entry is X, X.X, or .X in minutes from 0.1 to 9.9.

When climbing/descending through 14,000 feet with VNAV engaged and the SPD/TGT ALT values are displayed in large font, the FMC adjusts leg time (1.0 MIN at or below 14, 000 feet; 1.5 MIN above 14, 000 feet).

7 Leg Distance (LEG DIST)

Default display is —.– NM if no leg distance has been entered or if a LEG TIME is entered.

Valid entry is X.X, XX.X, or .X.

8 ERASE

Erases all FMC modifications.

9 **Speed/Target Altitude (SPD/TGT ALT)**

Waypoint holding fix speed/altitude constraint from the RTE LEGS page.

Manual entries are in large font.

During cruise, an altitude entry below cruise altitude activates the descent page, unless a new cruise altitude is entered. Altitude entry must be at or below cruise altitude.

A speed entry requires an altitude constraint.

10 **FIX ETA**

Displays the ETA to the next passing of the holding fix.

11 **Expect Further Clearance Time (EFC TIME)**

Enter the expect further clearance time to enable accurate fuel and ETA predictions after the hold.

12 **Hold Available (HOLD AVAIL)**

Displays calculated holding time available before requiring reserve fuel to reach the destination.

13 **BEST SPEED**

Displays the best holding speed for the airplane gross weight, altitude, and flap setting.

Note: May exceed ICAO limit speed.

Hold Page (Existing Hold)

When one or more holding patterns are already in the route, push the HOLD key to show the hold page for the first holding pattern. Holding parameters can be monitored and changed on this page. New holding patterns are added using the NEXT HOLD prompt.

1 NEXT HOLD

Push – displays a new hold page for a new holding pattern entry.

2 EXIT HOLD

Push –

- arms a return to the holding fix via the inbound course for holding pattern exit
- EXIT ARMED displayed
- EXEC light illuminated.

When the EXEC key is pushed, the airplane will cross the holding fix and exit holding. If executed when outbound in the holding pattern, the airplane will immediately turn inbound and exit holding when the fix is crossed.

The exit flight path is displayed as part of the active route when executed. Exit from the hold will be initiated prior to crossing the holding fix ("fly-by") if the course to the next route waypoint is not closely aligned with the inbound holding course. Acute angles between the inbound holding course and the course to the next waypoint may result in a substantial distance from the airplane to the holding fix during the exit maneuver; however, flight is maintained within FAA or ICAO protected holding airspace at all times.

Note: If a turn (course change) of 110°- 135° is required to exit the hold toward the next flight plan waypoint, the exit flight path may be displayed as a zigzag line, typically in the shape of a Z. In all instances, LNAV provides appropriate guidance via a smooth turn to intercept the active leg to the next route waypoint. There is no indication on the FMC CDU LEGS page if the displayed exit flight path is irregular.

Introduction

The CDUs can be used as an alternate navigation system if both FMCs fail. The CDUs perform lateral navigation computations. LNAV and VNAV are not available.

During normal FMC operation, all system capabilities are contained within the FMCs. During alternate navigation operation, the CDUs use their own internal memory and computing capability.

Each CDU performs its calculations based on inputs from its own IRS and provides information for display independent of the other CDU. Each CDU can display its route on its respective map display without database symbology.

Alternate Navigation Waypoints

The CDUs do not have a performance or navigation database. The CDUs continuously load the active route from the FMC. If both FMCs fail, the CDUs keep flight plan waypoints except for conditional waypoints, offsets, and holding patterns. Waypoints which are part of the route when the FMCs fail can be referenced by either their identifier, or latitude and longitude.

New waypoints can only be entered as latitude and longitude. This includes waypoints the flight crew has deleted from the CDU. Complete departure or arrival/approach procedures cannot be manually entered.

Waypoint Operations

Waypoint operations include:

- add new waypoints (latitude/longitude entry only)
- remove existing waypoints
- change the sequence of existing waypoints
- connect discontinuities.

Alternate Lateral Navigation

All CDU calculations are based on a great–circle course between waypoints.

Route Changes

Route changes are made on IRS LEGS page in almost the same manner as normal FMC operations. All courses between waypoints are direct routes. When the active waypoint is modified, the only navigational choice is present position direct to the modified active waypoint.

The two CDUs operate independently. A route change to one CDU does not change the other one. The route entered in the left CDU can be displayed on the captain's HSI using the left NAV source select switch. The route entered in the right CDU can be displayed on the first officer's HSI using the right NAV source select switch.

Course Reference

Each CDU uses its associated IRS for navigation data. The IRS supplies magnetic variation only for the present position. Therefore only the active waypoint course can be referenced to magnetic north. All subsequent courses are referenced to true north.

Alternate Navigation CDU Pages

The alternate navigation system provides two CDU pages:

- IRS LEGS
- IRS PROGRESS

Failure of a single FMC causes the related CDU to display the MENU page. Selecting the operable FMC on the NAV selector switch restores the CDU displays to normal.

If the other FMC fails, the IRS LEGS and IRS PROGRESS pages are available on either CDU via the LEGS and PROG mode select keys. Selecting CDU on the NAV source selectors provides a CDU generated map on the map display.

IRS Legs Page

This page displays data about each leg of the route. The route can be modified. Waypoint speed and altitude restrictions are not displayed because performance data is not available.

1 Leg Direction

Displays course to the waypoint.

Course reference is M for magnetic, T for true.

Active waypoint leg direction can be magnetic or true. Subsequent waypoint leg directions are true.

2 Waypoint Identifier

Displays the waypoint by name or latitude/longitude.

Valid entries are waypoint names that were in the route when the FMCs failed, or latitude/longitude for new waypoints.

3 Distance to Waypoint

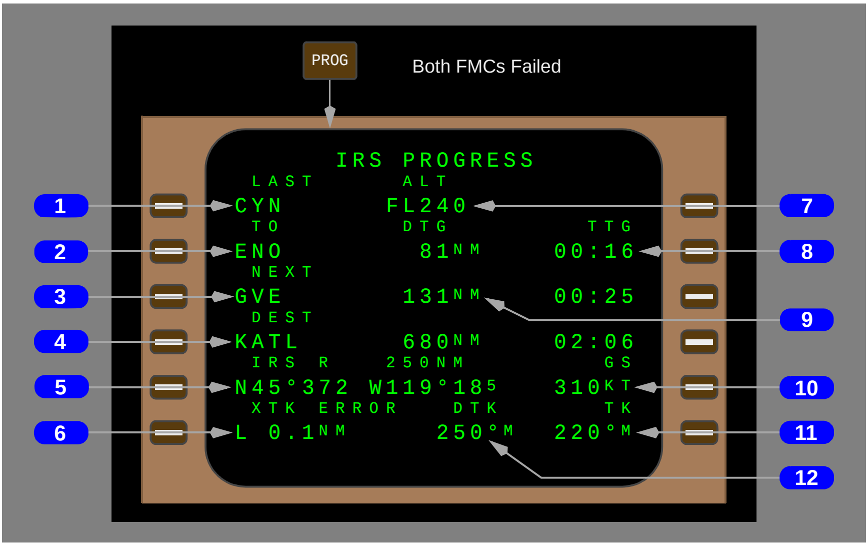
Displays the great circle distance between waypoints.

4 Waypoint Coordinates

Displays the waypoint coordinates.

IRS Progress Page

This page shows general data about flight progress.



1 LAST

Displays the identifier of the last waypoint.

2 TO

Displays the active waypoint.

3 NEXT

Displays the waypoint after the TO waypoint.

4 Destination (DEST)

Displays identifier for route destination waypoint or airport. Any waypoint on or off the route can be entered. Time and distance data temporarily displays for that waypoint.

Display options:

- destination airport identifier; distance and time to go along track to the destination airport
- entry of an existing flight plan waypoint (identifier or latitude/longitude) causes the line title to change to ENROUTE WPT. Time and distance to go are along the track to the enroute waypoint
- entry of a waypoint not in the flight plan causes the line title to change to DIR TO ALTERNATE. Time and distance to go are from the present position direct to the new waypoint.

5 IRS Position

Displays IRS present position.

Line title displays IRS source for position.

6 Cross Track Error (XTK ERROR)

Displays airplane left or right cross–track error in nautical miles from the active route track.

7 Altitude (ALT)

Displays airplane altitude when the LAST waypoint was crossed.

8 Time to Go (TTG)

Displays time to go to waypoint or destination.

9 Distance to Go (DTG)

Displays distance to go to waypoint or destination.

10 Ground Speed (GS)

Displays IRS groundspeed.

11 Track (TK)

Displays airplane track angle relative to the true or magnetic reference selected on the HEADING REFERENCE switch.

12 Desired Track (DTK)

Displays desired track angle relative to the true or magnetic reference selected on the HEADING REFERENCE switch.

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EICAS and CDU Messages

The following EICAS messages can be displayed to alert the flight crew to navigation system faults and failures.

Message	Level	Light	Aural	Condition

N422LA through N526LA

Message	Level	Light	Aural	Condition
ATC FAULT	Advisory	ATC FAIL		Selected transponder has failed.

N316LA

Message	Level	Light	Aural	Condition
ATC FAULT	Advisory	XPNDR FAIL		Selected transponder has failed.

Message	Level	Light	Aural	Condition
L FMC FAIL R FMC FAIL	Advisory	FAIL		FMC has failed.
FMC MESSAGE	Advisory	FMC		A message is in the FMC scratchpad.
L GPS R GPS	Advisory			Indicated GPS has failed.
GPS	Advisory			GPS system has failed.
L IRS DC FAIL C IRS DC FAIL R IRS DC FAIL	Advisory	DC FAIL		IRS DC backup power has failed and the IRS AC normal power is being used.
L IRS FAULT C IRS FAULT R IRS FAULT	Advisory	FAULT		An IRS fault is detected.
L IRS ON DC C IRS ON DC R IRS ON DC	Advisory	ON DC		Indicated IRS AC normal power has failed and the IRS DC backup power is being used.

Message	Level	Light	Aural	Condition
UNABLE RNP	Caution		Beeper	Navigation performance not meeting required accuracy. Message is a caution if fault occurs when the airplane is in "on approach" mode.
	Advisory			Message is an advisory if fault occurs when the airplane is not in "on approach" mode.

FMC Messages

FMC messages alert the flight crew to conditions that could degrade the system operation and advise the crew of input errors.

N422LA through N526LA
FMC messages also alert the flight crew to FMC datalink communications.

The messages are categorized as:

- alerting messages
- advisory messages

  N422LA through N526LA
- communications messages

The scratchpad messages display according to their level of importance. A less important message replaces another message in the scratchpad when the CLEAR key is pushed or the condition is corrected.

The FMC light illuminates and the EICAS advisory message FMC MESSAGE displays when there is an FMC alerting message.

N422LA through N526LA
The EICAS displays the white communications message •FMC when there is an FMC communications message.

N422LA through N526LA
The EICAS displays the white communications message •ATC when there is an ATC communications message.

Scratchpad advisory messages appear in the scratchpad without an EICAS message or FMC light. All FMC messages illuminate the CDU message (MSG) light. Clear the message or correct the condition to cancel the message.

Keying data into the scratchpad that contains an FMC message temporarily removes the message from the scratchpad. The message reappears in the scratchpad when the data is line selected into a display or cleared from the scratchpad.

FMC Alerting Messages

FMC alerting messages:

- display in the CDU scratchpad
- illuminate the amber FMC light on the center instrument panel
- cause the EICAS advisory message FMC MESSAGE to display
- illuminate the CDU message light (MSG).

Use the CLEAR key or correct the condition responsible for the message to remove the message.

N422LA through N526LA
ATC COMM ESTABLISHED – the active ATC data link connection is successfully established following initial AFN logon or a successful transfer.

N422LA through N526LA
ATC COMM TERMINATED – the active ATC data link connection is terminated without transfer.

N422LA through N526LA
ATC REPORT LIST FULL – an uplink message which includes an ATC REPORT or CONFIRM request is received and the ATC report list contains 10 reports.

CHECK AIRLINE POLICY – after loading a new airline modifiable information file, the FMC determines a parameter is invalid. The FMC uses the default value. This is a maintenance function.

CHECK ALT TGT – VNAV active and the airplane is between the MCP and FMC altitudes. VNAV maintains level flight.

CYCLE IRS OFF – NAV – With the airplane on the ground any IRS has detected a condition that requires cycling inertial power off and back to NAV.

DESCENT PATH DELETED – VNAV active and all waypoint altitude constraints defining the descent profile deleted.

Note: This message displays before execution of the modification which deletes the descent path.

DISCONTINUITY – LNAV active and the route is not defined after the waypoint (except when the waypoint is before a manually terminated leg, such as a VECTORS legs).

DRAG REQUIRED – VNAV active and additional drag required or autothrottle off and less thrust required to maintain the VNAV descent path.

END OF OFFSET – LNAV active and two minutes prior to end of active route offset. AFDS maintains last heading if active route offset overflown.

END OF ROUTE – LNAV active and end of active route overflown. AFDS maintains last heading.

ENTER IRS POSITION – the flight crew–entered present position did not pass one of the IRS comparison checks, or the IRS is ready to change to navigate mode and has not received a present position entry. Use the CLEAR key to remove this message.

FMC L (or R) OUTPUT LOSS – data output or discreet signals from indicated FMC are lost.

FUEL DISAGREE–PROG 2 – totalizer (TOTL) fuel quantity and FMC calculated (CALC) fuel quantity disagree by a significant amount.

INSUFFICIENT FUEL – estimated fuel at destination less than entered RESERVES value.

N422LA through N526LA
INVALID ATC UPLINK – an ATC uplink message received by the FMC contains errors.

IRS MOTION – an IRS has detected motion while in ALIGN.

IRS NAV ONLY – the FMC has been without radio or GPS updating for a predetermined time.

IRS POS/ORIGIN DISAGREE – valid inertial position differs from active origin airport.

LIMIT ALT FLXXX – the flight crew– or FMC–selected altitude is greater than the VNAV limit altitude.

N422LA through N526LA
MESSAGE LIMIT EXCEEDED – the flight crew attempts to select more than 5 message elements for inclusion in a downlink message.

NAV DATA OUT OF DATE – the clock calendar date is after the active navigation database valid calendar cycle.

NAV INVALID–TUNE XXXX – RNAV or VOR approach procedures must have a specific navaid tuned. It is either not tuned or a valid signal is not being received.

NO ACTIVE ROUTE – LNAV selected and no active route activated.

N422LA through N526LA
PARTIAL CLEARANCE LOADED – the FMC was able to load only a portion of the data contained in an ATC uplink clearance.

PERF/VNAV UNAVAILABLE – VNAV selected and gross weight, cost index, or cruise altitude are not entered.

N422LA through N526LA
RE–LOGON TO ATC COMM – one of the following conditions requires the flight crew to re–initiate ATC logon procedures.

- an invalid END SERVICE message is received
- an ATC LOGON message was transmitted and
  - no valid response received in the allotted time
  - the flight number is changed via the CDU
  - the tail number is changed via the CDU
  - the addressed ATC center sends a negative response.

RESET MCP ALT – 2 minutes prior to the top of descent point with VNAV active and MCP not set to altitude below cruise altitude.

N422LA through N526LA
RESPOND TO ATC UPLINKS – an ATC uplink is received which causes the pending uplink storage to be full.

N422LA through N526LA
RTA FIX DELETED – RTA fix has been deleted from the modified flight plan.

RW/ILS CRS ERROR – LOC mode armed and the selected ILS course is incorrect for the active route runway.

RW/ILS FREQ ERROR – the selected ILS frequency does not match frequency for runway in active route.

N422LA through N526LA
SET CLOCK TO UTC TIME – the UTC time from the GPS disagrees with the captain's clock by more than 12 seconds.

N422LA through N526LA
SET THRUST MODE – TO X – uplinked takeoff data is accepted and the thrust mode in the accepted data is different than currently set on the TMC.

SINGLE FMC L (or R) OPERATION – one FMC has failed, only the indicated FMC is operational.

SPLIT IRS OPERATION – a fault exists on an IRS making only two IRSs available for navigation.

TAKEOFF SPEEDS DELETED – selected V speeds have been deleted due to changes in takeoff performance or configuration data.

THRUST REQUIRED – VNAV active, autothrottle disconnected, and additional thrust required to track VNAV descent path and maintain speed.

N422LA through N526LA
UNABLE FLXXX AT RTA FIX – predicted crossing altitude at RTA fix less than FLXXX, but predicted ETA within tolerance.

UNABLE NEXT ALT – VNAV active and climb not sufficient to comply with waypoint altitude constraint.

N422LA through N526LA
UNABLE RTA – RTA not achievable within applicable arrival time tolerance.

N422LA through N526LA
UNABLE TO LOAD CLEARANCE – the FMC is unable to load any of the data contained in a loadable ATC uplink clearance/

N422LA through N526LA
UNABLE TO SEND MSG – FMC is unable to send a message after a manual initiation of a downlink.

VERIFY POSITION – the difference between the FMC position and other position data exceeds a comparison threshold. The possible conflicts are:

- the left FMC position differs from the right FMC position
- the radio position, with radio updating, differs from the FMC position
- the GPS position, with GPS updating, differs from the FMC position

VERIFY RNP – POS REF 2 – the default RNP has changed due to a change in flight phase and the flight crew entered RNP value exceeds the new default RNP value.

VIA OFFSET INVALID – flight conditions invalidate the modification with a divert to an alternate airport via OFFSET.

FMC Communications Messages
N422LA through N526LA

FMC communications messages:

- display in the CDU scratchpad
- cause the EICAS communications message •FMC to display
- illuminate the CDU message light (MSG)
- cause the communications aural high–low chime to sound.

ALTN UPLINK – Up to four company–preferred alternate airports and associated data has been received and is available for preview on the ALTN page.

ALTN INHIBIT UPLINK – uplink contains two airports for the ALTN page 1/2 ALTN INHIB line.

ALTN LIST UPLINK – a company list of up to 20 alternate airports has been received and is available on the ALTN LIST page.

DES FORECST UPLINK READY – descent forecast data has been received and is available for loading on the DESCENT FORECAST page.

FLT NUMBER UPLINK – a new flight number has been received and is available on the RTE page 1/X.

INVALID TAKEOFF XXX/YYY – takeoff data for up to six runways or runway intersection pairs has been received but some data for one runway or runway intersection pair (RWXXX/YYY) is invalid.

PARTIAL ROUTE X UPLINK – a new route has been uplinked to the FMC but a portion of the route could not be loaded.

PERF INIT UPLINK – performance initialization data has been received and is available for preview on the PERF INIT page.

ROUTE X UPLINK READY – a new route or route modification has been received and is available for loading on the RTE X page.

TAKEOFF DATA LOADED – An uplink containing takeoff data matching the runway/position entry on the takeoff page is available for preview (only displays after an initial takeoff uplink has been received) or alternate thrust and/or flaps have been selected.

TAKEOFF DATA UPLINK – an uplink containing takeoff data matching the runway on the takeoff page is available for preview.

WIND DATA UPLINK READY – wind data has been received and is available for loading into the active route.

FMC Advisory Messages

FMC advisory messages are displayed on the CDU scratchpad and illuminate the CDU message light (MSG). There are no EICAS messages associated with these messages and they do not cause the FMC light to illuminate.

Those messages which are caused by an entry error must be cleared before the entry can continue.

CRS REVERSAL AT FA FIX – a conflict exists between the default final approach (FA) waypoint (result of a runway or VFR approach selection) and the flight plan before it.

DELETE – DELETE key pushed.

ENG OUT SID MOD – an engine failure is sensed after takeoff before the flaps are fully retracted; the FMC has automatically loaded an available engine out standard instrument departure as a route modification to the active route.

HOLD AT XXXX – a waypoint not contained in the active route is entered into the HOLD AT box on the RTE LEGS page, after selection of the HOLD function key. Selection of HOLD AT XXXX into a RTE LEGS page waypoint line makes a holding fix at the XXXX waypoint.

INVALID DELETE – deletion of selected data is not allowed.

INVALID ENTRY – entry format or range is incorrect for the selected field or the entered airway or TO waypoint does not coincide with the navigation database.

N422LA through N526LA

INVALID ENTRY – RTA ACTIVE – entry of an ECON cruise speed while RTA is active.

INVALID TUNE REQUEST – attempt to remotely tune a VOR is not valid.

KEY/FUNCTION INOP – selected mode key is inoperative.

MANUALLY TUNED – attempt to remotely tune a VOR that is manually tuned.

MAX ALT FLXXX – the altitude entry on any CDU page is above the performance calculated maximum altitude.

NOT IN DATABASE – data is not in the route or the navigation database.

NOT ON INTERCEPT HEADING – LNAV selected and the airplane is outside active capture criteria and the present heading will not intercept the active leg.

ROUTE FULL – the route is filled to the allowable capacity.

RUNWAY N/A FOR SID – selected runway not compatible with SID.

STANDBY ONE – the FMC requires more than 4 seconds to display data.

TIMEOUT–RESELECT – communication between the FMC and the CDU has failed. The flight crew must reselect FMC on the CDU MENU page.

UNABLE CRZ ALT – performance predicts a zero cruise time at the entered cruise altitude.

VERIFY RNP ENTRY – the entered RNP value is greater than the default RNP value for the present flight phase or, less than the present Actual Navigation Performance.

VOR AAA INVALID – signal is lost from remotely tuned VOR. AAA is the identifier for the VOR.

XXXXX – altitude set in the MCP window when VNAV is engaged, the CLB or CRZ page is displayed, and the altitude is above, within 4000 feet below, and not equal to the CRZ ALT.

FMC Datalink Advisory Messages

N422LA through N526LA

FMC datalink advisory messages are displayed the same as other FMC advisory messages but are associated with datalink operations.

INVALID ALTN UPLINK – a company–preferred list of alternate airports and associated alternate data has been received but the data is not valid and can not be displayed.

INVALID ALTN LIST UPLINK – a company list of up to 20 alternate airports has been received but the data is not valid and cannot be displayed.

INVALID FLT NO UPLINK – a new flight number has been received but the data is not valid and cannot be displayed.

INVALID FORECAST UPLINK – descent forecast data has been received but the data is not valid and cannot be displayed.

INVALID PERF INIT UPLINK – performance initialization data has been received but the data is not valid and cannot be displayed.

INVALID ROUTE UPLINK – a new flight plan route or modification to the active flight plan route has been received but the data is not valid and cannot be displayed.

INVALID TAKEOFF UPLINK – takeoff data for up to six runways or runway–intersection pairs has been received but the data is not valid and cannot be displayed.

INVALID WIND DATA UPLINK – en route wind data has been received but the data is not valid and cannot be displayed.

ROUTE X UPLINK LOADING – a new flight plan route or modification to the active flight plan route has been received and is being loaded after flight crew selection of the LOAD prompt.

CDU Annunciator Lights

These annunciator lights illuminate when certain conditions exists.

DSPY – a flight plan modification is pending and the RTE, RTE LEGS, RTE DATA, or RTE HOLD page not containing the active leg or route segment is displayed, or a VNAV page (CLB, CRZ, or DES) not corresponding to the active VNAV mode is displayed.

OFST – an offset path has been entered and executed.

MSG – an FMC message is waiting to display or is displayed.

FAIL – the associated FMC has failed.

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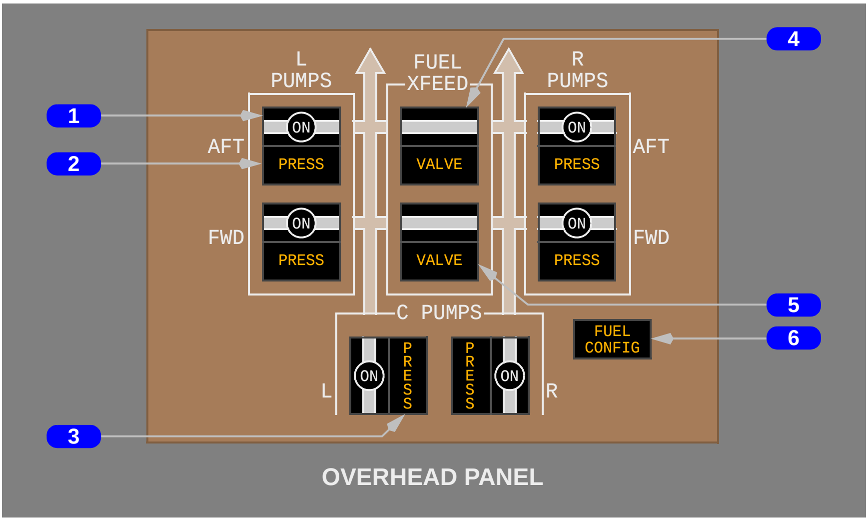
Fuel System



1 Left/Center/Right (L/C/R PUMPS) Switches

ON – the fuel pump is selected ON

Off (ON not visible) – the fuel pump is selected off

2 Left/Right Pump Pressure (PRESS) Lights

Illuminated (amber) – fuel pump output pressure is low

3 Center Pump Pressure (PRESS) Lights

Illuminated (amber) –

- fuel pump output pressure is low with the pump selected ON
- associated N2 below 50% with pump switch ON

Note: Illumination is inhibited when the center tank fuel pump switch is selected OFF.

4 Fuel Crossfeed (FUEL XFEED) Switches

On (bar visible) – the crossfeed valve is selected open

Off (bar not visible) – the crossfeed valve is selected closed

5 Crossfeed VALVE Light

Illuminated (amber) – the crossfeed valve is not in the selected position

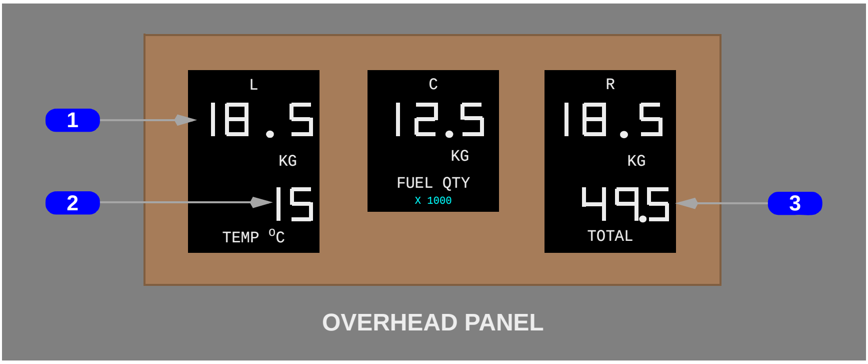
6 Fuel Configuration (FUEL CONFIG) Light

Illuminated (amber) –

- low fuel quantity
- imbalance between left and right main tanks
- center tank fuel pumps off with fuel in center tanks

Fuel Indications

Fuel Quantity Indicator



1 Fuel Quantity (L/C/R FUEL QTY) Indication

Displays usable fuel quantity in the left main, center, and right main tank (kilograms x 1000)

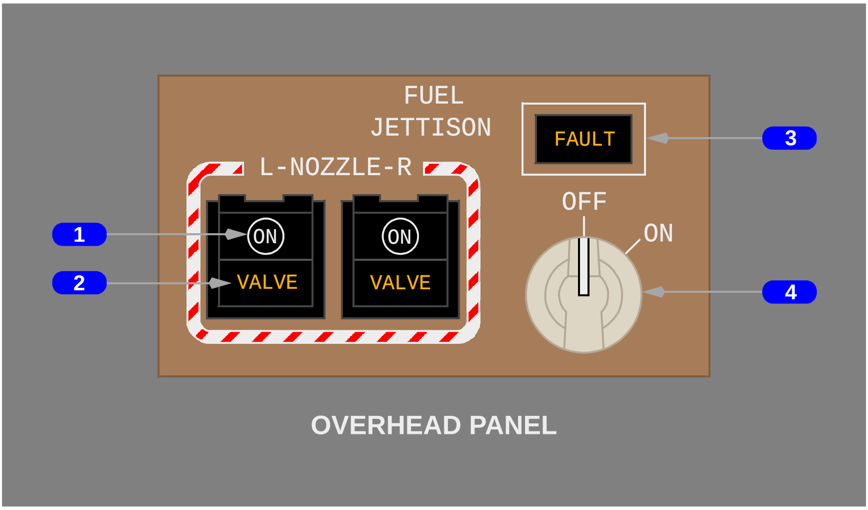
2 Fuel Temperature (TEMP) Indication

Displays temperature of fuel in the left main tank (degrees celsius)

3 TOTAL Fuel Quantity Indication

Displays total usable fuel quantity in all tanks (kilograms x 1000)

Fuel Jettison



1 Fuel Jettison Nozzle Switches (L–NOZZLE–R)

ON – opens respective jettison nozzle

Off (ON not visible) – closes respective jettison nozzle

2 Fuel Jettison Nozzle VALVE Lights

Illuminated (amber) – the jettison nozzle valve is not in the selected position

3 FAULT Light

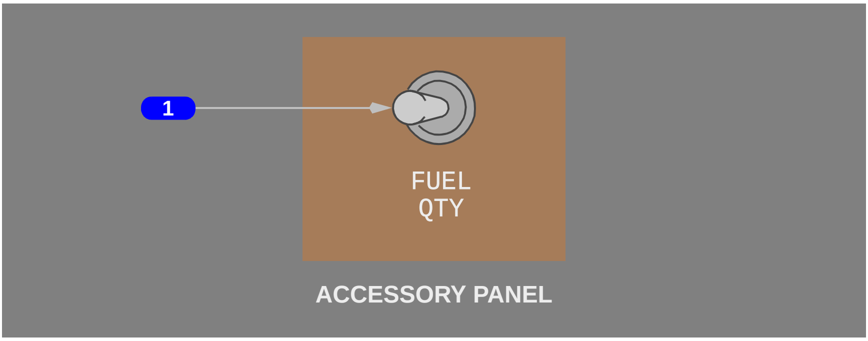
Illuminated (amber) – jettison pump(s) and/or transfer valve(s) disagree with jettison switch position

4 Fuel Jettison Selector

OFF – closes both jettison transfer valves and turns off jettison pumps

ON – opens both jettison transfer valves and turns on jettison pumps

Fuel Quantity Test



1 Fuel Quantity (FUEL QTY) Test Switch

Spring–loaded to center

Initiates fuel quantity test

Introduction

The fuel system supplies fuel to the engines and the APU. The fuel is contained in a center tank, and left and right main tanks.

Refer to Chapter 7, Engines, APU, for an additional description of the engine and APU fuel systems.

Fuel Quantity

Fuel quantity data, measured by probes in each tank, is fed to the fuel quantity processor where it is corrected for density then displayed on a fuel quantity indicator for each tank. Total fuel quantity, from a separate calculation, is shown on the total fuel quantity indicator and is also provided to the FMC.

When total usable fuel in either the left or right main tank drops below approximately 1000 kilograms, the FUEL CONFIG light illuminates and the LOW FUEL caution message is displayed.

Fuel Temperature

Temperature of the fuel in the left main tank is displayed on the fuel temperature indicator.

Fuel Pumps

Each fuel tank contains two AC–powered fuel pumps. A single pump can supply sufficient fuel to operate one engine under all conditions.

The two center tank fuel pumps have greater output pressure than the left and right main tank fuel pumps. When all six pumps are operating, the center tank pumps override the left and right main tank pumps so that center tank fuel is used before left or right main tank fuel.

If any pump has low output pressure, the appropriate switch PRESS light illuminates and the pump pressure EICAS message is displayed. If the main tank pump switches are OFF, the low pressure lights are illuminated and EICAS messages for the pumps are displayed. When the center pump switches are OFF, the low pressure lights and EICAS messages for the center pumps are inhibited.

To reduce electrical loads, the center tank pumps are inhibited when the associated N2 is less than 50% RPM. Thus both center tank pumps are inhibited when the engines are shutdown. As an engine is started and N2 RPM increases above 50%, the inhibit is removed for the associated center tank pump.

The EICAS caution messages, L or R FUEL SYS PRESS, displays when all fuel pumps have low output pressure or all fuel pumps on one side have low output pressure and the crossfeed switches are off.

The fuel pump low pressure messages are inhibited by the corresponding L or R FUEL SYS PRESS messages.

During normal operation, the EICAS advisory messages CTR L FUEL PUMP and CTR R FUEL PUMP display to indicate depletion of center tank fuel.

With either message displayed, a small amount of center tank fuel may be indicated. A scavenge system will operate automatically to transfer any remaining center tank fuel to the main tanks. Fuel scavenge begins when the main tanks are approximately half empty.

N422LA through N526LA
(SB Adds N316LA when center tank fuel pumps auto shutoff system installed.)
An automatic center tank fuel pump power removal system is installed on each center tank fuel pump. Several seconds after display of the CTR L FUEL PUMP or CTR R FUEL PUMP message on EICAS, power is automatically removed from the respective pump. Operation of the automatic power removal system is transparent to the flight crew and is installed to ensure continued center tank fuel pump operation is terminated. Reselecting a center tank fuel pump switch on will reset power to the respective pump.

The left main tank contains a DC–powered fuel pump. It has no controls or indicators. The DC pump operates automatically to provide fuel to the APU when AC power is not available and the APU selector is ON.

Fuel Crossfeed

The fuel manifolds are arranged so that any fuel tank pump can supply either engine. Two crossfeed valves isolate the left fuel manifold from the right. These valves are normally closed providing fuel feed from tank to engine. Both valves are opened any time it becomes necessary to feed an engine from an opposite fuel tank. Only one open crossfeed valve is required for successful crossfeed operation. A valve disagreement light illuminates and the EICAS advisory message FWD FUEL X–FEED or AFT FUEL X–FEED displays if a valve position does not agree with its switch position. The L or R FUEL SYS PRESS messages are inhibited with either crossfeed valve open.

Suction Feed

When main tank fuel pump pressure is low, each engine can draw fuel from its corresponding main tank through a suction feed line that bypasses the pumps. As the airplane climbs, dissolved air is released from the fuel in the tank due to the decrease in air pressure. This air may collect in the suction feed line and restrict fuel flow. At high altitude, thrust deterioration or engine flameout may occur as a result of the fuel flow reduction.

Fuel pressure can be provided from a main tank with operating fuel pumps to both engines by opening the fuel crossfeed valves. Continued crossfeed use will result in a progressive fuel imbalance.

The dissolved air in the fuel tank will eventually deplete after reaching cruise altitude. The depletion time is dependent upon airplane altitude, fuel temperature, and type of fuel. Once the dissolved air is depleted, the engine may be capable of suction feed operation at cruise power.

Fuel Configuration Light

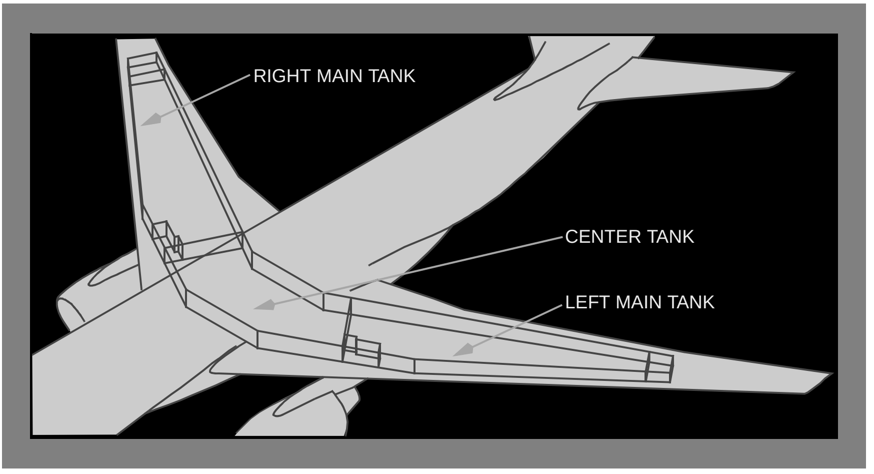
When the fuel quantity in left and right main tanks differ by 900 kilograms (plus or minus 200 kilograms) or center fuel pump switches are OFF with more than 500 kilograms in the center tank, the FUEL CONFIG light illuminates and the EICAS advisory message FUEL CONFIG is displayed.

The FUEL CONFIG light also illuminates when the EICAS caution message LOW FUEL is displayed.

Fuel Imbalance

Fuel balancing is accomplished by opening the crossfeed valves and turning off the fuel pump switches for the left or right main fuel tank that has the lowest quantity. Fuel balancing may be done in any phase of flight.

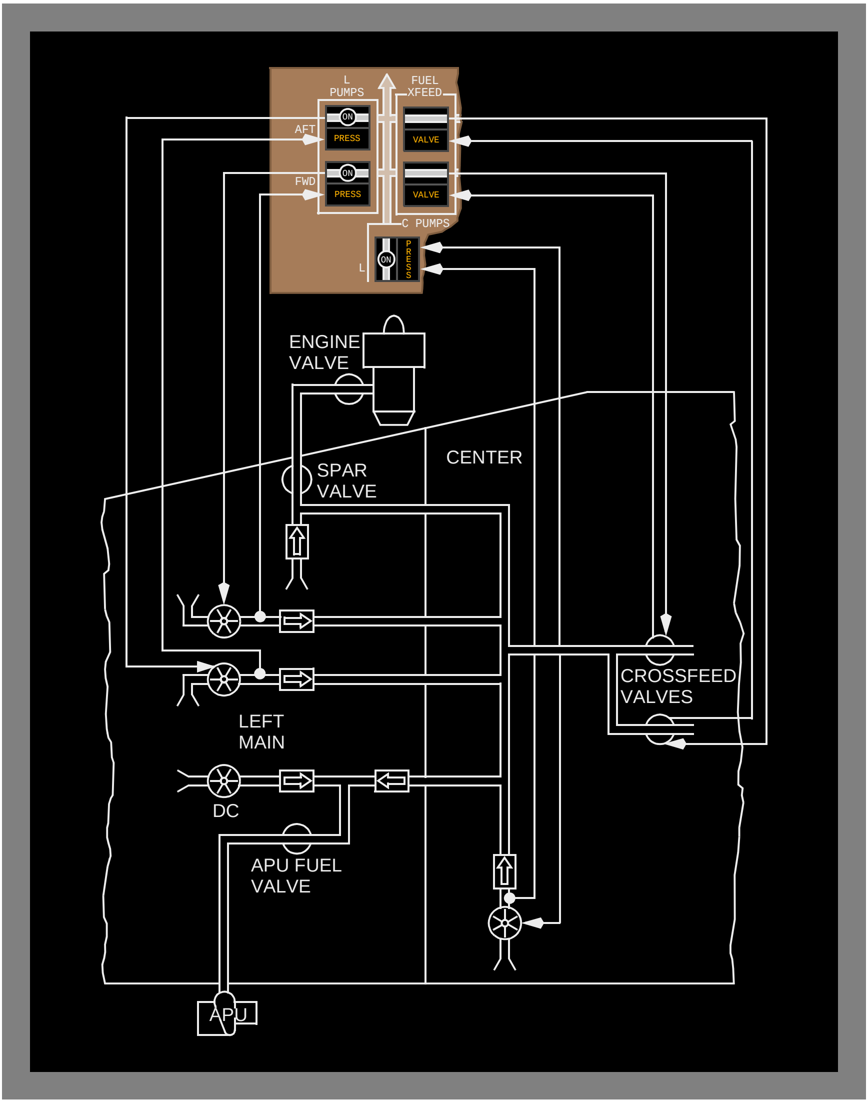
Fuel Tank Locations and Capacities
Fuel Tank Locations



Fuel Tank Capacities

Tank	Liters	Kilograms *
Left main	22,751	18,267
Right main	22,751	18,267
Center	45,272	36,349
Total	90,774	72,882
* Usable fuel at level attitude, fuel density = 0.8029 kilograms per liter		

Fuel System Schematic



APU Fuel Feed

APU fuel is supplied from the left fuel manifold. APU fuel can be provided by any AC fuel pump supplying fuel to the left fuel manifold or by the left main tank DC fuel pump.

On the ground, with the APU selector ON and no AC power available, the DC pump runs automatically. With AC power available, the left forward AC fuel pump operates automatically, regardless of fuel pump switch position, and the DC fuel pump turns off.

Fuel Jettison

The fuel jettison system allows jettison from the center fuel tank. Fuel is jettisoned through nozzles inboard of each outboard aileron. The common fuel manifold allows jettison pumps in the center tank to pump fuel overboard.

Two dual pump units provide a high capacity jettison rate of approximately 1200 kilograms per minute.

N422LA through N526LA
(SB Adds N316LA when center tank fuel pumps auto shutoff system installed.)
The automatic center tank fuel pump power removal system is inhibited during fuel jettison operation. All center tank fuel pumps associated with fuel jettison operation will continue to operate whenever the Fuel Jettison Selector is positioned ON.

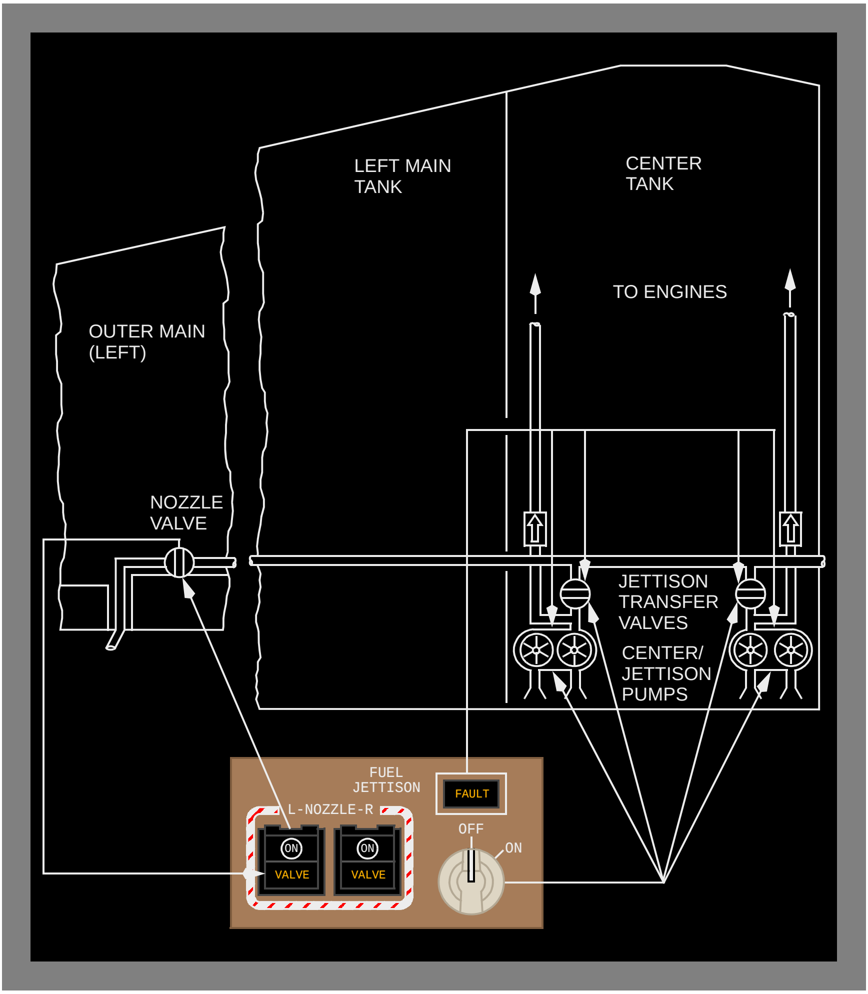
Fuel jettison begins when:

- the FUEL JETTISON selector is selected ON
- the jettison transfer valves open
- the jettison pumps operate
- the FUEL JETTISON NOZZLE switches are selected ON
- the nozzle valves open

The FMC discontinues fuel value calculations and the totalizer value is used during fuel jettison operation. After fuel jettison is complete, the calculated value will reset using the same value as the totalizer value.

The fuel disagree message is not displayed during fuel jettison operation.

Fuel Jettison Schematic



Fuel System FMS CDU Messages

The CDU can display the following messages.

INSUFFICIENT FUEL – Predicted fuel at destination is less than the FMC reserves

FUEL DISAGREE–PROG 2 – The fuel totalizer and calculated fuel quantity disagree

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Fuel System EICAS Messages

The following EICAS messages can be displayed.

Message	Level	Light	Aural	Condition
FUEL CONFIG	Advisory	FUEL CONFIG		Both center pump switches are OFF with fuel in the center tank, or a fuel imbalance between main tanks, or the fuel quantity is low in a main tank.
AFT FUEL X-FEED FWD FUEL X-FEED	Advisory	VALVE		The crossfeed valve position disagrees with the commanded position
FUEL JET NOZ	Advisory	VALVE		In flight, the nozzle valve position disagrees with the commanded position On the ground indicates one or both fuel nozzle valves are open
L FUEL JET PUMP R FUEL JET PUMP	Advisory	FAULT		The associated fuel jettison pump is inoperative
L JET XFER VALVE R JET XFER VALVE	Advisory	FAULT		The associated fuel jettison transfer valve is not in the commanded position

Message	Level	Light	Aural	Condition
CTR L FUEL PUMP CTR R FUEL PUMP L AFT FUEL PUMP R AFT FUEL PUMP L FWD FUEL PUMP R FWD FUEL PUMP	Advisory	PRESS		Fuel pump output pressure is low
L FUEL SYS PRESS R FUEL SYS PRESS	Caution		Beeper	All fuel pumps have low output pressure or all fuel pumps on one side have low output pressure and the crossfeed switches are off
LOW FUEL	Caution	FUEL CONFIG	Beeper	Fuel quantity is low in either left or right main tank

Hydraulics — Chapter 13
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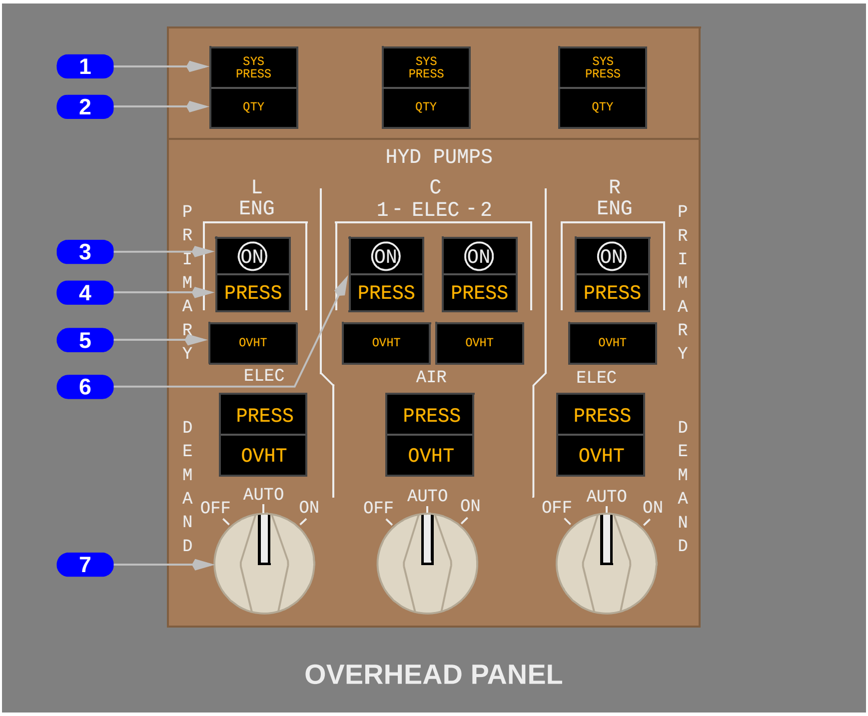
Hydraulic Panel



1 System Pressure (SYS PRESS) Lights

Illuminated (amber) – system pressure is low.

2 Reservoir Low Quantity (QTY) Lights

Illuminated (amber) – reservoir quantity is low.

3 Left/Right Engine (L/R ENG) Primary Pump Switches

ON – the engine–driven hydraulic pump pressurizes when engine rotates.

Off (ON not visible) – the engine–driven hydraulic pump is turned off and depressurized.

4 Pump Pressure (PRESS) Lights

Illuminated (amber) – pump output pressure is low.

5 Pump Overheat (OVHT) Lights

Illuminated (amber) – pump temperature is high.

6 Center 1/2 Electric (C1/2 ELEC) Primary Pump Switches

ON – the electric motor–driven pump pressurizes the center hydraulic system.

OFF (ON not visible) – the electric motor–driven hydraulic pump is turned off.

7 Left/Right Electric and Center Air (L/R ELEC and C AIR) Demand Pump Selectors

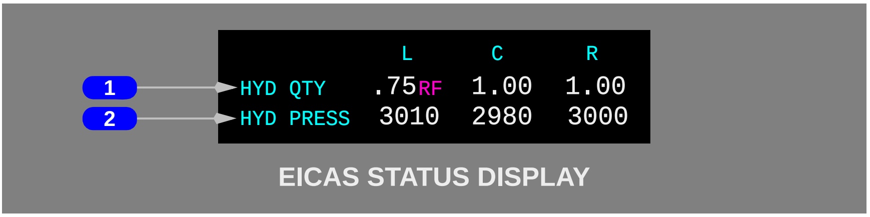
ON – continuous operation.

AUTO –

- left/right electric pumps operate when engine pump pressure is low
- center air demand pump operates when both center electric pump pressures are low
- center air demand pump operates when heavy load items are selected

OFF – pump off.

Status Display



1 Hydraulic Fluid Quantities (HYD QTY)

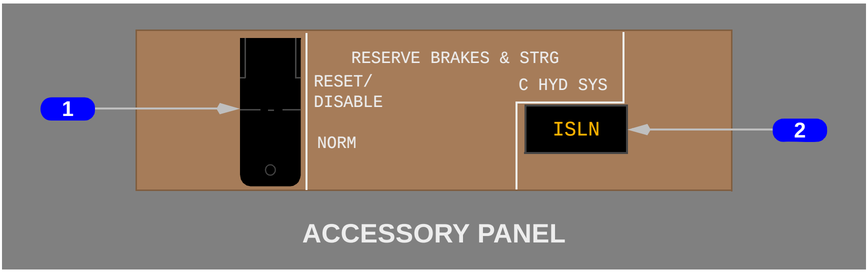
- displays system reservoir quantity (1.00 is the normal service level)
- RF (magenta) – displayed when the reservoir requires refilling

2 Hydraulic System Pressures (HYD PRESS)

Displays hydraulic pressure in pounds per square inch of the pump with the highest pressure.

Miscellaneous Hydraulic System Controls

Reserve Brakes and Steering Reset/Disable Switch



1 Reset/Disable Switch

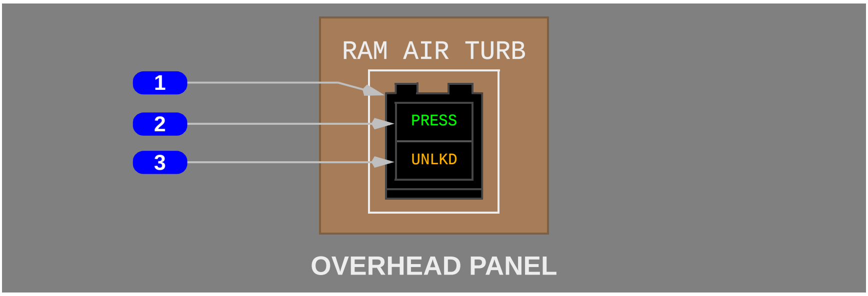
RESET/DISABLE – resets or disables the automatic isolation feature of the center hydraulic system.

NORM – the isolation feature is armed for automatic operation.

2 Isolation (ISLN) Light

Illuminated (white) – the center number one electric primary hydraulic pump is isolated to provide hydraulic pressure to the reserve brakes and steering system.

Ram Air Turbine



1 RAM AIR Turbine (TURB) Switch

Push – deploys the RAT.

2 Ram Air Turbine Pressure (PRESS) Light

Illuminated (green) –

- the RAT is deployed
- the RAT is producing hydraulic pressure

3 Ram Air Turbine Unlocked (UNLKD) Light

Illuminated (amber) – the RAT is not stowed and locked.

Hydraulics — Chapter 13
System Description — Section 20

Introduction

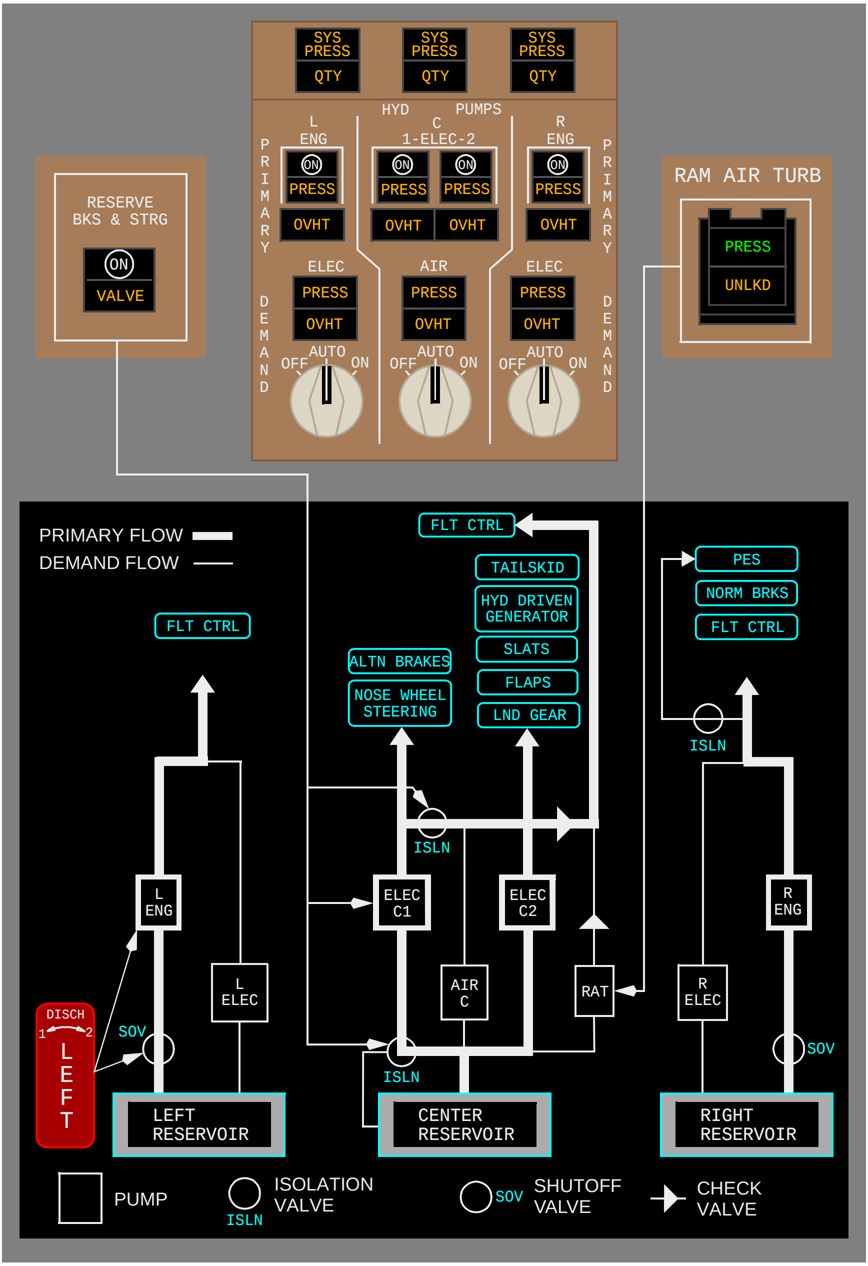
The airplane has three independent hydraulic systems: left, right, and center. The hydraulic systems power the:

- flight controls
- leading edge slats
- trailing edge flaps
- landing gear
- wheel brakes
- nose wheel steering
- autopilot servos
- tailskid

Flight control system components are distributed so that any one hydraulic system can provide adequate airplane controllability.

Hydraulic fluid is supplied to each hydraulic pump from the associated system reservoir. The reservoirs are pressurized by the bleed air system.

Hydraulic Systems Schematic



Left Hydraulic System

The left hydraulic system powers:

- flight controls

The system consists of a reservoir, engine–driven primary pump, and an electric motor–driven demand pump.

Fluid Supply

Hydraulic fluid is supplied to each hydraulic pump from a reservoir. The reservoir is pressurized by the bleed air system. A quantity measuring system provides information to the EICAS status display. RF displays on the EICAS status page when a reservoir requires refilling prior to dispatch.

The QTY light illuminates and the EICAS advisory message L HYD QTY displays when the reservoir quantity is low.

Fluid for the engine–driven pump flows through a shutoff valve controlled by the engine fire switch. Pulling the fire switch shuts off the flow of fluid to the engine pump and depressurizes the pump.

Engine–driven Primary Pump

The primary hydraulic system pump is an engine–driven pump.

The primary pump PRESS light illuminates and the EICAS advisory message L HYD PRIM PUMP displays when the pump output pressure is low. The pump OVHT light illuminates and the EICAS advisory message L PRIM HYD OVHT displays when the pump temperature is high.

Electric Motor–driven Demand Pump

An electric motor–driven demand pump provides additional hydraulic power either on demand or continuously for periods of high system demand. The demand pump also provides a backup hydraulic power source for the engine–driven primary pump.

The pump PRESS light illuminates and the EICAS advisory message L HYD DEM PUMP displays when the pump output pressure is low. The pump OVHT light illuminates and the EICAS advisory message L DEM HYD OVHT displays when the pump temperature is high.

To reduce electrical load, the left electric demand pump is inhibited on the ground during engine start of either engine, when only one electrical generator is operating. The left demand pump PRESS and SYS PRESS lights may illuminate when starting engines on the ground.

System Pressure Indications

The SYS PRESS light illuminates and the EICAS caution message L HYD SYS PRESS displays when the hydraulic system pressure is low.

Hydraulic system pressure displays on the EICAS status page.

Right Hydraulic System

The right hydraulic system is similar to the left system. The right system powers:

- flight controls
- normal brakes
- pitch enhancement system

The system consists of a reservoir, engine–driven primary pump, and an electric motor–driven demand pump.

Fluid Supply

The right reservoir is similar to the left system. The associated EICAS message for low reservoir quantity is R HYD QTY.

Engine–driven Primary Pump

The right engine–driven primary pump is identical to the left system. The associated EICAS messages for low pump output pressure or high pump temperature are R HYD PRIM PUMP and R PRIM HYD OVHT.

Electric Motor–driven Demand Pump

The right electric motor–driven demand pump is identical to the left system. The associated EICAS messages for low pump output pressure or high pump temperature are R HYD DEM PUMP and R DEM HYD OVHT.

System Pressure Indications

The right system pressure indications are similar to the left system. The associated message for low system pressure is R HYD SYS PRESS.

Hydraulic system pressure displays on the EICAS status page.

Center Hydraulic System

The center system powers:

- flight controls
- nose wheel steering
- flaps and slats
- alternate brakes
- landing gear

- hydraulic driven generator
- tailskid

The system consists of a reservoir, two electric motor–driven pumps, an air–driven demand pump, and a ram air turbine (RAT) pump.

Fluid Supply

The center reservoir is similar to the left system. The associated EICAS messages for low reservoir quantity is C HYD QTY.

The reservoir maintains reserve hydraulic fluid for use by the brakes and steering in the event of a center system hydraulic leak.

Electric Motor–driven Primary Pumps

The two center electric motor–driven primary pumps are identical to the left and right system electric motor-driven pumps. The C2 pump may be load shed automatically to reduce electrical loads. The associated EICAS messages for low pump output pressure or high pump temperature are C HYD PRIM 1, C HYD PRIM 2, C HYD 1 OVHT, and C HYD 2 OVHT.

Air–driven Demand Pump

An air–driven demand pump provides additional hydraulic power either on demand or continuously for periods of high system demand. The demand pump also provides a backup hydraulic power source for the electric motor–driven primary pumps.

The pump PRESS light illuminates and the EICAS advisory message C HYD DEM PUMP displays when the pump output pressure is low. The pump OVHT light illuminates and the EICAS advisory message C DEM HYD OVHT displays when the pump temperature is high.

Note: Landing gear retraction and flap extension/retraction times will be increased when the air–driven demand pump is inoperative.

System Pressure Indications

The center system pressure indications are similar to the left system. The associated message for low system pressure is C HYD SYS PRESS.

Hydraulic system pressure displays on the EICAS status page.

Reserve Brakes and Steering Isolation

The center number one electric primary hydraulic pump is automatically isolated, if system quantity is sensed low, to provide hydraulic pressure to the reserve brakes and steering system.

Hydraulic Driven Generator

A hydraulic driven generator is automatically powered by the center hydraulic system when electrical power is lost from both main AC busses. The center air demand pump will then operate continuously to ensure sufficient hydraulic pressure to drive the generator.

Ram Air Turbine (RAT) Pump

When deployed, the RAT, provides hydraulic power to the flight controls portion of the center hydraulic system. The RAT provides adequate hydraulic power at speeds above 130 knots. In flight, the RAT deploys automatically when both engines fail. The RAT is inhibited from auto deployment on the ground.

The RAT can be deployed manually by pushing the RAM AIR TURB switch. The UNLKD light illuminates and the EICAS advisory message RAT UNLOCKED displays when the RAT is not stowed and locked. Once the RAT is producing pressure the ram air turbine PRESS light illuminates. The SYS PRESS light remains illuminated if the RAT is the only source of center system pressure. Once deployed, the RAT cannot be stowed in flight.

Hydraulics EICAS Messages

The following EICAS messages can be displayed.

Message	Level	Light	Aural	Condition
C DEM HYD OVHT L DEM HYD OVHT R DEM HYD OVHT C HYD 1 OVHT C HYD 2 OVHT L PRIM HYD OVHT R PRIM HYD OVHT	Advisory	OVHT		Pump temperature is high.
C HYD DEM PUMP L HYD DEM PUMP R HYD DEM PUMP L HYD PRIM PUMP R HYD PRIM PUMP C HYD PRIM 1 C HYD PRIM 2	Advisory	PRESS		Pump output pressure is low.
C HYD QTY L HYD QTY R HYD QTY	Advisory	QTY		Hydraulic quantity is low.
C HYD SYS PRESS L HYD SYS PRESS R HYD SYS PRESS	Caution	SYS PRESS	Beeper	Hydraulic system pressure is low.
RAT UNLOCKED	Advisory	UNLKD		The ram air turbine is not stowed and locked.

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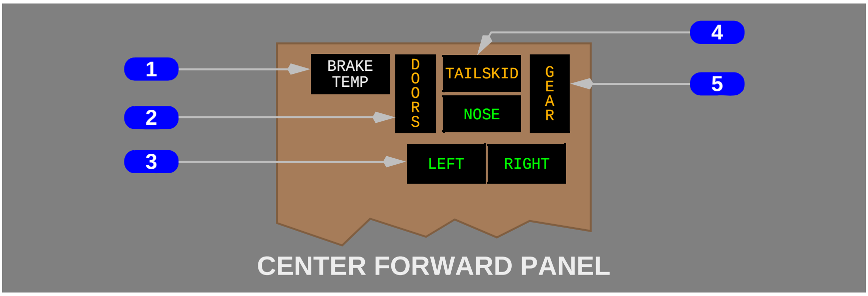
Landing Gear — Chapter 14
Controls and Indicators — Section 10

Landing Gear Panel



1 Brake Temperature (BRAKE TEMP) Light

Illuminated (white) – a wheel brake temperature is in high range (a value of 5 or above on the status page).

2 DOORS Light

Illuminated (amber) – a door is not closed.

3 Landing Gear Down Lights (NOSE, LEFT, and RIGHT)

Illuminated (green) – the associated landing gear is down and locked.

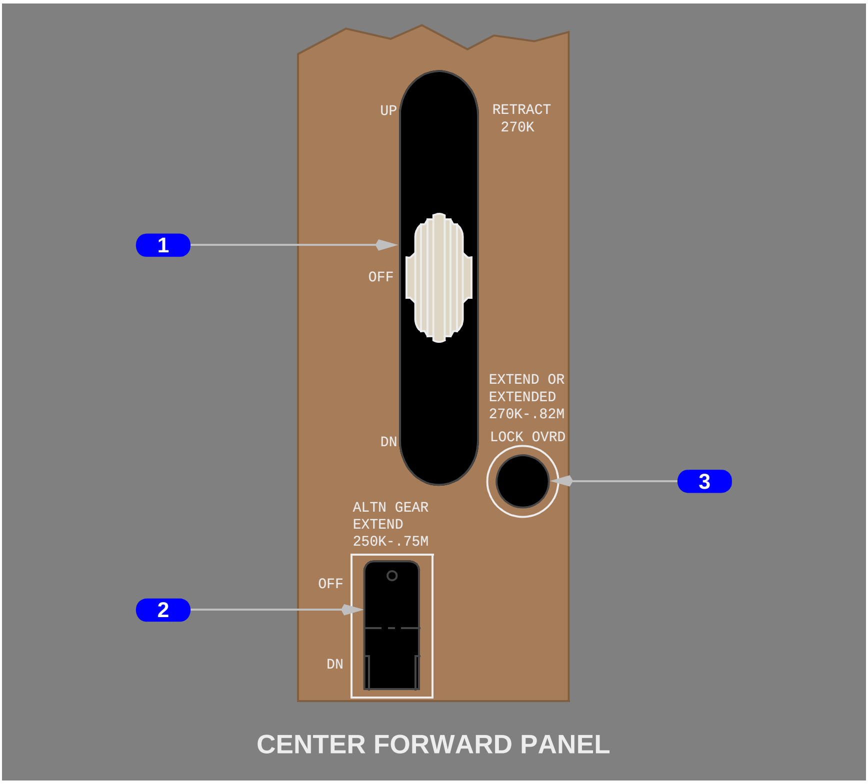
4 TAILSKID Light

Illuminated (amber) – the tailskid position disagrees with the landing gear lever position.

5 Landing GEAR Disagree Light

Illuminated (amber) –the gear position disagrees with the lever position.

Gear Extension/Retraction



1 Landing Gear Lever

UP – the landing gear retracts.

OFF – hydraulic pressure is removed from landing gear system.

DN – the landing gear extends.

2 Alternate Gear Extend (ALTN GEAR EXTEND) Switch

OFF – the landing gear lever operates normally.

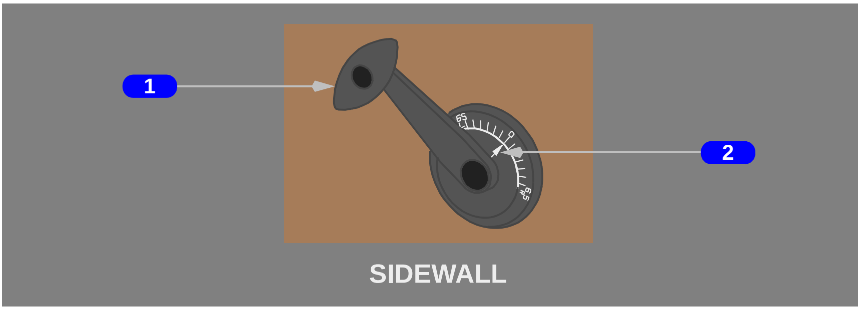
DN (down) – the landing gear extends by the alternate extension system.

3 Landing Gear Lever Lock Override (LOCK OVRD) Switch

Push – releases the landing gear lever lock.

Nose Wheel Steering Tiller

A nose wheel steering tiller is installed on the left sidewall.



1 Nose Wheel Steering Tiller

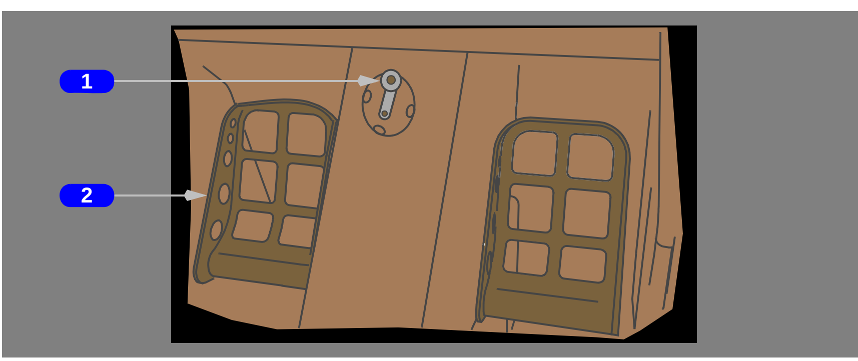
Rotate –

- turns the nose wheels up to 65 degrees in either direction
- overrides rudder pedal steering

2 Tiller Position Indicator

Shows tiller displacement from the straight–ahead, neutral position.

Brake System
Rudder/Brake Pedals



1 Rudder Pedal Adjust Crank

Pull and Rotate – adjusts the rudder pedals forward or aft.

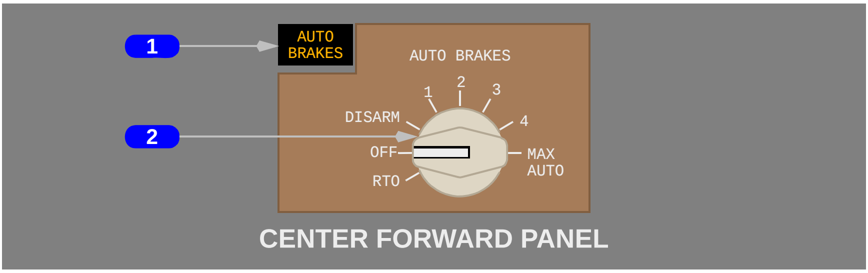
2 Rudder/Brake Pedals

Push the full pedal –turns the nose wheel up to seven degrees in either direction.

Push the top of the pedals – actuates the wheel brakes.

Refer to Chapter 9, Flight Controls for the description of rudder operation.

Auto Brakes Selector



1 AUTO BRAKES Light

Illuminated (amber) – the auto brakes are disarmed or inoperative.

2 AUTO BRAKES Selector

OFF – deactivates the autobrake system.

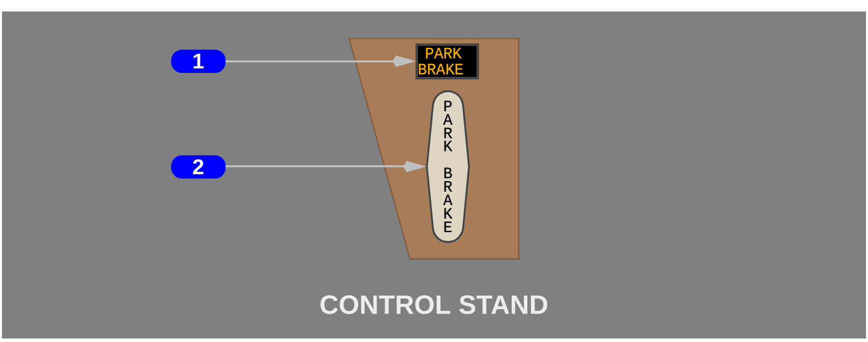
DISARM –

- disengages the auto brake system
- releases brake pressure

1,2,3,4, MAX AUTO – selects the desired deceleration rate.

RTO – automatically applies maximum brake pressure when the thrust levers are retarded to idle above 85 knots.

Parking Brake Handle



1 Parking Brake (PARK BRAKE) Light

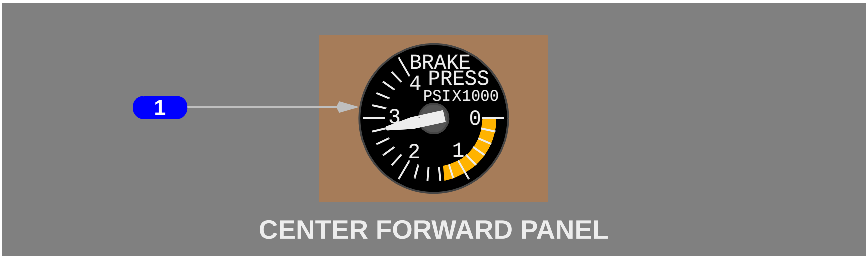
Illuminated (amber) – the parking brake is set.

2 Parking Brake (PARK BRAKE) Handle

Pull – sets the parking brake when both brake pedals are simultaneously depressed.

Release – simultaneously depress both brake pedals.

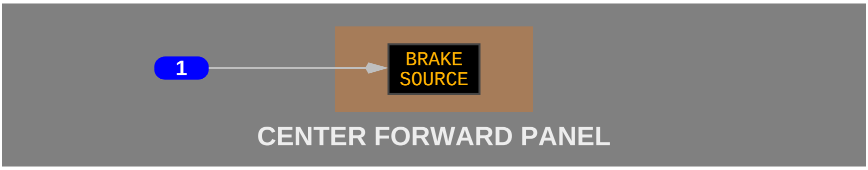
Brake Accumulator Pressure Indicator



1 Brake Accumulator Pressure (BRAKE PRESS) Indicator

Indicates brake accumulator pressure (psi x1000).

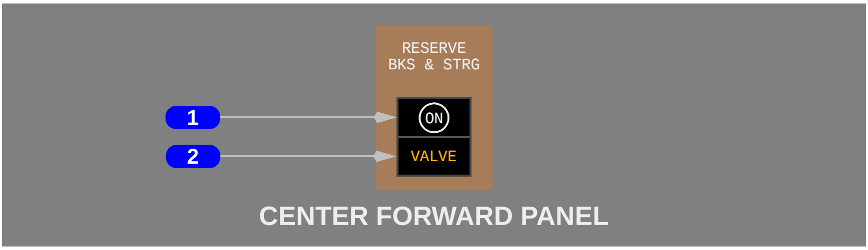
Brake Source Light



1 BRAKE SOURCE Light

Illuminated (amber) – both normal and alternate brake system pressures are low.

Reserve Brakes and Steering Switch



1 RESERVE Brakes and Steering (BKS & STRG) Switch

ON – provides pressure to alternate brake system and nose wheel steering system.

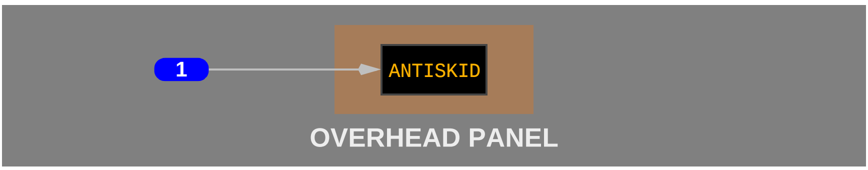
Off – (ON not visible) – the reserve brakes and steering system is commanded off.

2 Reserve Brakes and Steering VALVE Light

Illuminated (amber) –

- switch OFF – valve(s) disagree with commanded position from automatic isolation feature
- switch ON – valve(s) disagree with manually selected switch position

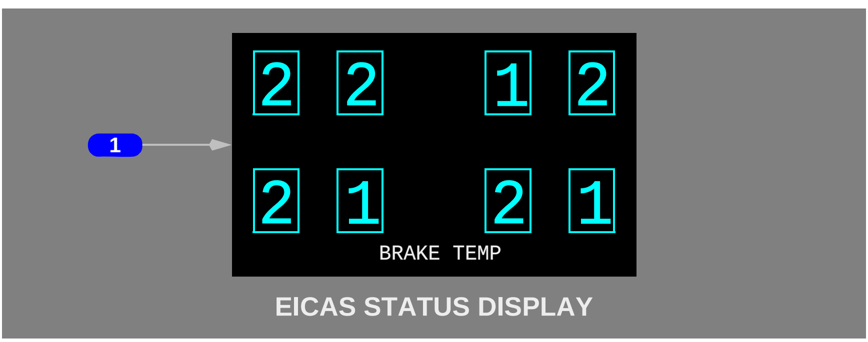
Antiskid Light



1 ANTISKID Light

Illuminated (amber) – a fault is detected in the antiskid system.

Brake Temperature



1 Brake Temperature (BRAKE TEMP)

Indicates a relative value of wheel brake temperature.

- values range from 0 to 9
- 0 to 2 – initial range, box and number are cyan
- 3 to 4 – normal range, box is white for the first brake per truck that exceeds a value of 2 and number is cyan
- 5 to 9 – high range, box and number are white for each brake with a value of 5 or above

Introduction

The airplane has two main landing gear and a single nose gear. The nose gear is a conventional steerable two–wheel unit. Each main gear has four wheels in tandem pairs.

Hydraulic power for retraction, extension, and steering is supplied by the center hydraulic system. An alternate extension system is also provided.

The normal brake hydraulic system is powered by the right hydraulic system. The alternate brake hydraulic system is powered by the center hydraulic system. Antiskid protection is provided with both systems, but the autobrake system is available only through the normal system.

A brake temperature monitor system displays each brake temperature on the EICAS status display.

Air/Ground Sensing System

In–flight and ground operation of various airplane systems are controlled by the air/ground sensing system and the nose air/ground sensing system.

The air/ground sensing system receives air/ground logic signals from tilt sensors located on each main landing gear. These signals are used to configure the airplane systems to the appropriate air or ground status.

A nose air/ground sensing system receives air/ground logic signals from nose gear strut compression sensors. These signals are for controlling stall warning and portions of the caution and warning system.

An EICAS advisory message AIR/GND SYS or NOSE A/G SYS indicates that some portion of the sensing system failed. Affected equipment and systems will not operate normally and therefore takeoff is not allowed.

Landing Gear Operation

The landing gear are normally controlled by the landing gear lever. On the ground, the lever is prevented from moving to the UP position by an automatic lever lock controlled by the main gear tilt sensors. When the gear is not tilted (aircraft on the ground) the lock is engaged. The lever lock can be manually overridden by pushing and holding the landing gear lever LOCK OVRD switch. In flight, the lever lock is automatically released through air/ground sensing of main gear tilt sensor.

Landing Gear Retraction

After takeoff both main gear tilt, releasing the lever lock. When the landing gear lever is positioned to UP, the tilted landing gear begins to retract. The landing gear doors open and the gear retracts to up position. Automatic wheel braking occurs during gear retraction.

The GEAR and DOORS lights illuminate as the landing gear retracts into the wheel wells. After retraction, the nose gear is held up by uplocks and the main gear is held up by the door structure. The GEAR and DOORS lights extinguish. The landing gear lever is placed in the OFF position to depressurize the landing gear system. The GEAR light remains illuminated and the EICAS caution message GEAR DISAGREE displays if any gear is not up and locked up after the normal transit time. The affected gear's, gear down light, remains illuminated if the gear never unlocked from the down position. The DOORS light remains illuminated.

Landing Gear Extension

When the landing gear lever is moved to DN, the landing gear doors open, the gear are unlocked, and the GEAR and DOORS lights illuminate.

The gear are hydraulically powered to the down and locked position. The downlocks are powered to the locked position, all hydraulically actuated gear doors close, and the main gear trucks hydraulically tilt to the flight position. When all gear are down and locked, the gear down lights illuminate and the GEAR and DOORS lights extinguish.

The amber GEAR light remains illuminated and the EICAS caution messages GEAR DISAGREE, L or R SIDE BRACE, L or R DRAG BRACE displays if any gear is not locked down after the normal transit time. The extinguished green gear down light indicates the affected gear. The DOORS light remains illuminated and the EICAS advisory message GEAR DOORS displays only if any main gear door is not closed after the normal transit time.

Landing Gear Alternate Extension

The alternate landing gear extension system uses an electric motor to trip the locking mechanism for each gear. Selecting DN on the ALTN GEAR EXTEND switch releases all door and gear uplocks. The landing gear free–fall to the down and locked position.

When all gear are down and locked, the gear down lights illuminate and the GEAR light extinguishes. During alternate extension, the DOORS light remains illuminated and the EICAS advisory message GEAR DOORS displays because all the hydraulically powered gear doors remain open.

Nose Wheel Steering

Nose wheel steering is powered by the center hydraulic system. In the event of a center hydraulic system leak, a reserve brakes and steering system can power the nose wheel steering.

Primary steering control is provided by the nose wheel steering tiller.Limited steering control is available through the rudder pedals. The tiller can turn the nose wheel up to 65 degrees in either direction. A pointer on the tiller assembly shows tiller position relative to the neutral setting. The rudder pedals can be used to turn the nose wheels up to seven degrees in either direction. Tiller inputs override rudder pedal inputs.

Brake System

Each main gear wheel has a multiple disc brake. The nose wheels have no brakes. The brake system includes:

- normal brake hydraulic system
- alternate brake hydraulic system
- brake accumulator
- antiskid protection
- autobrake system
- parking brake

Normal Brake Hydraulic System

The normal brake hydraulic system is powered by the right hydraulic system. The brake pedals provide independent control of the left and right brakes.

Alternate Brake Hydraulic System

Alternate brake hydraulic system selection is automatic. If the right hydraulic system pressure is low, the center hydraulic system automatically supplies pressure to the alternate brake system. Pushing a brake pedal then sends hydraulic pressure through the alternate antiskid valves to the brakes.

The BRAKE SOURCE light illuminates and the EICAS advisory message BRAKE SOURCE displays if both normal and alternate brake system pressures are low.

Reserve Brakes and Steering

Pressing the RESERVE BKS & STRG switch provides hydraulic fluid to the center number one electric primary hydraulic pump. Pump pressure is then supplied exclusively to the alternate brake system and nose wheel steering system. The BRAKE SOURCE light and EICAS message extinguish when pressure is available.

The VALVE light illuminates and the EICAS advisory message RSV BRAKE VAL displays if a reserve brake valve disagrees with the commanded position.

Brake Accumulator

If normal and alternate brake hydraulic power is lost, the brake accumulator can provide several braking applications or parking brake application.

Antiskid Protection

Antiskid protection is provided in the normal and alternate brake hydraulic systems.

The normal brake hydraulic system provides each main gear wheel with individual antiskid protection. When a wheel speed sensor detects a skid, the associated antiskid valve reduces brake pressure until skidding stops.

The alternate brake hydraulic system provides antiskid protection to laterally paired wheels.

Touchdown, hydroplaning, and locked wheel protection are provided.

The ANTISKID light illuminates and the EICAS advisory message ANTISKID displays to indicate a fault is detected in the antiskid system.

The ANTISKID light illuminates and the EICAS advisory message ANTISKID OFF displays to indicate the antiskid system is inoperative.

Autobrake System

The autobrake system provides automatic braking at pre–selected deceleration rates for landing.

The system operates only when the normal brake system is functioning. Antiskid system protection is provided during autobrake operation.

The AUTO BRAKES light illuminates and the EICAS advisory message AUTOBRAKES displays if the autobrake system is disarmed or inoperative.

Rejected Takeoff

Selecting RTO prior to takeoff arms the autobrake system. The RTO mode can be selected only on the ground. The RTO autobrake setting commands maximum braking pressure if:

- the airplane is on the ground
- groundspeed is above 85 knots, and
- both thrust levers are retarded to idle

Maximum braking is obtained in this mode. If an RTO is initiated below 85 knots, the RTO autobrake function does not operate.

Landing

Five levels of deceleration can be selected for landing. However, on dry runways, the maximum autobrake deceleration rate in the landing mode is less than that produced by full pedal braking.

After landing, autobrake application begins when:

- both thrust levers are retarded to idle, and
- the wheels have spun up

Autobrake application occurs slightly after main gear touchdown. Deceleration is limited until main landing gear truck untilt occurs, then deceleration increases to the selected level. The deceleration level can be changed (without disarming the system) by rotating the selector.

To maintain the selected airplane deceleration rate, autobrake pressure is reduced as other controls, such as thrust reversers and spoilers, contribute to total deceleration. The system provides braking to a complete stop or until it is disarmed.

Autobrake – Disarm

The system disarms immediately, the AUTO BRAKES light illuminates, and the EICAS advisory message AUTOBRAKES displays if any of the following occur:

- pedal braking applied
- either thrust lever advanced after landing
- speedbrake lever is moved from the full up position after the speedbrakes have deployed on the ground
- DISARM or OFF position selected on the autobrakes selector
- autobrake fault
- normal antiskid system fault

When the autobrakes system disarms after landing:

- the autobrakes selector automatically moves to the DISARM position
- power is removed from the autobrake system
- the AUTO BRAKES light illuminates

When the autobrake system disarms during takeoff, the autobrakes selector remains in the RTO position. After takeoff, the autobrakes selector automatically moves to OFF.

Parking Brake

The parking brake can be set with the normal or alternate brake hydraulic system pressurized. If the normal and alternate brake systems are not pressurized, parking brake pressure is maintained by the brake accumulator. The brake accumulator is pressurized by the right hydraulic system. Accumulator pressure is shown on the BRAKE PRESS indicator.

The parking brake is set by fully depressing both brake pedals, pulling the parking brake handle up, then releasing the pedals. This mechanically latches the pedals in the depressed position and commands the parking brake valve to close.

The parking brake is released by depressing the pedals until the parking brake handle releases.

The PARK BRAKE light illuminates and the EICAS advisory message PARKING BRAKE displays when the parking brake is set.

Brake Temperature Indication

Wheel brake temperatures are displayed on the EICAS status page. Numerical values related to wheel brake temperature are displayed for each main gear brake. Brake temperature values range from 0 to 9. Temperature values are not instantaneous and tend to build for 10 to 15 minutes after the brakes are applied. Initial range values of 0 to 2 are cyan numbers in a cyan box. For normal range values of 3 and 4, the number is cyan and the box is white for the first brake per truck that exceeds a value of 2. Values in the high range of 5 to 9 have a white number and box. The BRAKE TEMP light illuminates for values of 5 and above.

Tailskid

The airplane is equipped with a tailskid system. The tailskid extends for takeoff and landing and retracts during flight. It helps to protect the pressurized part of the airplane from contact with the runway. The tailskid uses the main landing gear actuation system.

The TAILSKID light illuminates and the EICAS advisory message TAILSKID is displayed when the tailskid position disagrees with the landing gear lever position.

Landing Gear EICAS Messages

The following EICAS messages can be displayed.

Note: Refer to Chapter 15, Warning Systems, for configuration warning messages.

Brakes

Message	Level	Light	Aural	Condition
ANTISKID	Advisory	ANTISKID		A fault is detected in the antiskid system.
ANTISKID OFF	Advisory	ANTISKID		Antiskid system is inoperative.
AUTOBRAKES	Advisory	AUTO BRAKES		Auto brakes are disarmed or inoperative.
BRAKE SOURCE	Advisory	BRAKE SOURCE		Normal and alternate brake system pressures are low.
PARKING BRAKE	Advisory	PARK BRAKE		The parking brake is set.
RSV BRAKE VAL	Advisory	VALVE		Valve(s) position disagrees with the commanded position.

Landing Gear

Message	Level	Light	Aural	Condition
AIR/GND SYS	Advisory			Air/ground sensing system failed.
GEAR DISAGREE	Caution	GEAR	Beeper	Gear position disagrees with landing gear lever position.
GEAR DOORS	Advisory	DOORS		One or more gear doors are not closed.

Message	Level	Light	Aural	Condition
L DRAG BRACE R DRAG BRACE	Caution	GEAR	Beeper	The main gear drag brace is not locked down.
L SIDE BRACE R SIDE BRACE	Caution	GEAR	Beeper	The main gear side brace is not locked down.
NOSE A/G SYS	Advisory			Nose air/ground sensing system failed.

Tailskid

Message	Level	Light	Aural	Condition
TAILSKID	Advisory	TAILSKID		Tailskid position disagrees with landing gear lever position.

Warning Systems — Chapter 15
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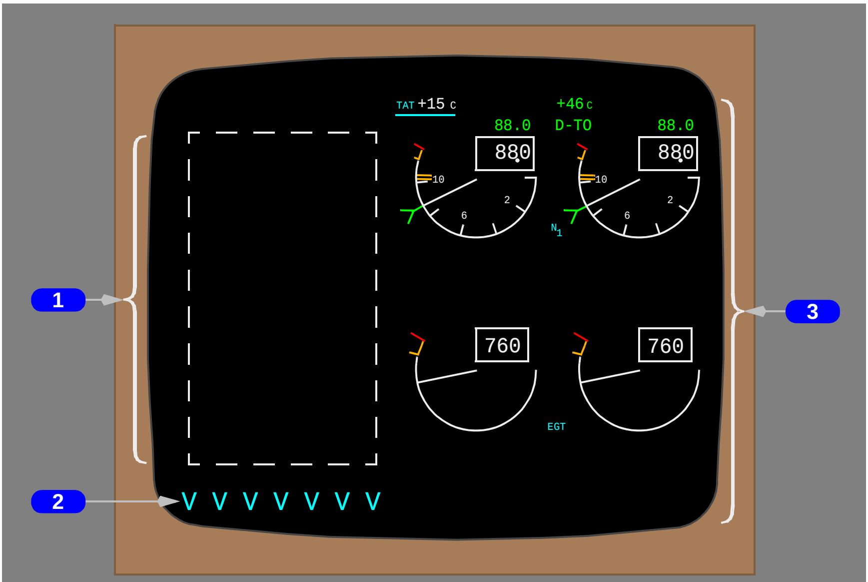
Intentionally
Blank

Engine Indication and Crew Alerting System (EICAS)

Primary EICAS Display



PRIMARY EICAS DISPLAY

1 EICAS Message Field

Eleven lines are available for system alerts. Additional pages are available, if need.

Communications alerts are also displayed.

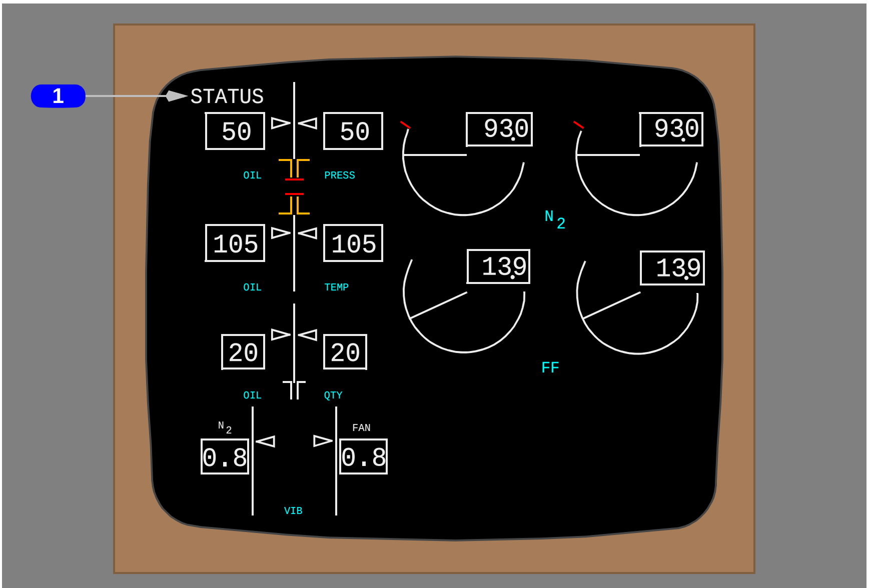
2 Engine Secondary Data Cue

Displays (cyan) – secondary engine data should be displayed on lower CRT

3 Primary Engine Indications

Displays full time on the EICAS display.

Secondary EICAS Display



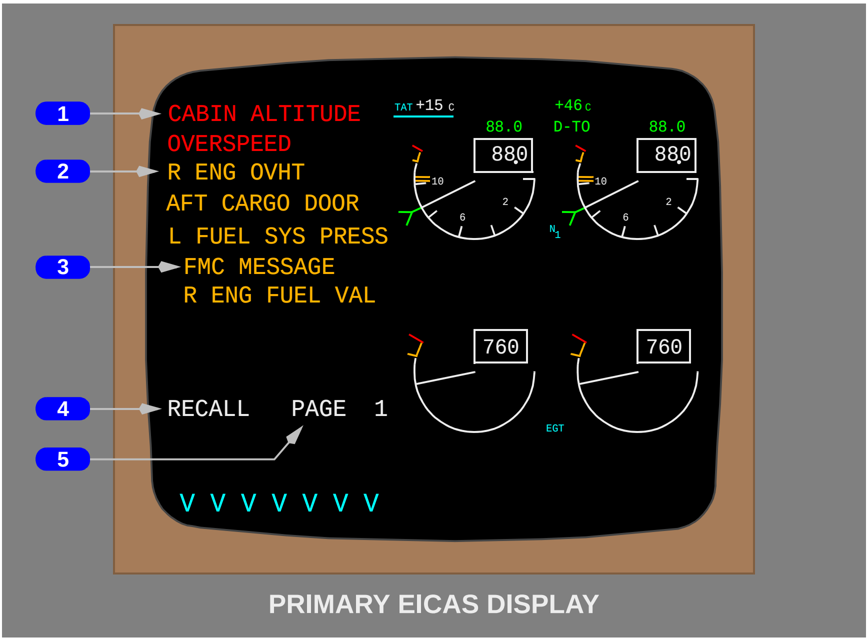
SECONDARY EICAS DISPLAY

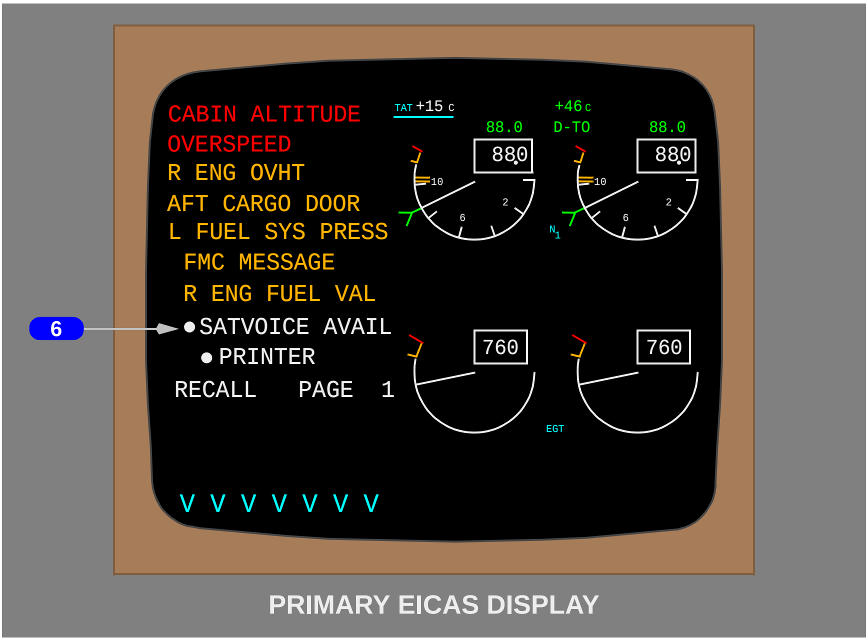
1 Status Cue

Displays when a new status message exists

Removed when the status page is displayed.

EICAS Message Display





1 **Warning Messages**

Displays (red) – the highest priority alert messages

2 **Caution Messages**

Displays (amber) – the next highest priority alert messages after warning messages

3 **Advisory Messages**

Displays (amber) –

- the lowest priority alert messages
- indented one space

4 **Recall Indication**

Displays when the RECALL switch is pushed

Remains displayed for one second after the switch is released

5 **Page Number**

Displays (white) –

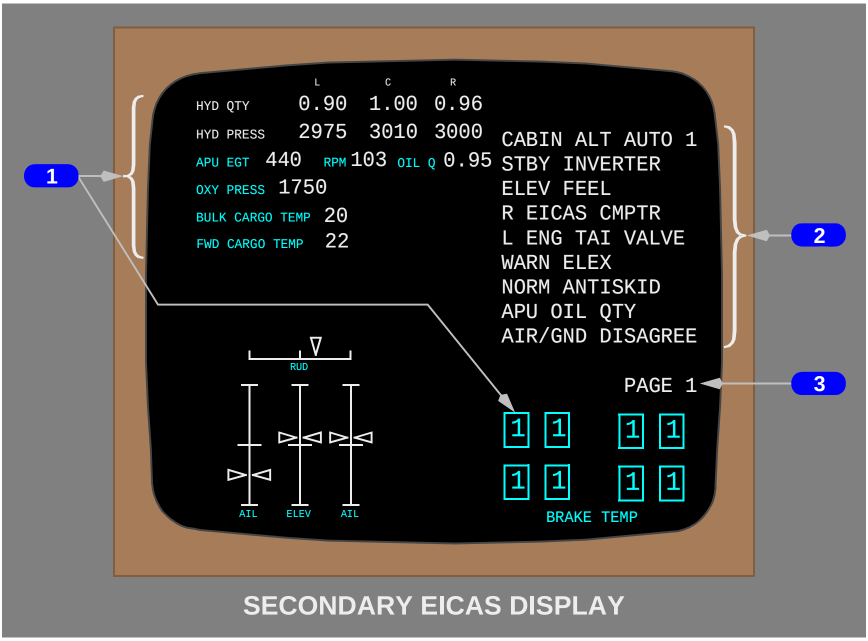
- more than one page of alert or communication messages exists
- indicates the number of the page selected

6 **Communication Messages**

Displays (white) –

- indicates incoming communication messages
- preceded by a white dot
- COMM LOW messages are indented one space

EICAS Status Display



1 System Indications

System indications are displayed.

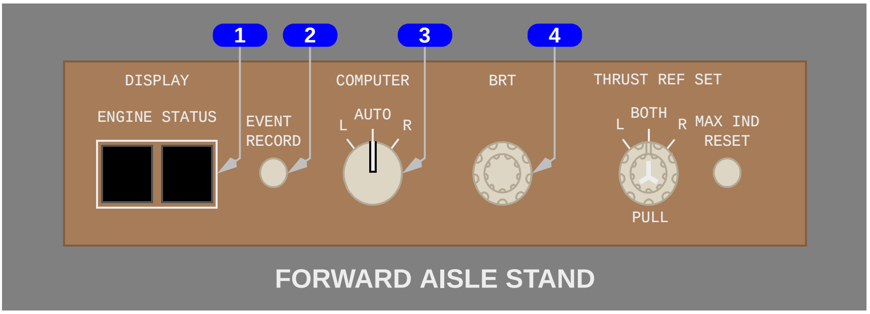
2 Status Messages

Status messages indicate conditions requiring minimum equipment list (MEL) reference for dispatch.

3 Page Number

A page number appears if additional pages of status messages exist.

EICAS Control Panel



1 STATUS Display Switch

Push – displays the status display on the lower EICAS CRT.

Subsequent pushes –

- displays the next page of status messages when additional pages exist
- the status display blanks after the last page of status messages is displayed.

2 EVENT RECORD Switch

Push – records the last EICAS event into memory.

3 COMPUTER Selector

L – left EICAS computer controls displays.

AUTO – EICAS display control automatically transfers to the right EICAS computer if the left computer fails.

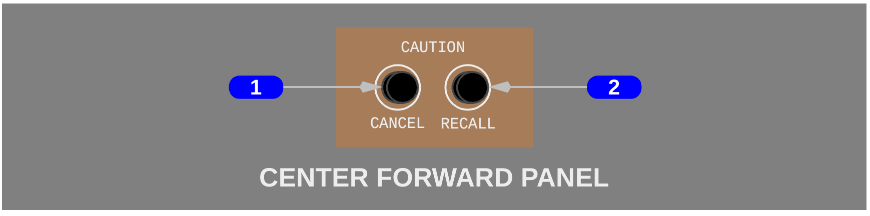
R – right EICAS computer controls displays.

4 Brightness (BRT) Control

Rotate –

- Outer control – adjusts brightness of lower display
- Inner control – adjusts brightness of upper display

Caution Cancel/Recall Switches



1 CANCEL Switch

Push –

- displays the next page of EICAS messages when additional pages exist
- cancels caution and advisory messages when the last page is displayed

Note: Warning messages remain

Note: Communication messages remain

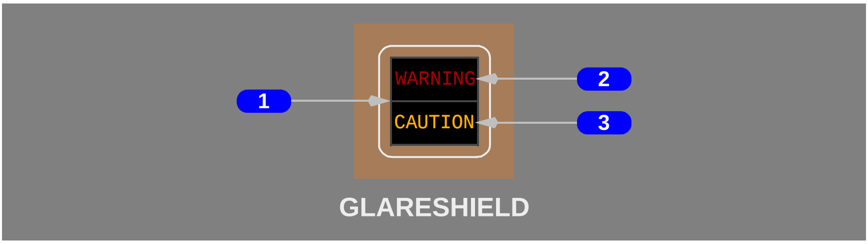
2 RECALL Switch

Push –

- displays the previously cancelled EICAS messages, if the associated condition(s) still exist
- displays the first page of messages when multiple pages exist.

Warning System Switches and Lights

Master Warning/Caution Reset Switches and Lights



1 Master WARNING/CAUTION Reset Switch

Push –

- extinguishes the master WARNING lights
- extinguishes the Master CAUTION lights
- silences most associated aural alerts (for exceptions, see Section 20, Master Warning/Caution Reset Switches and Lights)

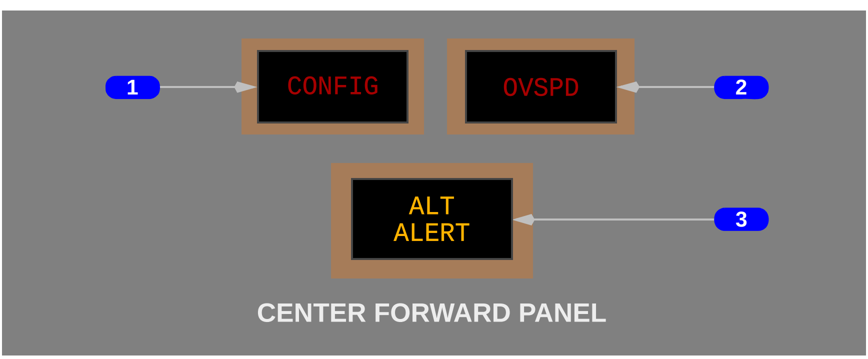
2 Master WARNING Light

Illuminated (red) – a time critical warning or warning condition exists

3 Master CAUTION Light

Illuminated (amber) – a caution condition exists

Miscellaneous Lights



1 Configuration (CONFIG) Light

Illuminated (red) – a configuration warning exists

2 Overspeed (OVSPD) Light

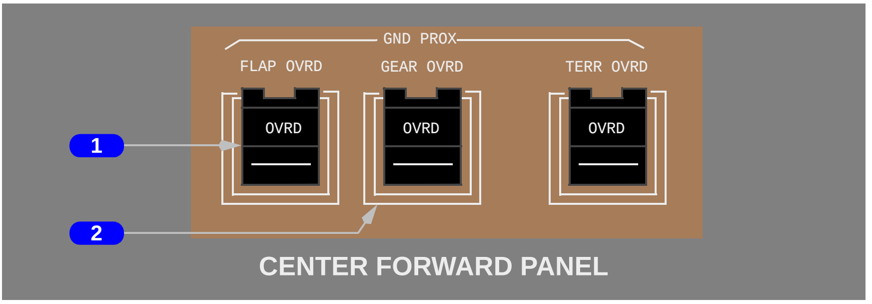
Illuminated (red) – airplane is exceeding Mmo or Vmo

3 Altitude Alert (ALT ALERT) Light

Illuminated (amber) –

- between 300 and 900 foot deviation from selected altitude

Ground Proximity Warning System (GPWS)
GPWS Controls



1 Ground Proximity Flap Override (GND PROX FLAP OVRD) Switch

Push (OVRD visible) –

- inhibits the ground proximity TOO LOW FLAPS caution
- inhibits the ground proximity TOO LOW TERRAIN caution

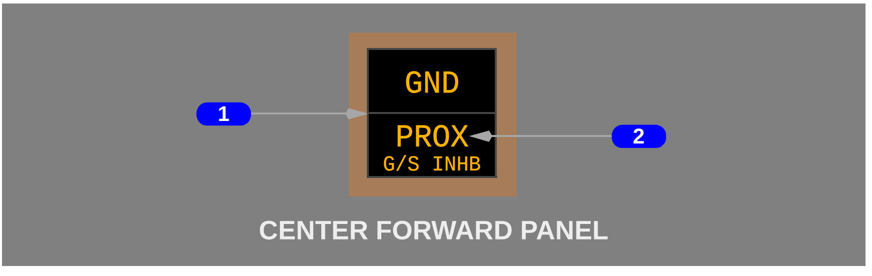
Note: The EICAS advisory message GND PROX SYS is displayed when FLAP OVRD is selected for more than 60 seconds while airspeed is greater than 250 knots.

2 Ground Proximity Configuration Gear Override (GND PROX/CONFIG GEAR OVRD) Switch

Push (OVRD visible) –

- inhibits the ground proximity TOO LOW GEAR caution
- inhibits the ground proximity TOO LOW TERRAIN caution
- inhibits the landing configuration warning siren

Note: The EICAS advisory message GND PROX SYS is displayed when GEAR OVRD is selected for more than 60 seconds while airspeed is greater than 290 knots.



1 Ground Proximity Glideslope Inhibit (GND PROX G/S INHB) Switch

Push (momentary) –

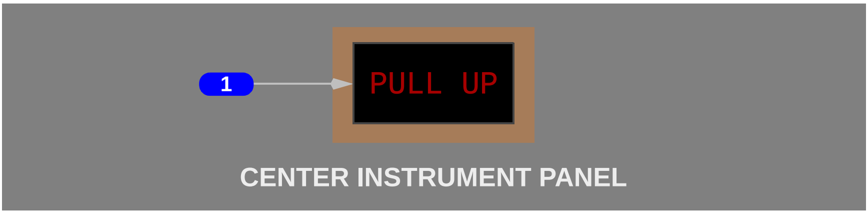
- inhibits the ground proximity GLIDESLOPE caution when below 1,000 feet radio altitude

2 Ground Proximity (GND PROX) Light

Illuminated (amber) –.

- a ground proximity caution exists
- an enhanced GPWS look-ahead caution exists

GPWS Immediate-Alert Annunciations



1 PULL UP Light

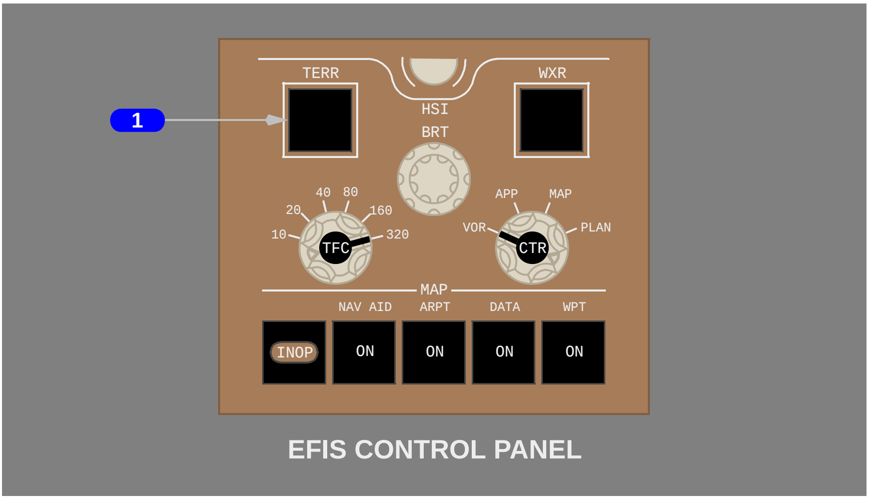
PULL UP (red) –

- the airplane descent rate is severe
- the airplane closure rate is excessive with the landing gear and/or flaps not in the landing configuration
- an enhanced GPWS look-ahead warning exists

Enhanced GPWS

GPWS with Look-Ahead Display and Alerting

Look-Ahead Display Switches

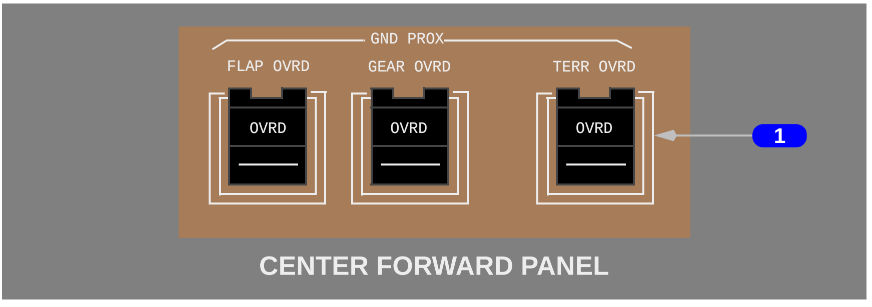


1 Terrain (TERR) Display Select Switch

Push –

- displays GPWS look-ahead data in VOR, APP, MAP, and CTR MAP modes
- arms GPWS look-ahead data in CTR VOR, CTR APP, and PLAN modes
- deselects the weather radar display regardless of the HSI mode selector position
- second push deselects GPWS look-ahead display

Look-Ahead Inhibit Switches

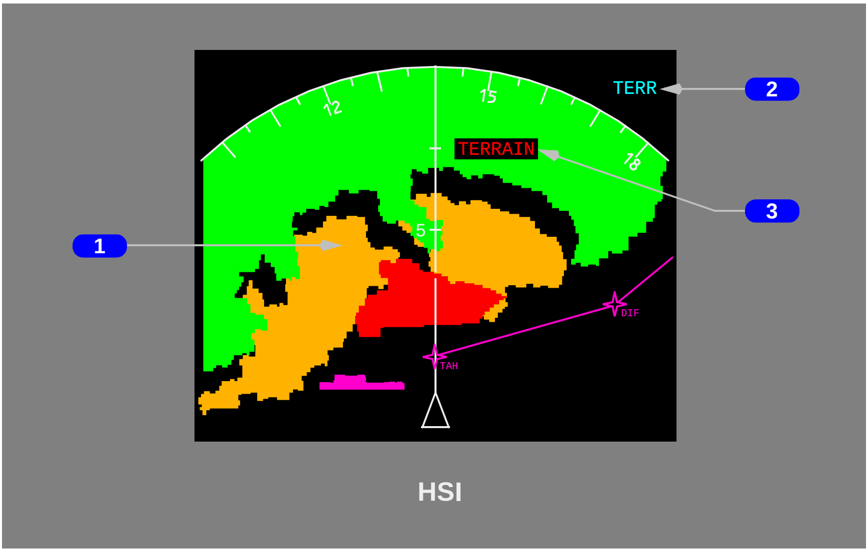


1 Terrain System Override Switch

Push – (OVRD visible)

- inhibits GPWS look–ahead alerts and displays
- second push deselects inhibit

Terrain Display
N316LA



1 Terrain Display

Color and density vary based on terrain height verse airplane altitude:

- dotted green: terrain from 2,000 feet below to 500 feet (250 feet with gear down) below the airplane's current altitude
- dotted amber: terrain 500 feet (250 feet with gear down) below to 2,000 feet above the airplane's current altitude
- dotted red: terrain more than 2,000 feet above airplane's current altitude
- dotted magenta: no terrain data available
- solid amber: look–ahead terrain caution active.
- solid red: look–ahead terrain warning active

Note: In areas without terrain data, look-ahead terrain alerting and display functions are not available. GPWS immediate-alert modes function normally.

Note: Terrain more than 2,000 feet below airplane altitude or within 400 feet of nearest airport runway elevation is not displayed.

Terrain is displayed automatically when:

- a look-ahead terrain alert occurs; and
- Terrain (TERR) Display Select Switch is not selected by either pilot; and
- HSI Mode Selector in the VOR, APP, MAP, or CTR MAP mode

The look-ahead display updates with a sweep similar to the weather radar display.

2 Terrain (TERR) Mode Annunciation

TERR (cyan) – terrain display enabled (manual or automatic display)

3 TERRAIN Annunciation

TERRAIN (red):

- terrain warning is occurring
- 20-30 seconds from projected impact with terrain

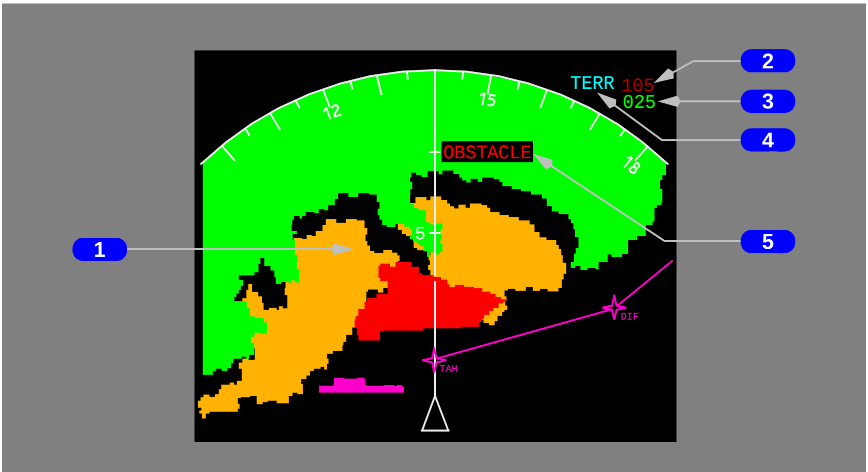
TERRAIN (amber):

- terrain caution is occurring
- 40-60 seconds from projected impact with terrain

Note: TERRAIN annunciation displays in all HSI modes.

Obstacles and Terrain Display

N422LA through N526LA



HSI

1 Obstacle and Terrain Display

When the airplane is higher than 2,000 feet above the terrain, display color density depends on obstacle or terrain height:

- solid green – highest obstacles or terrain displayed
- high density green – intermediate height obstacles or terrain displayed
- low density green – lowest obstacles or terrain displayed

When the airplane is at or lower than 2,000 feet above the terrain, color and density depends on obstacle height, terrain height, and airplane altitude:

- dotted green – obstacles or terrain from 2,000 feet below to 500 feet (250 feet with gear down) below airplane altitude
- dotted amber – obstacles or terrain 500 feet (250 feet with gear down) below to 2,000 feet above airplane altitude
- dotted red – obstacles or terrain more than 2,000 feet above airplane altitude
- dotted magenta – no terrain data available
- solid amber – look-ahead obstacle or terrain caution is occurring
- solid red – look-ahead obstacle or terrain warning is occurring

Note: In areas without obstacle or terrain data, look-ahead obstacle or terrain alerting and display functions are not available. GPWS immediate-alert modes function normally.

Note: Terrain within 400 feet of nearest airport runway elevation is not displayed.

Obstacles or terrain are displayed automatically when:

- a look-ahead obstacle or terrain alert occurs; and
- Terrain (TERR) Display Select Switch is not selected by either pilot; and
- HSI Mode Selector in the VOR, APP, MAP, or CTR MAP mode

The look-ahead display updates with a sweep similar to the weather radar display.

2 Highest Elevation of Obstacle or Terrain Displayed

Highest elevation within selected map range expressed in hundreds of feet above sea level. Color (amber, green, or red) same as color of corresponding obstacle or terrain displayed.

3 Lowest Elevation of Obstacle or Terrain Displayed

Lowest elevation within selected map range expressed in hundreds of feet above sea level. Color (amber, green, or red) same as color of corresponding obstacle or terrain displayed. Blank above leval terrain or if all terrain is within 400 feet of nearest airport elevation.

4 Terrain Mode Annunciation

TERR (cyan) – GPWS look-ahead display enabled

5 TERRAIN/OBSTACLE Annunciations

TERRAIN (red):

- terrain warning is occurring
- 20-30 seconds from projected impact with terrain

OBSTACLE (red):

- obstacle warning is occurring
- 20-30 seconds from projected impact with an obstacle

TERRAIN (amber):

- terrain caution is occurring
- 40-60 seconds from projected impact with terrain

OBSTACLE (amber):

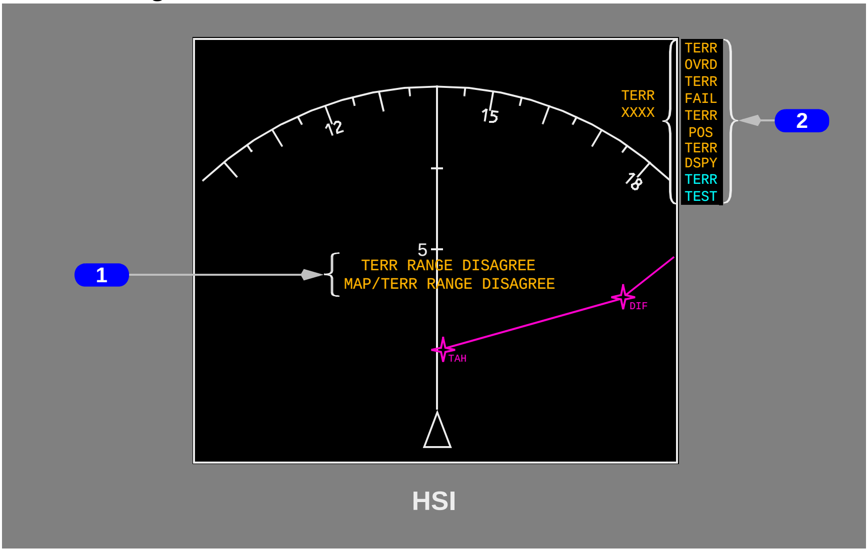
- obstacle caution is occurring
- 40-60 seconds from projected impact with an obstacle

Displays in all HSI navigation modes.

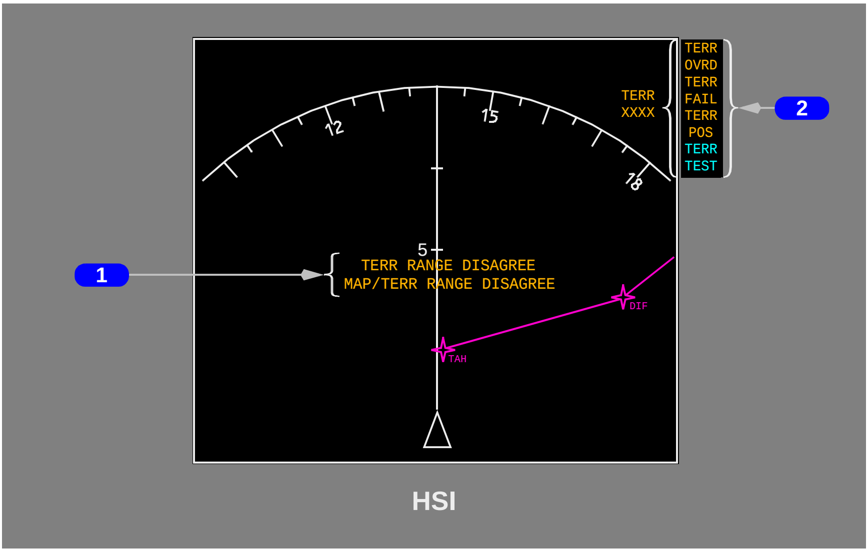
Note: If an obstacle alert occurs while a TERRAIN alert message is displayed, the OBSTACLE alert message replaces the TERRAIN alert message. Both messages can not be displayed at the same time.

Look-Ahead HSI Systems Annunciations

N422LA through N526LA



N316LA



1 Terrain Range Disagree Annunciation

TERR RANGE DISAGREE (amber) –

- GPWS look-ahead display enabled
- GPWS look-ahead display output range disagrees with the HSI Range Selector

MAP/TERR RANGE DISAGREE (amber) –

- GPWS look-ahead display enabled
- GPWS look-ahead display output range disagrees with the HSI Range Selector
- map display output range disagrees with the HSI Range Selector

2 GPWS Status/Mode Annunciation

TERR OVRD (amber) – GND PROX TERR OVRD switch pushed

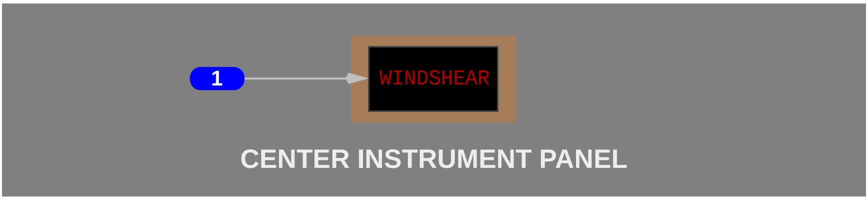
TERR FAIL (amber) – GPWS look-ahead alerting and display have failed

TERR POS (amber) – GPWS look-ahead alerting and display unavailable due to FMS position uncertainty

N422LA through N526LA
TERR DSPY (amber) - HSI overheat or loss of distribution unit cooling.

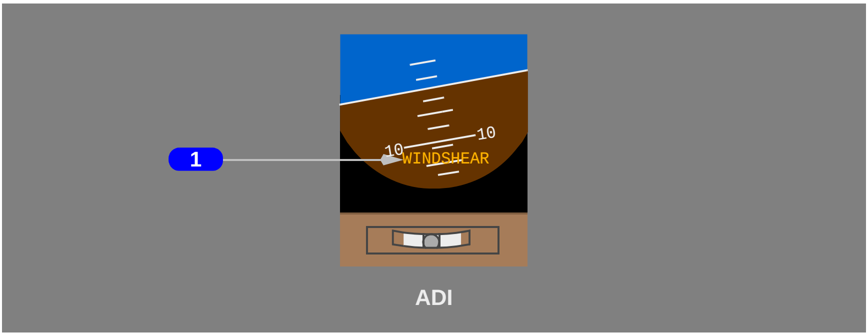
TERR TEST (cyan) – GPWS operating in self–test mode

Windshear Warning System
Windshear Immediate-Alert Annunciations



1 WINDSHEAR Light

WINDSHEAR (red) – encountering a windshear condition

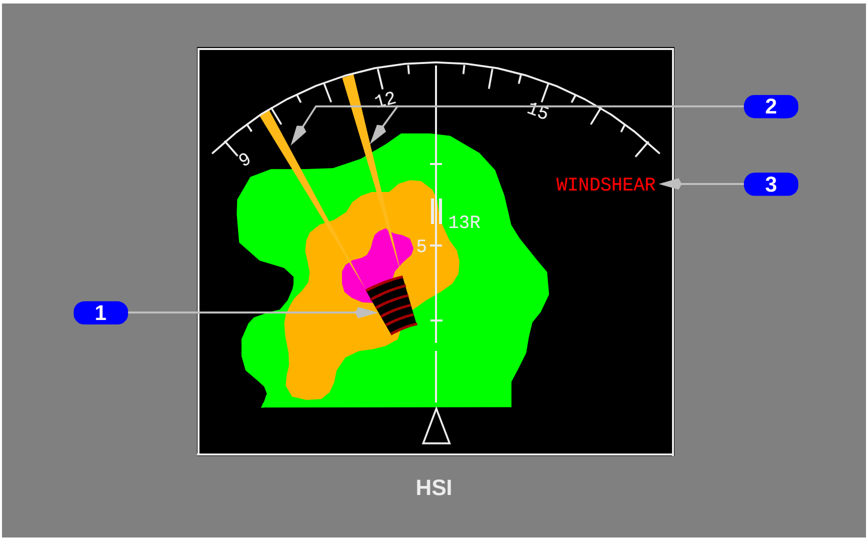


1 WINDSHEAR Annunciation

WINDSHEAR (red) – encountering a windshear condition

Predictive Windshear (PWS)

PWS Displays



1 Predictive Windshear Symbol

Displayed (red and black) – PWS alert active

Shows predicted windshear location and approximate geometric size (width and depth).

Symbol, radials and weather radar returns display automatically on an HSI when:

- the aircraft is below 1200’ AGL
- a PWS alert occurs
- weather (WXR) display select switch is not selected by either pilot; and
- respective HSI Mode Selector in the VOR, APP, MAP, or CTR MAP mode

Note: If a PWS alert occurs when terrain (TERR) is selected on both pilot HSI displays and there is not an active terrain alert occurring, weather radar display replaces terrain display. The weather radar display, including PWS symbology, can be deselected by pushing the TERR switch for the respective HSI.

2 Predictive Windshear Symbol Radials

Displayed (amber) – PWS alert active

Extend from predictive windshear symbol to help identify location of the PWS event.

3 WINDSHEAR

WINDSHEAR (red) – PWS warning is active

WINDSHEAR (amber) – PWS caution is active

Note: The size of the PWS symbol is proportional to the geographic size of the PWS event it represents and bears no relationship to its intensity.

Traffic Alert and Collision Avoidance System (TCAS)
TCAS Controls
Transponder Panel

N422LA through N526LA

1 TCAS Mode Selector

STBY – places transponders and TCAS system in standby

- displays TCAS OFF on HSI

XPDR – activates transponder only mode, TCAS system in standby

- displays TCAS OFF on HSI

TA – enables TCAS in Traffic Advisory mode

- display of Traffic Advisory (TA) symbols
- voice alerts
- displays TA ONLY on HSI

TA/RA – enables TCAS in Traffic Advisory and Resolution Advisory mode

- display of Traffic Advisory (TA) and Resolution Advisory (RA) symbols
- voice alerts
- vertical guidance for RAs
- displays TFC on HSI

2 Altitude Display Select Switch

ABOVE - displays TCAS traffic:

- from 9,900 feet above to 2,700 feet below own airplane

N (Normal) – displays TCAS traffic:

- from 2,700 feet above to 2,700 feet below own airplane

BELOW – displays TCAS traffic:

- from 2,700 feet above to 9,900 feet below own airplane

3 Absolute/Relative (ABS/REL) Switch

ABS (absolute) – displays traffic with indicated barometric altitude.

REL (relative) – displays traffic with relative altitude difference.

N316LA

1 TCAS Mode Selector

STBY – places transponders and TCAS system in standby

- displays TCAS OFF on HSI

ALT RPTG OFF – deactivates altitude reporting, TCAS system in standby

- displays TCAS OFF on HSI

XPNDR – activates transponder only mode, TCAS system in standby

- displays TCAS OFF on HSI

TA ONLY– enables TCAS in Traffic Advisory mode

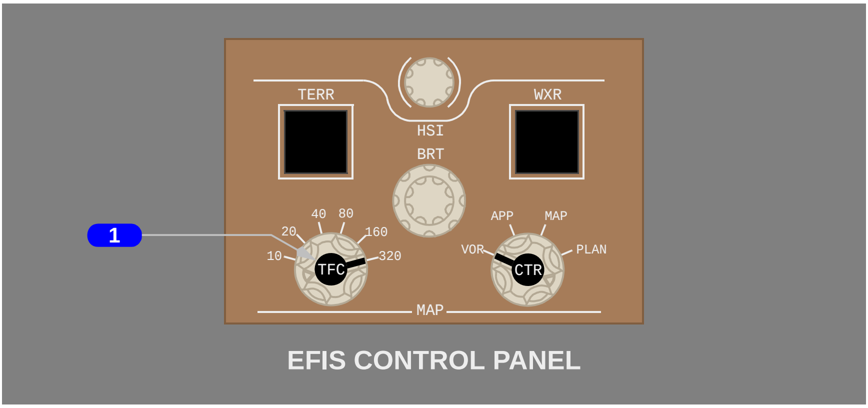
- display of Traffic Advisory (TA) symbols
- voice alerts
- displays TA ONLY on HSI

TA/RA – enables TCAS in Traffic Advisory and Resolution Advisory mode

- display of Traffic Advisory (TA) and Resolution Advisory (RA) symbols
- voice alerts

- vertical guidance for RAs
- displays TFC on HSI

EFIS Control Panel



1 Traffic (TFC) Switch

Note: TCAS must be enabled on the Transponder Panel.

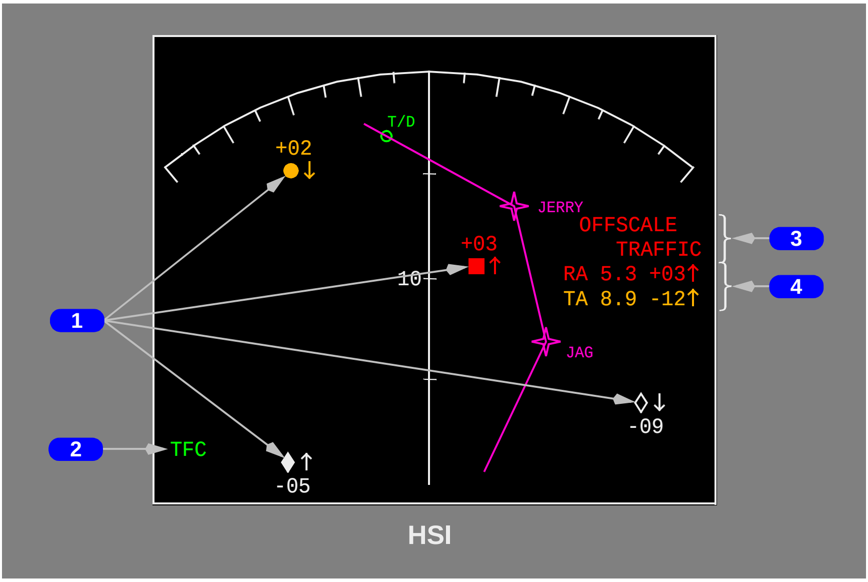
Push –

- displays or removes TCAS traffic information on HSI

TCAS Displays

HSI

Note: See HSI TCAS symbology tables for description.



1 Traffic Aircraft Symbology

N316LA
Indicates the relative position of traffic aircraft.

N422LA through N526LA
Indicates the relative or absolute position of traffic aircraft.

2 Mode Annunciations

3 Traffic Messages

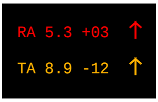
4 No-Bearing Symbology

HSI TCAS Symbology

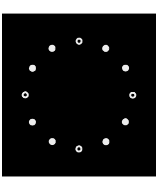
Symbol	Name (Color)	Applicable Mode(s)	Remarks
	TCAS resolution advisory (RA), relative altitude (R)	MAP CTR MAP APP VOR	These symbols are displayed only when the EFIS control panel traffic (TFC) switch is selected on. The arrow indicates traffic climbing or descending at a rate greater than or equal to 500 fpm. At rates less than 500 fpm, the arrow is not displayed. The number and associated signs indicate altitude of traffic in hundreds of feet relative to the airplane. The number is below the traffic symbol when the traffic is below, and above the traffic symbol when the traffic is above the airplane. Absence of the number implies altitude unknown.
	TCAS traffic advisory (TA), relative altitude (A)		
	TCAS proximate traffic, relative altitude (W)		
	TCAS other traffic, relative altitude (W)		

N422LA through N526LA

	Absolute altitude (R,A,W)	MAP CTR MAP APP VOR	Displays absolute traffic altitude (referenced to QNH or QNE). First two digits indicate thousands of feet, and third digit indicates hundreds of feet.

Symbol	Name (Color)	Applicable Mode(s)	Remarks
	TCAS no bearing message (RA–R, TA–A)	MAP CTR MAP APP VOR	A TA (amber) or RA (red) is occurring and bearing information is not available • maximum of two messages **N316LA** • data tag provides distance (nm), relative altitude (hundreds of feet), and vertical motion (in excess of 500 feet per minute) **N422LA through N526LA** • data tag provides distance (nm), relative or absolute altitude (hundreds of feet), and vertical motion (in excess of 500 feet per minute) Only displayed when the EFIS control panel traffic (TFC) switch is selected on.

N422LA through N526LA

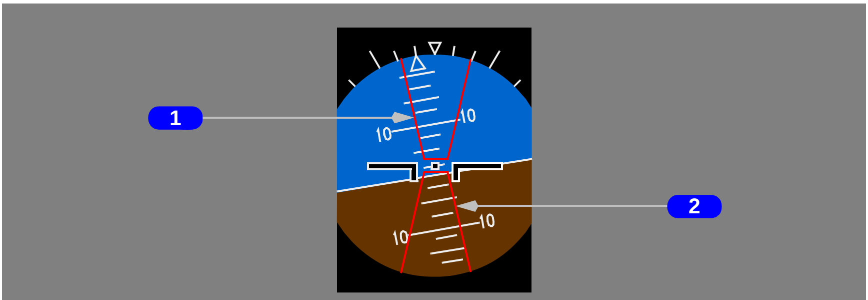
	3 NM Range Ring (W)	MAP CTR MAP APP VOR	Displayed when TFC is selected on the EFIS control panel and range is 80 NM or less. Ring is centered around the airplane symbol.

Symbol	Name (Color)	Applicable Mode(s)	Remarks
TRAFFIC	TCAS traffic alert message (RA–R, TA–A)	All	Displayed whenever a TCAS RA or TA is active. EFIS control panel TFC switch does not have to be selected on.
OFFSCALE	TCAS off scale message (RA–R, TA–A)	MAP CTR MAP APP VOR	Displayed whenever RA or TA traffic is outside the traffic area covered by the HSI range. Displayed only if the EFIS control panel TFC switch is selected on.
TFC	TCAS mode (G)	MAP CTR MAP APP VOR	Indicates the HSI TCAS display is active and the EFIS control panel TFC switch is selected on. Not displayed when TCAS TEST, TCAS FAIL, or TCAS OFF is annunciated.
TA ONLY	TCAS mode (G)	All	TCAS control panel Mode Selector in: **N422LA through N526LA** • TA **N316LA** • TA ONLY Indicates TCAS computer is not computing RAs. Displayed whether the EFIS control panel TFC switch is selected on or off.

Symbol	Name (Color)	Applicable Mode(s)	Remarks
TCAS TEST	TCAS mode (W)	All	Indicates TCAS is operating in the test mode. Displayed whether EFIS control panel TFC switch is selected on or off.
TCAS OFF	TCAS off message (W)	MAP CTR MAP APP VOR	Displayed when the TCAS/ATC mode switch is not in TA ONLY or TA/RA. Not displayed if TCAS is failed.
TCAS FAIL	TCAS fail message (A)	MAP CTR MAP APP VOR	Indicates TCAS failure.

TCAS Vertical Guidance

ADI



ADI

1 Vertical Guidance (Down Advisory)

Displayed (red) –

- a RA is occurring
- indicates pitch attitude region to be avoided for traffic-avoidance maneuver

2 Vertical Guidance (Up Advisory)

Displayed (red) –

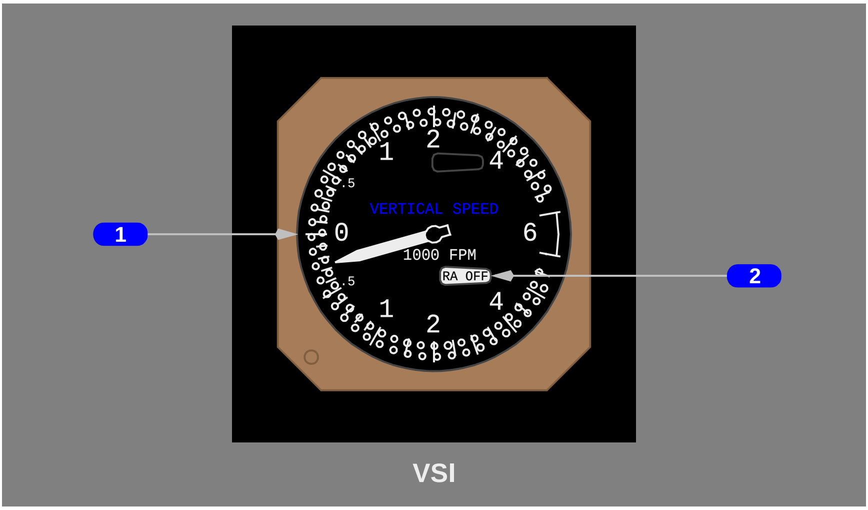
- a RA is occurring
- indicates pitch attitude region to be avoided for traffic-avoidance maneuver

Note: Both of the TCAS RA pitch commands (above and below) may be displayed at the same time and are shown for clarity.

Note: The area inside the red lines indicates the pitch region to avoid in order to resolve the traffic conflict. The center of the airplane symbol must be outside the red RA pitch command area to ensure traffic avoidance.

VSI with Vertical Guidance Only

N422LA through N526LA



1 Vertical Guidance

Displayed (red and green):

- RA is occurring
- red indicates vertical speeds to avoid
- green (or no colored arc) indicates safe vertical speeds

2 Failure and Mode Annunciations

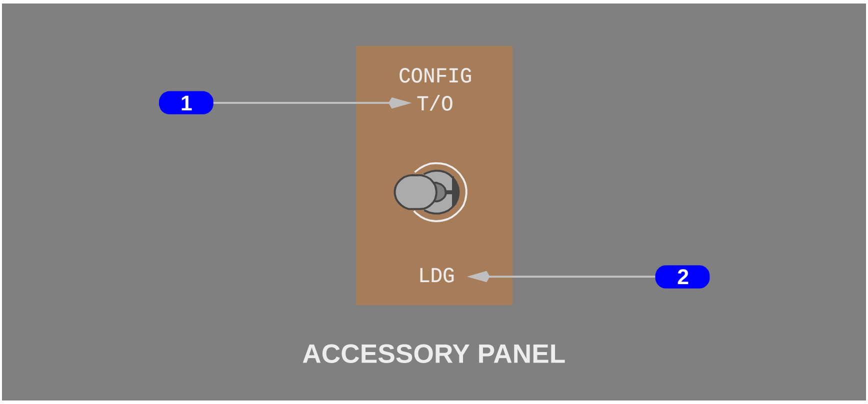
TCAS (amber) – TCAS failure. TAs and RAs not available.

RA OFF (white):

- TCAS Mode Selector in STBY
- TCAS Mode Selector in TA
- VSI power loss.

Miscellaneous Switches

Configuration (CONFIG) Test Switches



1 Takeoff (T/O) Test Switch

Spring-loaded to center

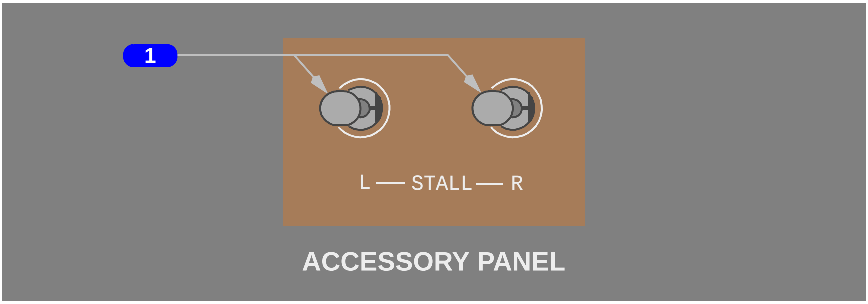
T/O – activates configuration warning if improper takeoff configuration exists

2 Landing (LDG) Test Switch

Spring-loaded to center

LDG – activates a landing configuration warning

Stall Warning Test Switches

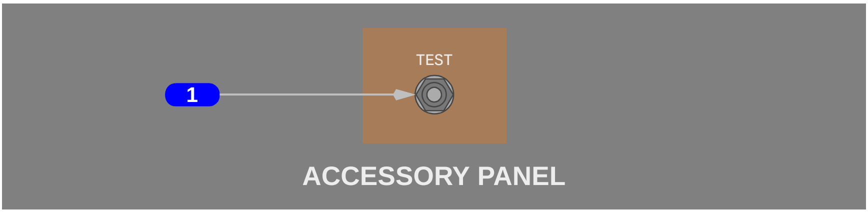


1 **Stall (STALL L/R) Warning Test Switch**

Spring-loaded to center

Activates stall warning system

EICAS Test Switch



1 **TEST Switch**

Push – activates EICAS test

Introduction

The warning system consists of the following separate systems:

- engine indication and crew alerting system (EICAS)
- warning system
- ground proximity warning system (GPWS)
- traffic alert and collision avoidance system (TCAS)

These systems provide all airplane crew alerting.

Alert is defined as a visual, tactile and/or aural alert requiring crew awareness and possible crew action.

Engine Indication and Crew Alerting System (EICAS)

EICAS consolidates engine and subsystem indications and provides a centrally located crew alerting message display. EICAS also displays some system status and maintenance information. EICAS provides:

- system alerts
- maintenance information
- status messages
- communication alerts

System Alert Messages

System alert messages are associated with aircraft-system failures or faults. These may require performance of non–normal procedures, or affect the way the flight crew operates the airplane. There are four categories of system alert messages:

- time-critical warning
- warning
- caution
- advisory

System alert messages not associated with aircraft-system failures or faults but which may affect the way the flight crew operates the airplane include the following:

- configuration
- airspeed
- altitude
- windshear
- ground proximity warning system (GPWS)
- traffic alert and collision avoidance system (TCAS)

- communication alert messages such as SELCAL, ACARS, ATC or PRINTER
- FMC messages (See Chapter 11, Flight Management, Navigation)

Non–normal airplane system conditions not affecting the normal airplane operations are annunciated using status or maintenance messages.

System Alert Level Definitions

Time Critical Warnings

Time critical warnings alert the crew of a non–normal operational condition requiring immediate crew awareness and corrective action to maintain safe flight. Time critical warnings are usually associated with primary flight path control. Master WARNING lights, voice alerts, and ADI indications or stick shakers announce time critical warning conditions.

Warnings

Warnings alert the crew to a non–normal operational or system condition requiring immediate crew awareness and corrective action.

Cautions

Cautions alert the crew to a non–normal operational or system condition requiring immediate crew awareness. Corrective action may be required.

Advisories

Advisories alert the crew to a non–normal operational or system condition requiring routine crew awareness. Corrective action may be required.

Communication Alerts

Communication alerts are triggered by the communication management system. These alerts direct the crew to the appropriate message display:

There are three levels of communication alert:

- low – identifies an incoming communication requiring timely awareness and response
- medium – identify an incoming communication requiring immediate awareness and a prompt response. It is accompanied by an aural chime
- high – reserved for future use.

A detailed description of the communication management system is described in Chapter 5, Communications.

Status Messages

Status messages identify system faults affecting airplane dispatch and are not considered crew alerts.The messages are displayed on the EICAS STATUS page.

Alert Message Displays

Alert messages are displayed in both prioritized and chronological order. The priority in descending order is:

- warning (red)
- caution (amber)
- advisory (amber, indented)
- medium level communication (white, preceded by a dot)
- low level communication (white, indented, preceded by a dot)

Warnings, cautions, and advisories are displayed from the top down in the EICAS display message area.

The most recent message is displayed at the top of its respective level.

If the number of messages exceeds eleven, the area below the alert field displays a page cue, indicating more than one page of messages is available for display. Paging is accomplished by pushing the CANCEL/RECALL switch on the display select panel.

Warning alerts can only be cleared by correcting the condition causing the warning. All caution and advisory alerts can be cleared. When the last page is displayed, pushing the CANCEL/RECALL switch clears all displayed caution and advisory alerts. Cleared caution and advisory alerts whose conditions still exist can be recalled by pushing the CANCEL/RECALL switch again. This also recalls the first page for review.

Communication alert messages are displayed at the bottom of the message area. Except for the Communication Alert Line, an overflow of system alert messages displaces communication alerts.

The Communication Alert Line, the bottom line of the EICAS message field (line 11), is reserved for a communication alert (medium or low) if one is active. The Communication Alert Line can not be displaced by a system alert even if more than 10 lines are active.

N422LA through N526LA
Communication alerts are removed when a pilot has acknowledged the communication alert via the appropriate display unit or selects the appropriate switch on the Pilot’s call panel (See Chapter 5, Communications).

N316LA
Communication alerts are removed when a pilot selects the appropriate switch on the Pilot’s call panel.

Master Warning/Caution Reset Switches and Lights

Two Master WARNING/CAUTION reset switches each contain a Master WARNING light and Master CAUTION light.

The red Master WARNING lights illuminate when any warning alert or time critical warning occurs (except a stall warning). The lights remain illuminated as long as the warning alert exists or until either Master WARNING/CAUTION reset switch is pushed. Pushing either switch:

- extinguishes both Master WARNING lights
- resets the lights for future warning alerts.

Pushing either Master WARNING/CAUTION reset switch also silences the warning siren and fire bell except for the following warnings:

- landing configuration (for example, when the flaps are in a landing position and landing gear are not down)
- autopilot disconnect
- takeoff configuration

Pushing either Master WARNING/CAUTION reset switch also silences the overspeed warning siren.

The amber Master CAUTION lights illuminate when any caution alert occurs. The lights remain on as long as the caution alert exists or until either Master WARNING/CAUTION reset switch is pushed. Pushing either switch:

- extinguishes both Master CAUTION lights
- resets the lights for future caution alerts.

Flight Deck Panel Annunciator Lights

Flight deck panel annunciator lights are used in conjunction with EICAS messages to:

- help locate and identify affected systems and controls
- reduce the potential for error.

The annunciator lights provide system feedback in response to flight crew action. The lights also assist in fault detection and system preflight configuration when the engines are shut down and to supplement EICAS information.

Aural Alerts

Aural alerts are provided to ensure crew attention, recognition, and response. Aural alerts include synthetic voices and tones. Aural voice alerts are the most direct and rapid method of communicating a specific alert condition to the crew. Aural tones are used to alert the crew and to discriminate between the different alert types and levels.

Aural alerts annunciate warnings and cautions. There are no aural annunciations associated with advisories.

Aural alerts also annunciate medium level communication alerts. There are no aural alerts associated with low level communication alerts.

The aural alerts are:

- Beeper – used for all system alert caution level messages. The beeper consists of a tone that sounds four times in a second. The beeper automatically silences after one series of four beeps
- Bell – used for fire warnings. The bell sounds repeatedly until crew action is initiated
- Voice – synthetic voices annunciate time critical warning alert conditions. Synthetic voices also annunciate certain normal but time critical operational information, such as approach phase altitude callouts.
- Siren – used to annunciate cabin altitude, configuration, autopilot disconnect, and overspeed warning alerts. The siren consists of alternating high and low tones
- Chime – a high–low tone chime used for medium level communication alerts. The chime sounds once for each communication alert.

All continuous aural alerts are silenced automatically when the respective alert condition no longer exists.

Alert Inhibits

Alerts are inhibited during part of the takeoff in order not to distract the crew. Alerts are also inhibited when they are operationally unnecessary or inappropriate.

Alert messages, except for warnings and messages directly relevant to flight operations, are inhibited during engine start to eliminate nuisance messages.

Alert messages are inhibited individually at other times, such as during the preflight and postflight phases or engine shutdown, when they are operationally unnecessary.

Message Consolidation

On the ground with both engines shut down, certain caution and advisory alert messages are inhibited by collecting them into more general alert messages. These include individual fuel, hydraulic, door, and electrical messages. For example, two or more individual entry, cargo, and access door EICAS messages are replaced by the EICAS advisory message DOORS.

Engine Start Message Inhibits

During ground engine start, most new caution and advisory alerts are inhibited from engine start switch engagement until one of the following occurs:

- the engine reaches idle RPM
- the start is aborted, or
- 2 minutes elapse from engine start switch engagement.

The following messages are not inhibited:

- ENG FUEL VAL
- ENG SHUTDOWN
- ENG STARTER
- STARTER CUTOUT.

Takeoff Inhibits

Warning Inhibits

The Master WARNING lights and fire bell are inhibited for fire during part of the takeoff. The inhibit begins at nose gear extension during rotation and continues until the first to occur:

- 400 feet AGL, or
- 20 seconds elapsed time

If a fire occurs during the inhibit, an EICAS warning message appears, but the fire bell and Master WARNING lights do not activate. If the warning condition still exists when the inhibit is removed, the fire bell and Master WARNING lights activate immediately.

Note: Takeoff configuration warnings are terminated at rotation.

Caution Inhibits

The Master CAUTION lights and aural annunciations are inhibited for all cautions during part of the takeoff. The inhibit begins at 80 knots and continues until the first to occur:

- 400 feet AGL, or
- 20 seconds elapsed time following nose gear extension

If a caution occurs during the inhibit and exists on the ground when the airspeed decreases below 75 knots, both Master CAUTION lights and aural activate.

Note: EICAS caution messages are not inhibited during takeoff.

Advisory Inhibits

The following EICAS advisory messages are inhibited on takeoff:

N422LA through N526LA

- DATALINK LOST to indicate data link is temporarily lost.
- WINDSHEAR SYS to indicate windshear alerting functions are inoperative.

The inhibit begins from the time either engine is advanced to takeoff thrust until the first to occur:

- 400 feet AGL, or
- 20 seconds elapsed time following nose gear extension

All other EICAS advisory messages are not inhibited on takeoff:

Communication Inhibits

The following are inhibited during takeoff:

- EICAS communication alert messages and associated aural chimes such as SELCAL, ACARS, CARGO CALL, ATC or PRINTER

The inhibit begins from the time either engine is advanced to takeoff thrust until the first to occur:

- 400 feet AGL, or
- 20 seconds elapsed time following nose gear extension

Inhibits are cleared on the ground with both engines below takeoff thrust. If a message alert occurs during the inhibit and exists when the inhibit ends, the EICAS alert message and aural chime activate.

Landing Inhibits

Communication Inhibits

The following are inhibited during landing:

- EICAS communication alert messages such as SELCAL, ACARS, CARGO CALL, ATC or PRINTER and associated aural chimes.

The inhibit begins on descent at 800 feet AGL and terminates at:

- less than 75 knots groundspeed
- 900 feet AGL on missed approach

If a communication alert message occurs during the inhibit and exists when inhibit ends, the EICAS alert message and associated aural chime activate.

Engine Shutdown Inhibits

Engine–driven pumps, generators, and other components whose alert messages would result from an engine shutdown are inhibited by the ENG SHUTDOWN message. When an engine is shutdown (FUEL CONTROL switch in cut off or fire handle pulled), the EICAS alert message L ENG SHUTDOWN or R ENG SHUTDOWN is displayed and the following L or R alerts are inhibited:

- ENG ANTI–ICE
- ENG BLEED OFF
- GEN DRIVE
- GEN OFF

- ENG OIL PRESS
- HYD PRIM PUMP
- ENG CONTROL

When the airplane is on the ground and both FUEL CONTROL switches are in the CUT OFF position, the Master CAUTION lights and the caution alert beeper are inhibited. This prevents alerts associated with routine gate operations from triggering nuisance lights and aural alerts.

When the shutdown inhibit is removed, the Master CAUTION lights and alert beeper do not activate for alerts that existed prior to its removal. For example, if the right hydraulic system is depressurized with both engines shutdown, and the left engine is then started, the Master CAUTION lights and beeper do not activate. The Master CAUTION lights and beeper activate only when the alert first occurs, provided no other inhibit is in effect.

Alert Message Inhibits

Alert message inhibits are those inhibits where one message is inhibited by the presence of another alert message. For example, individual fuel or hydraulic pump pressure messages are inhibited by higher priority system pressure messages.

Certain alert messages are time delayed, even though discrete system lights may illuminate. Time delay inhibits prevent normal in–transit indications from appearing as EICAS system alert messages. For example, valves are generally only sensed open and/or closed, not in–transit. When a valve is in–transit, the alert message indicating the valve has failed to open or close is inhibited to allow the valve time to move to the commanded position. If the valve is not in the commanded position at the end of the inhibit period, an EICAS system alert message is displayed.

Altitude Alerting Inhibits

Altitude alerting is inhibited in flight with all landing gear down and locked.

Master Caution Lights and Beeper Inhibit

The Master CAUTION lights and the associated alert beeper are inhibited for the L and R ENG SHUTDOWN caution level message.

EICAS Event Record

The flight crew can manually capture and record any suspect condition into EICAS memory using the EICAS EVENT RECORD switch.

Systems which provide recorded information when the switch is activated include:

- anti–ice, ice detection
- air systems
- APU
- electrical
- electronic engine control
- fire protection
- flight controls/flaps and slats
- fuel quantity and fuel management
- hydraulic
- landing gear and brakes
- performance.

Only the last manual event recorded will be retained for future retrieval. The event record function also has an automatic feature. When an EICAS event occurs, conditions are automatically written to EICAS memory.

EICAS Failure Indications

If a fault is detected in one of the cathode ray tubes (CRTs), the faulty display is blanked. Engine indications and crew alerting messages appear on the operable display. An EICAS DISPLAY advisory message displays when one CRT fails.

To ensure that all engine indications can be displayed with a CRT failure, an EICAS compacted display mode is available. The compacted display mode is described in the Engines, APU chapter.

If the EICAS control panel fails an EICAS CONT PNL advisory message displays and the EICAS full up engine mode automatically displays. The full engine mode is described in Chapter 7, Engines, APU. The cancel and recall switches will not operate when the EICAS control panel fails, however, brightness and computer select controls remain operative.

If both EICAS computers or CRTs fail, a standby engine indicator (SEI) is automatically activated. The SEI, system lights and indicators are used to monitor the engines and system operation when a total EICAS failure occurs.

Warning System

The warning system consists of flight deck speakers, Master WARNING/CAUTION lights, EICAS alert messages, and stick shaker motors.

The warning system controls and activates alerts for:

- fire (See Chapter 8, Fire Protection)
- cabin altitude (See Chapter 2, Air Systems)
- autopilot disconnect (See Chapter 4, Automatic Flight)
- configuration
- airspeed
- altitude

N422LA through N526LA
- crew alertness
- ground proximity warning system (GPWS)

- windshear
- traffic alert and collision avoidance system (TCAS)

Configuration Alerts

Takeoff

Takeoff configuration warnings are armed when the airplane is on the ground and thrust is in the takeoff range on either engine. Takeoff configuration warnings consist of:

- Master WARNING lights illuminate
- CONFIG warning light illuminates
- aural warning siren sounds
- applicable EICAS configuration warning alert message(s) are displayed.

Takeoff configuration warning messages include:

- FLAPS
- PARKING BRAKE
- SPOILERS
- STABILIZER

Takeoff configuration warnings are disarmed at rotation.

Existing takeoff configuration warning are:

- cancelled when the configuration error is corrected
- terminated at rotation

When a takeoff configuration warning occurs, pushing either Master WARNING/CAUTION reset switch resets the Master WARNING lights but does not silence the siren or clear the EICAS alert message. Before reaching rotation, the siren can be silenced and the EICAS alert message cleared only by retarding both thrust levers or correcting the condition. If thrust is reduced, the EICAS takeoff configuration message remains displayed for 10 seconds so the crew can positively identify the configuration problem.

Holding the configuration test switch in the takeoff (T/O) position simulates accelerating an engine to takeoff power. No warnings occur when testing an airplane properly configured for takeoff. If the airplane is not configured for takeoff a configuration warning results. Releasing the test switch cancels the test.

Landing

The landing configuration warning system alerts the crew that the landing gear is not extended for landing. The landing configuration warning activates if:

- the airplane is in flight, and
- any landing gear is not down and locked, and

- either of the following conditions exists:
  - flaps in a landing position (25 or 30), or
  - any thrust lever is at idle with radio altitude below 800 feet.

The landing configuration warning consists of:

- Master WARNING lights illuminate
- CONFIG warning light illuminates
- aural warning siren activates
- the GEAR NOT DOWN EICAS warning alert message is displayed.

With the flaps in a landing position, the siren and alert message cannot be deactivated with the Master WARNING/CAUTION reset switches. The siren and message continue until the condition is corrected or the gear override switch is pushed.

If the warning is due to an idle thrust setting at low altitude, pushing either Master WARNING/CAUTION reset switch silences the siren and extinguishes the Master WARNING lights. The EICAS message remains displayed until the configuration error is corrected.

Holding the configuration test switch in the landing (LDG) position results in a configuration warning regardless of landing gear position. All warning indications disappear when the switch is released.

Airspeed Alerts

Stall Warning

Warning of an impending stall is provided by left and right stick shakers, which independently vibrate the left and right control columns. If the flaps are in the retracted position and the angle of attack continues to increase, a control column nudger moves the control column forward. Both systems are energized in flight and deactivated on the ground through air/ground logic.

Holding the stall warning tests switches to either the L or R position checks the left and right stall warning systems, respectively. If the systems are tested at the same time, both columns vibrate and the control column nudger activates.

Overspeed Warning

An overspeed warning occurs if Vmo/Mmo limits are exceeded. The overspeed warning consists of:

- Master WARNING lights illuminate
- OVSPD light illuminates
- the EICAS warning alert message OVERSPEED is displayed
- aural warning siren sounds

All warning indications remain activated until airspeed is reduced below Vmo/Mmo.

The aural warning can be silenced by pushing either Master WARNING/CAUTION reset switch.

Altitude Alerts

Altitude alerting occurs when approaching or departing the MCP–selected altitude.

Approaching A Selected Altitude

At 900 feet prior to reaching the selected altitude, the ALT light on each pilot's altimeter illuminates. At 300 feet prior to reaching the selected altitude, the ALT lights extinguish.

Deviating From A Selected Altitude

When deviating 300 feet from the selected altitude:

- the Master CAUTION lights illuminate
- the caution aural sounds
- the EICAS caution message ALTITUDE ALERT is displayed
- the ALT ALERT light illuminates.

When deviating more than 900 feet from the selected altitude, or upon returning to within 300 feet of the selected altitude:

- the Master CAUTION lights extinguish
- the EICAS caution message ALTITUDE ALERT is no longer displayed
- The ALT ALERT light extinguishes.

Resetting To A Selected Altitude

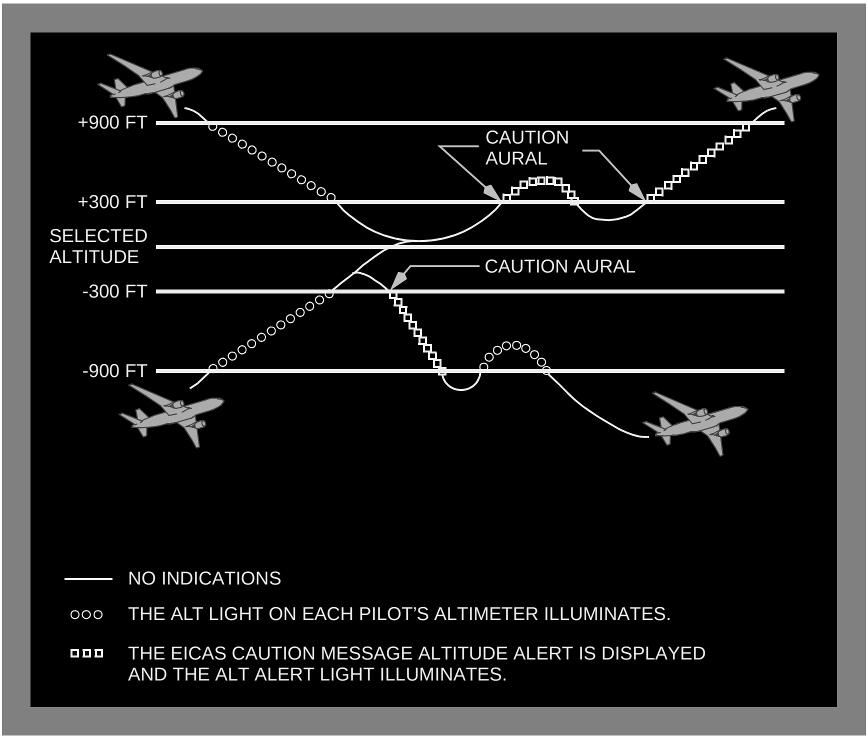
Altitude alerting is reset when:

- the airplane returns to within 300 feet of the altitude selected or deviates more than 900 feet from the altitude selected
- the MCP-selected altitude is changed

Altitude Alert Inhibits

Altitude alerting is inhibited in flight with all landing gear down and locked.

Altitude Alert Profile



Crew Alertness Monitor

N422LA through N526LA

The FMC continuously monitors the activation of switches on the mode control panel, EFIS control panel, display select panel, CDUs, and radio transmitter microphone switches. When a predefined time elapses after the last control activation, the EICAS advisory message PILOT RESPONSE is generated. The PILOT RESPONSE message can be cleared by pushing any control on any of the monitored systems or panels. If there is still no response after a short time, the EICAS caution message PILOT RESPONSE is displayed. If there is still no response, the warning message PILOT RESPONSE is displayed. Any control activation on the MCP, EFIS control panel, display select panel, CDUs, or radio transmitters resets the PILOT RESPONSE message.

Ground Proximity Warning System (GPWS)

Introduction

The ground proximity warning system (GPWS) provides time-critical alerts for potentially hazardous flight conditions involving imminent impact with the ground. GPWS is enabled whenever power is applied to the airplane. Override or inhibit switches allow the flight crew to inhibit certain GPWS alerts.

GPWS provides voice callouts (Mode 6) to assist the flight crew with situational awareness and to advise the flight crew of the aircraft's approximate height above the ground.

In addition to aircraft configuration, GPWS requires inputs from the following for proper operation:

- air data system
- inertial reference system
- instrument landing system
- radio altimeters

Note: Loss of an input does not necessarily inhibit operation of the entire GPWS.

Standard GPWS alerts are radio altitude based and provided for the following:

- excessive and severe descent rate (Mode 1)
- excessive terrain closure rate (Mode 2)
- altitude loss after takeoff or go-around (Mode 3)
- unsafe terrain clearance when not in the landing configuration (Mode 4)
- excessive deviation below an ILS glideslope (Mode 5)
- windshear (Mode 7)

GPWS (Enhanced)

In addition to standard alerts, enhanced GPWS provides look-ahead terrain awareness, including alerting and display functions. These functions compare the airplane's geographic position and altitude against an internal terrain database to predict and display potential conflicts between the airplane flight path and terrain.

N422LA through N526LA

The enhanced GPWS internal database also provides prediction and display of potential conflicts between the airplane flight path and man-made obstacles.

In addition to standard GPWS inputs, enhanced GPWS requires inputs from the following for proper operation:

- global positioning system

Note: Loss of an input does not necessarily inhibit operation of the entire GPWS.

GPWS Alert Prioritization

GPWS and Windshear Warning System alerts are prioritized based on the level of hazard and the required flight crew response. The following are listed in order of decreasing priority:

GPWS Alerts

Condition	Alert Level	Description
Windshear - Immediate	Warning	Mode 7 - Actual windshear conditions (downdraft) A windshear immediate-alert warning inhibits all other GPWS and windshear alerts.
Ground proximity - Immediate	Warning	Mode 1 - Severe descent rate
Ground proximity - Immediate	Warning	Mode 2 - Severe terrain closure rate
Terrain - Awareness	Warning	Look-Ahead - Terrain along flight path (Near)
N422LA through N526LA		
Obstacle - Awareness	Warning	Look-Ahead - Obstacle along flight path (Near)
Windshear - Awareness	Warning	Predictive - Windshear condition along flight path
Ground proximity - Immediate	Caution	Mode 2 - Excessive terrain closure rate
Terrain - Awareness	Caution	Look-Ahead - Terrain along flight path
N422LA through N526LA		
Obstacle - Awareness	Caution	Look-Ahead - Obstacle along flight path

Condition	Alert Level	Description
Ground proximity - Immediate	Caution	Mode 4 - Unsafe terrain clearance
Altitude - Awareness		Mode 6 - Altitude callouts
Ground proximity - Immediate	Caution	Mode 4 - Unsafe terrain clearance - Gear
		Mode 4 - Unsafe terrain clearance - Flaps
		Mode 1 - Excessive descent rate
		Mode 3 - Descent (sink rate) after takeoff
		Mode 5 - Below glideslope - ILS deviation
Windshear - Awareness	Caution	Predictive - Windshear adjacent to flight path

GPWS Immediate-Alerts

GPWS immediate-alert warnings (Modes 1-2) are accompanied by:

- visual alerts (see tables)
- aural alerts (see tables)

If illuminated, pushing a Master WARNING/CAUTION Reset switch resets the Master WARNING lights but does not inhibit the GPWS warning.

GPWS immediate-alert cautions (Modes 1-5) are accompanied by:

- visual alerts (see tables)
- voice aural alerts (see tables)

GPWS Immediate-Alert Warnings

Aural Alert	Visual Alert	Description
PULL UP	PULL UP light (red) Master WARNING lights	Follows SINK RATE alert if descent rate becomes severe. (Mode 1) Follows TERRAIN alert if excessive terrain closure rate continues and landing gear and/or flaps are not in landing configuration. (Mode 2)

GPWS Immediate-Alert Cautions

Aural Alert	Visual Alert	Description
TERRAIN	GND PROX light (amber)	Excessive terrain closure rate. (Mode 2)
DON’T SINK	GND PROX light (amber)	Excessive altitude loss after takeoff or go–around. (Mode 3)
GLIDESLOPE	GND PROX light (amber)	Deviation below glideslope. (Mode 5) Volume and repetition rate increase as deviation increases. **Note:** Pushing the GND PROX G/S INHB switch cancels or inhibits the alert below 1,000 feet radio altitude.
SINK RATE	GND PROX light (amber)	Excessive descent rate. (Mode 1)
TOO LOW, FLAPS	GND PROX light (amber)	Unsafe terrain clearance at low airspeed with flaps not in landing configuration. (Mode 4) **Note:** Pushing the GND PROX FLAP OVRD switch to OVRD inhibits the alert.
TOO LOW, GEAR	GND PROX light (amber)	Unsafe terrain clearance at low airspeed with landing gear not down. (Mode 4) **Note:** Pushing the GND PROX/CONFIG GEAR OVRD switch to OVRD inhibits the alert.

Aural Alert	Visual Alert	Description
TOO LOW, TERRAIN	GND PROX light (amber)	Follows DON'T SINK if another descent is initiated after initial alert and before climbing to the altitude where the initial descent began. (Mode 3) Unsafe terrain clearance at low airspeed with either landing gear not down or flaps not in landing position. (Mode 4) **Note:** Pushing the GND PROX FLAP OVRD switch to OVRD inhibits the alert, when the alert is due to flaps not in landing position. **Note:** Pushing the GND PROX/CONFIG GEAR OVRD switch to OVRD inhibits the alert, when the alert is due to gear not down.

GPWS Voice Callouts

GPWS provides voice callouts (Mode 6) to assist the flight crew with situational awareness and to advise the flight crew of the aircraft's approximate height above the ground.

Callout	Description
TWENTY FIVE HUNDRED	Airplane is at 2,500 feet AGL
ONE THOUSAND	Airplane is at 1,000 feet AGL
FIFTY	Airplane is at 50 feet AGL
FORTY	Airplane is at 40 feet AGL
THIRTY	Airplane is at 30 feet AGL
TWENTY	Airplane is at 20 feet AGL
TEN	Airplane is at 10 feet AGL
APPROACHING DECISION HEIGHT	Airplane reaches 100 feet prior to the DH set in the captain's Decision Height Reference Window.

Callout	Description
MINIMUMS	Airplane reaching the DH set in the captain's Decision Height Reference Window.
BANK ANGLE, BANK ANGLE	Voice callout occurs when airplane roll angle reaches: • 35 degrees • 40 degrees • 45 degrees **Note:** Callout is reset when roll angle decreases below 30 degrees.

GPWS Look–Ahead Alerts and Display

GPWS provides look-ahead alerts for potentially hazardous flight conditions involving impact with the ground. GPWS monitors terrain proximity and generates a display from a world-wide terrain data base in the GPWS computer. The data base contains detailed terrain data near major airports and data in lesser detail for areas between airports.

N422LA through N526LA
In addition to terrain alerting, GPWS provides look-ahead alerts for potentially hazardous flight conditions involving impact with human-made obstacles (minimum height of approximately 100 feet). GPWS monitors obstacle proximity and generates a display from a a separate obstacle data base in the GPWS computer. The data base contains detailed obstacle data near major airports and data in lesser detail for areas between airports.

N422LA through N526LA
Note: The obstacle data base is not yet world wide.

Airplane horizontal position is determined using the:

- global positioning system. If GPS data is intermittently unavailable, GPWS derives horizontal position from the IRS.

Barometric altitude errors induced from temperature extremes or from non-standard pressure altitudes are minimized. Airplane vertical position is determined using a blended solution calculated from the following:

- GPS altitude
- barometric altitude
- radio altitude
- static air temperature

Look-Ahead Displays

When the EFIS control panel terrain (TERR) display select switch is pushed on, the TERR annunciation is displayed on the HSI and terrain contours may be displayed.

GPWS look-ahead data and weather radar returns cannot be displayed simultaneously on an HSI. If either pilot selects terrain while the other selects weather radar, each display updates on alternating sweeps. All other navigation displays can be simultaneously displayed with terrain data.

When the airplane is lower than 2,000 feet above the terrain, terrain within 2,000 feet of airplane barometric altitude is displayed on the HSI. Non-threat terrain is depicted as several densities of dot patterns in green, amber, or red depending on relative vertical distance between the airplane and the terrain.

N316LA
When the airplane is higher than 2,000 feet above the terrain or within 400 feet of the nearest airport runway elevation, terrain is not displayed.

N422LA through N526LA
The HSI may also display man-made obstacles. When the airplane is higher than 2,000 feet above the terrain, non-threat obstacles and terrain peaks are displayed using solid, high density, and low density contours of green. The highest obstacle or terrain is represented by solid green, and the lowest obstacle or terrain displayed is represented by low density green.

N422LA through N526LA
When the enhanced GPWS look-ahead display is selected the HSI displays a digital indication of the highest and lowest terrain or obstacle within the selected map range. The elevation numbers are expressed in hundreds of feet above sea level (e.g. 125 is 12,500 ft. MSL) with the highest elevation on top and the lowest on the bottom. The color of the elevation numbers match the color of the represented terrain or obstacle.

Note: The GPWS look-ahead display is not designed to be used as an independent navigation aid.

Look-Ahead Alerting

The enhanced GPWS computer continuously computes clearance envelopes looking down and ahead of the airplane. Estimated time to impact is calculated from airplane position, barometric altitude, present track, vertical path, and ground speed. FMC VNAV or LNAV (Refer to Chapter 11, Flight Management, Navigation) paths are not considered in the estimated time to impact.

When the terrain clearance boundaries are crossed the GPWS issues alerts. Alert levels, warning or caution, are based on estimated time to impact. Look-ahead alerts will cause the GPWS look-ahead awareness display to "pop-up" when:

- the HSI display is in an appropriate mode (see tables)
- neither terrain (TERR) display select switch is ON

N316LA
Note: Terrain ahead of the airplane may exceed available climb performance. A GPWS caution or warning alert does not guarantee terrain clearance.

N422LA through N526LA
Note: Obstacles or terrain ahead of the airplane may exceed available climb performance. A GPWS caution or warning alert does not guarantee obstacle or terrain clearance.

Look-Ahead Alerting - Warnings

GPWS look-ahead warning alerts are accompanied by:

- visual alerts (see tables)
- voice aural alerts (see tables)

N316LA
- solid red terrain displayed on HSIs

N422LA through N526LA
- solid red obstacles or solid red terrain displayed on HSIs

If illuminated, pushing a Master WARNING/CAUTION Reset switch resets the Master WARNING lights but does not inhibit the GPWS warning.

Aural Alert	Visual Alert	Description
TERRAIN TERRAIN PULL UP	PULL UP light (red) Master WARNING lights Solid red terrain on HSI Red TERRAIN annunciation on both HSIs	20 to 30 seconds from projected impact with terrain shown in solid red on the HSI. Pop-up look-ahead display is only available in the following modes: • VOR, APP, MAP and CTR MAP **Note:** Pushing the TERR OVRD switch to OVRD inhibits the alert.

Aural Alert	Visual Alert	Description

N422LA through N526LA

Aural Alert	Visual Alert	Description
OBSTACLE OBSTACLE PULL UP	PULL UP light (red) Master WARNING lights Solid red obstacle on HSI Red OBSTACLE message on both HSIs	20 to 30 seconds from projected impact with an obstacle shown solid red on the HSI. Pop-up look-ahead display is only available in the following modes: • VOR, APP, MAP and CTR MAP **Note:** Pushing the TERR OVRD switch to OVRD inhibits the alert. **Note:** If an obstacle alert occurs while a TERRAIN annunciation is displayed, the OBSTACLE annunciation replaces the TERRAIN annunciation. Both annunciations can not be displayed at the same time.

Look-Ahead Alerting - Cautions

GPWS look-ahead caution alerts are accompanied by:

- visual alerts (see tables)
- voice aural alerts (see tables)

N316LA
- solid amber terrain displayed on HSIs

N422LA through N526LA
- solid amber obstacles or solid amber terrain displayed on HSIs

Aural Alert	Visual Alert	Description
CAUTION TERRAIN	GND PROX light (amber) Solid amber terrain on HSI Amber TERRAIN annunciation on both HSIs	40 to 60 seconds from projected impact with terrain shown in solid amber on the HSI. Pop-up look-ahead display is only available in the following modes: • VOR, APP, MAP and CTR MAP **Note:** Pushing the TERR OVRD switch to OVRD inhibits the alert.

N422LA through N526LA

CAUTION OBSTACLE	GND PROX light (amber) Solid amber obstacle on HSI Amber OBSTACLE annunciation on both HSIs	40 to 60 seconds from projected impact with an obstacle shown in solid amber on the HSI. Pop-up look-ahead display is only available in the following modes: • VOR, APP, MAP and CTR MAP **Note:** Pushing the TERR OVRD switch to OVRD inhibits the alert. **Note:** If an obstacle alert occurs while a TERRAIN annunciation is displayed, the OBSTACLE annunciation replaces the TERRAIN annunciation. Both annunciations can not be displayed at the same time.

TOO LOW, TERRAIN	GND PROX light (amber)	Terrain Clearance Floor (TCF) alert indicating unsafe terrain clearance based on current airplane location, nearest runway center point and radio altitude. Similar to Mode 4 but available in all flight modes. **Note:** Pushing the TERR OVRD switch to OVRD inhibits the alert.

Windshear Warning System
Windshear Immediate-Alerts

The GPWS takes additional data from the stall warning computer (STC) and determines if decreasing-performance windshear conditions are occurring in the immediate vicinity of the airplane. GPWS issues Windshear Immediate-Warnings whenever decreasing-performance windshear conditions are present during takeoff, approach and landing.

Warnings

Windshear warnings are accompanied by:

- visual alerts (see tables)
- voice or aural alert (see tables)

If illuminated, pushing a Master WARNING/CAUTION reset switch resets the Master WARNING lights but does not deactivate the windshear warning.

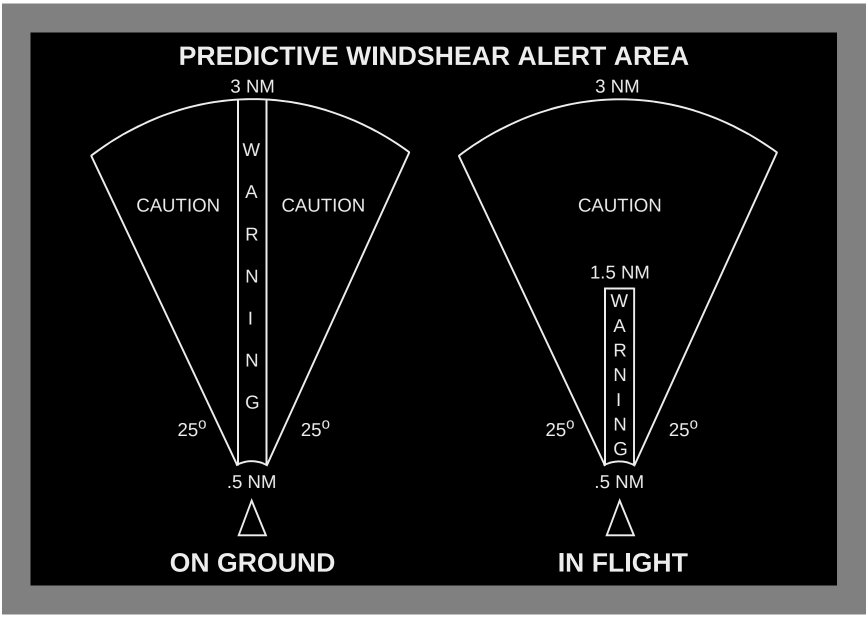
Windshear Immediate-Alert Warnings

Aural Alert	Visual Alert	Description
Two–tone siren followed by WINDSHEAR	WINDSHEAR light (red) Master WARNING lights Red WINDSHEAR on both ADIs	Excessive windshear at the current airplane position detected by GPWS. Enabled below 1,500 feet radio altitude. GPWS Windshear detection begins at rotation.

Predictive Windshear (PWS)

The weather radar (See Chapter 11, Flight Management, Navigation) provides PWS alerts when it detects disturbed air ahead of the aircraft which contains moisture or particulate matter and which fits a known pattern of windshear activity.

The PWS alert area ahead of the aircraft is shown as follows:



When the PWS mode is enabled, the radar system is time-shared between the weather display and the PWS display. During the time-share:

- the weather display is slower to update
- PWS alerts are available approximately 12 seconds after the system begins scanning
- PWS automatically, regardless of actual Weather Radar Control Panel settings, adjusts the antenna TILT and the system GAIN for optimum windshear detection

The PWS mode is automatically enabled when:

- in flight, the aircraft is below 2,300 feet AGL
- on the ground, the thrust levers are set for takeoff
- on the ground, WXR is selected on the EFIS control panel and any mode other than TEST is selected on the weather radar control panel

PWS alerts are automatically enabled below 1,200 feet AGL. If a PWS alert occurs when weather (WXR) is not selected on either pilot HSI displays and there is not an active terrain alert occurring; the weather radar display, including PWS symbology, automatically pops-up on the HSI.

Note: PWS does not provide alerting for all types of windshear. The flight crew must continue to rely on traditional windshear avoidance methods.

Warnings

PWS warnings are accompanied by:

- visual alerts (see tables)
- voice or aural alerts (see tables)

If illuminated, pushing a Master WARNING/CAUTION reset switch resets the Master WARNING lights but does not deactivate the windshear warning.

Predictive Windshear Warnings

Aural Alert	Visual Alert	Description
WINDSHEAR AHEAD WINDSHEAR AHEAD	WINDSHEAR light (Red) MASTER WARNING lights Red WINDSHEAR annunciation on both ADIs RED and BLACK PWS symbol on HSI Red WINDSHEAR annunciation on HSI (all modes)	Enabled during takeoff, below 1,200 feet AGL. Windshear within 3.0 miles and directly ahead of the airplane. If weather (WXR) is not selected on either HSI, the weather display, including PWS symbology, will automatically pop-up on the HSI. PWS symbol on the HSI shows windshear position and size only when the HSI Mode Selector is in the VOR, APP, MAP or CTR MAP mode.

Aural Alert	Visual Alert	Description
GO AROUND, WINDSHEAR AHEAD	WINDSHEAR light (Red) MASTER WARNING lights Red WINDSHEAR annunciation on both ADIs RED and BLACK PWS symbol on HSI Red WINDSHEAR annunciation on HSI (all modes)	Enabled during approach, below 1,200 feet AGL. Windshear within 1.5 miles and directly ahead of the airplane. If weather (WXR) is not selected on either HSI, the weather display, including PWS symbology, will automatically pop-up on the HSI. PWS symbol on the HSI shows windshear position and size only when the HSI Mode Selector is in the VOR, APP, MAP or CTR MAP mode.

Cautions

PWS caution alerts are accompanied by:

- visual alerts (see tables)
- voice or aural alerts (see tables)

Predictive Windshear Caution

Aural Alert	Visual Alert	Description
MONITOR RADAR DISPLAY	RED and BLACK PWS symbol on HSI Amber WINDSHEAR annunciation on HSI	Windshear within 3 miles and ahead of the airplane. Enabled during takeoff and approach, below 1,200 feet AGL. If weather (WXR) is not selected on either HSI, the weather display, including PWS symbology, will automatically pop-up on the HSI. PWS symbol on the HSI shows windshear position and size only when the HSI Mode Selector is in the VOR, APP, MAP or CTR MAP mode.

Inhibits

PWS alerts are inhibited during takeoff and landing as follows:

- WARNINGS, between 100 knots and 50 feet AGL
- CAUTIONS, between 80 knots and 400 feet AGL

Note: These inhibits do not remove existing PWS alerts.

PWS alerts are also inhibited by:

- Windshear Immediate-Alert Warnings
- GPWS Immediate-Alert Warnings
- GPWS Look–Ahead-Alert Warnings

Traffic Alert and Collision Avoidance System (TCAS)

TCAS alerts the crew to conflicting traffic. The system identifies a three–dimensional airspace around the airplane where a high likelihood of air traffic conflicts exist. These dimensions depend upon closure rates between the airplane and potentially conflicting traffic.

TCAS interrogates operating transponders in other aircraft, analyzes the replies, predicts flight paths and designates possible conflicting traffic as a "traffic aircraft."

When the system designates a traffic aircraft, TCAS provides the flight crew with a situational display. Additionally, TCAS may provide an aural annunciation and flight path guidance.

Note: Other aircraft that do not have an operating transponder can not initiate situational displays, aural annunciations or flight path guidance.

Note: TCAS is independent of ground–based air traffic control.

During normal operations, when TCAS designates a traffic aircraft, the system provides the following advisories and displays:

- Resolution Advisories (RA) and Displays
- Traffic Advisories (TA) and Displays
- Proximate Traffic and Other Traffic Displays

Normal Operations

TCAS is enabled from the Transponder Panel. The system is normally operated with the TCAS Mode Selector in the TA/RA mode.

N422LA through N526LA
The TA mode may be used:

- during engine out operations to prevent RAs when adequate thrust may not be available to follow the RA commands
- when intentionally operating near other traffic that may cause RAs, such as during parallel approaches or during VFR operations.

N316LA
The TA ONLY mode may be used:

- during engine out operations to prevent RAs when adequate thrust may not be available to follow the RA commands
- when intentionally operating near other traffic that may cause RAs, such as during parallel approaches or during VFR operations.

Resolution Advisories (RA) and Displays

A Resolution Advisory (RA) is an immediate-threat prediction that traffic aircraft will enter the TCAS collision airspace within approximately 20 to 30 seconds. If altitude data from the traffic aircraft’s transponder is not available, no RA can be provided.

When TCAS issues a RA:

- a voice alert sounds
- vertical guidance is displayed
- symbology is displayed

Voice Alert

When a RA is predicted, one of several initial RA voice alerts will sound. These voice alerts aurally elaborate on the displayed Vertical Guidance and are described in this Chapter under TCAS Vertical Guidance.

Display Symbology

The RA traffic symbol is a filled red square with an accompanying data tag when the traffic aircraft is providing altitude information.

The data tag appears in red and contains the following information about the traffic aircraft:

N316LA

- a two-digit number proceeded with a "+" or a "-" sign and positioned above or below the RA symbol. This number represents, in hundreds of feet, the relative vertical position and altitude difference between the airplane and the traffic aircraft.

N422LA through N526LA

- a two-digit number proceeded with a "+" or a "-" sign and positioned above or below the RA symbol. The signed number represents, in hundreds of feet, the relative vertical position and the relative or absolute altitude of the traffic aircraft.
- a vertical arrow appears to the right of the RA symbol when the traffic aircraft is either climbing or descending in excess of 500 feet per minute.

The RA is displayed as follows:

HSI

- When the red TRAFFIC message appears and the traffic aircraft is within the selected display range, the traffic symbol's relative position is displayed.
- When the traffic aircraft is outside the selected range, the red OFFSCALE message appears.
- When TCAS is unable to track the traffic aircraft's bearing, the red RA symbol is displayed below the TRAFFIC message.

Traffic Advisories (TA) and Displays

A Traffic Advisory (TA) is a prediction that traffic aircraft will enter the TCAS collision airspace within approximately 35 to 40 seconds. TAs are intended to assist the crew in establishing visual contact with the traffic aircraft.

When TCAS issues a TA:

- a voice alert sounds
- symbology is displayed

Voice Alert

When a TA is predicted, TRAFFIC, TRAFFIC sounds once.

Display Symbology

The TA traffic symbol is a filled amber circle with an accompanying data tag when the traffic aircraft is providing altitude information.

The data tag appears in amber and contains the following information about the traffic aircraft:

N316LA

- a two-digit number proceeded with a "+" or a "-" sign and positioned above or below the TA symbol. This number represents, in hundreds of feet, the relative vertical position and altitude difference between the airplane and the traffic aircraft.

N422LA through N526LA

- a two-digit number proceeded with a "+" or a "-" sign and positioned above or below the TA symbol. The signed number represents, in hundreds of feet, the relative vertical position and the relative or absolute altitude of the traffic aircraft.
- a vertical arrow appears to the right of the TA symbol when the traffic aircraft is either climbing or descending in excess of 500 feet per minute.

The TA is displayed as follows:

HSI

- When the amber TRAFFIC message appears and the traffic aircraft is within the selected display range, the traffic symbol's relative position is displayed.
- When TCAS is unable to track the traffic aircraft's bearing, the amber TA symbol is displayed below the TRAFFIC message.
- When the traffic aircraft is outside the selected range, the amber OFFSCALE message appears.

Automatic TA and RA Display

TCAS automatically displays RA and TA symbols on the HSI when:

- a RA or TA occurs, and
- neither pilot has pushed the EFIS Traffic (TFC) Switch, and
- the HSI Mode Selector is in the VOR, APP, or MAP mode, and

N422LA through N526LA

- the TCAS Mode Selector is in TA or TA/RA

N316LA

- the TCAS Mode Selector is in TA ONLY or TA/RA

Proximate Traffic and Other Traffic Displays

Proximate Traffic is a traffic aircraft that is neither a RA nor a TA but is within:

- six miles laterally, and
- 1,200 feet vertically

Other Traffic is a traffic aircraft that is neither a RA, TA, or Proximate Traffic

When TCAS identifies Proximate Traffic or Other Traffic:

- symbology is displayed

Display Symbology

The Proximate Traffic symbol is a filled diamond and the Other Traffic symbol is a hollow diamond. Both Proximate Traffic and Other Traffic symbols are displayed with an accompanying data tag when the traffic aircraft is providing altitude information.

The data tag contains the following information about the traffic aircraft:

N316LA

- a two-digit number proceeded with a "+" or a "-" sign and positioned above or below the Proximate or Other Traffic symbol. This number represents, in hundreds of feet, the relative vertical position and altitude difference between the airplane and the traffic aircraft.

N422LA through N526LA

- a two-digit number proceeded with a "+" or a "-" sign and positioned above or below the Proximate or Other Traffic symbol. The signed number represents, in hundreds of feet, the relative vertical position and the relative or absolute altitude of the traffic aircraft.
- a vertical arrow appears to the right of the Proximate or Other Traffic symbol when the traffic aircraft is either climbing or descending in excess of 500 feet per minute.

Proximate Traffic and Other Traffic are displayed as follows:

HSI

- When Proximate Traffic is within the selected display range, the traffic aircraft's relative position is displayed as a filled white diamond.
- When Other Traffic is within the selected display range, the traffic aircraft's relative position is displayed as an unfilled white diamond.

TCAS Vertical Guidance

Vertical guidance is displayed for a traffic-avoidance maneuver. Traffic avoidance is ensured by adjusting or maintaining:

- an ADI pitch attitude outside the displayed red RA regions

N422LA through N526LA

- a VSI vertical speed outside the displayed red RA regions

Note: If the traffic aircraft also has TCAS and an operating mode S transponder, vertical guidance is coordinated with the traffic aircraft.

Voice Annunciations

TCAS voice annunciations occur whenever a TA or RA is issued and elaborate on vertical guidance. Based on updated TCAS logic, corrective or preventive RA voice annunciations may be issued which adjust or reverse the initial guidance.

N422LA through N526LA
Note: Available voice annunciations are modified or deleted with updated TCAS software.

Voice Annunciation	Condition	Response
TRAFFIC, TRAFFIC	TCAS has issued a TA	Attempt to visually locate the traffic

Voice Annunciation	Condition	Response
N316LA CLIMB, CLIMB, CLIMB **N422LA through N526LA** CLIMB, CLIMB	Climb RA, present pitch attitude or vertical speed are within the red RA regions	Increase pitch attitude or vertical speed to remain outside the red RA regions
CLIMB, CROSSING CLIMB CLIMB, CROSSING CLIMB	Climb RA, present pitch attitude or vertical speed are within the red RA regions Airplane will climb through the traffic aircraft's altitude	
N316LA DESCEND, DESCEND, DESCEND **N422LA through N526LA** DESCEND, DESCEND	Decent RA, present pitch attitude or vertical speed are within the red RA regions	Decrease pitch attitude or vertical speed to remain outside the red RA regions
DESCEND, CROSSING DESCEND DESCEND, CROSSING DESCEND	Decent RA, present pitch attitude or vertical speed are within the red RA regions Airplane will descend through the traffic aircraft's altitude	
INCREASE CLIMB, INCREASE CLIMB	Existing RA, TCAS requires change in vertical rate Present pitch attitude or vertical speed are within the red RA regions	Adjust pitch attitude or vertical speed to remain outside the red RA regions
INCREASE DESCENT, INCREASE DESCENT		
CLIMB, CLIMB NOW CLIMB, CLIMB NOW	Corrective RA, previous vertical guidance was to descend Present pitch attitude or vertical speed are within the red RA regions	Climb and adjust pitch attitude or vertical speed to remain outside the red RA regions

Voice Annunciation	Condition	Response
DESCEND, DESCEND NOW DESCEND, DESCEND NOW	Corrective RA, previous vertical guidance was to climb Present pitch attitude and/or vertical speed are within the red RA regions	Descend and adjust pitch attitude or vertical speed to remain outside the red RA regions

N316LA

REDUCE CLIMB, REDUCE CLIMB	TCAS requires change in pitch attitude or vertical speed Present pitch attitude or vertical speed are within the red RA regions	Adjust pitch attitude or vertical speed to remain outside the red RA regions
REDUCE DESCENT, REDUCE DESCENT		
MONITOR VERTICAL SPEED, MONITOR VERTICAL SPEED	Preventive RA, no change in vertical rate is required, present pitch attitude or vertical speed are outside the red RA regions	Continue to keep pitch attitude or vertical speed outside the red RA regions
MONITOR VERTICAL SPEED	Minimum vertical rate required to ensure separation has changed, present pitch attitude or vertical speed are outside the red RA regions	

N422LA through N526LA

Voice Annunciation	Condition	Response
MONITOR VERTICAL SPEED	Preventive RA, present pitch attitude or vertical speed are outside the red RA regions	Continue to keep pitch attitude or vertical speed outside the red RA regions
MAINTAIN VERTICAL SPEED MAINTAIN	Corrective RA, present pitch attitude or vertical speed are outside the red RA regions	
MAINTAIN VERTICAL SPEED CROSSING MAINTAIN	Corrective RA, present pitch attitude and vertical speed are outside the red RA regions Airplane will pass through the traffic aircraft's altitude	

N422LA through N526LA

ADJUST VERTICAL SPEED, ADJUST	Minimum vertical speed required to ensure separation has decreased, present pitch attitude or vertical speed are outside the red RA regions or, new RA, present pitch attitude or vertical speed are within the red RA region	Continue to keep pitch attitude or vertical speed outside the red RA regions. Vertical speed may be decreased, or adjust pitch attitude or vertical speed to remain outside the red RA regions.

Voice Annunciation	Condition	Response
CLEAR OF CONFLICT	Vertical guidance is no longer displayed and traffic symbology changes to TA Separation between the airplane and the traffic aircraft is increasing CLEAR OF CONFLICT will not sound if TCAS can no longer predict the track of the traffic aircraft	Attempt to visually locate the traffic aircraft

Inhibits

INCREASE DESCENT RAs are inhibited below approximately 1,450 feet radio altitude.

DESCEND RAs are inhibited below approximately 1,100 feet radio altitude.

N316LA
All TCAS voice annunciations and all RAs are inhibited below approximately 1,000 feet radio altitude. Below approximately 1,000 feet when the TA/RA mode is selected on the transponder panel, the TA mode is enabled automatically.

N422LA through N526LA
RAs are inhibited below approximately 1,000 feet radio altitude. Below approximately 1,000 feet when the TA/RA mode is selected on the transponder panel, the TA mode is enabled automatically. All TCAS voice annunciations are inhibited below approximately 500 feet radio altitude.

Note: All TCAS alerts are inhibited by the following

- PWS Annunciations
- GPWS Immediate-Alert Annunciations
- Windshear Immediate-Alert Annunciations

Non–Normal Operations

HSI Messages

When the HSI message:

N422LA through N526LA
- TCAS OFF is displayed, neither TA nor TA/RA is selected with the TCAS Mode Selector. The system cannot display symbology or vertical guidance. Voice Annunciations will not occur.

N316LA

- TCAS OFF is displayed, neither TA ONLY nor TA/RA is selected with the TCAS Mode Selector. The system cannot display symbology or vertical guidance. Voice Annunciations will not occur.
- TCAS FAIL is displayed, the system cannot display symbology or vertical guidance. Voice Annunciations will not occur.
- TCAS OFF does not display if TCAS FAIL is annunciated.

VSI Messages

N422LA through N526LA

When the VSI message:

- TCAS is displayed, the TCAS system is not operational. Neither vertical guidance nor voice annunciations will occur.
- RA OFF is displayed, the VSI display is unable to provide vertical guidance.

EICAS Messages

N316LA
(SB Adds N422LA through N526LA with TCAS EICAS advisory message option.)

When the EICAS advisory message:

- TCAS is displayed, the system cannot display symbology or vertical guidance. Voice annunciations will not occur.

N422LA through N526LA

- TCAS OFF is displayed, neither TA nor TA/RA is selected with the TCAS Mode Selector. The system cannot display symbology or vertical guidance. Voice annunciations will not occur.

Note: The TCAS OFF message is inhibited below approximately 400 feet radio altitude.

N316LA

- TCAS OFF is displayed, neither TA ONLY nor TA/RA is selected with the TCAS Mode Selector. The system cannot display symbology or vertical guidance. Voice annunciations will not occur.

Note: The TCAS OFF message is inhibited below approximately 400 feet radio altitude.

Warning Systems EICAS Messages

The following EICAS messages can be displayed.

GPWS

Message	Level	Light	Aural	Condition
ALT CALLOUTS	Advisory			Altitude callouts are no longer provided.
GND PROX SYS	Advisory			Ground proximity alerts may not be provided.
TERR OVRD	Advisory			Ground proximity terrain override switch is in OVRD.
TERR POS	Advisory			Terrain position data has been lost.
WINDSHEAR SYS	Advisory			Windshear alerts may not be provided.

TCAS

N316LA
(SB Adds N422LA through N526LA with TCAS capability.)

Message	Level	Light	Aural	Condition
TCAS	Advisory			The TCAS system is inoperative.
TCAS OFF	Advisory			The TCAS system is off. Inhibited below 400 feet radio altitude.

Configuration

Message	Level	Light	Aural	Condition
FLAPS	Warning	CONFIG	Siren	Flaps are not in a takeoff position when either engine's thrust is in the takeoff range on the ground.
GEAR NOT DOWN	Warning	CONFIG	Siren	Any landing gear is not down and locked when either thrust lever is closed below 800 feet radio altitude or when flaps are in a landing position.
PARKING BRAKE	Warning	CONFIG	Siren	Parking brake is set when either engine's thrust is in the takeoff range on the ground.
SPOILERS	Warning	CONFIG	Siren	Speedbrake lever is not DOWN when either engine's thrust is in the takeoff range on the ground.
STABILIZER	Warning	CONFIG	Siren	Stabilizer is not within the greenband when either engine's thrust is in the takeoff range on the ground.

Miscellaneous

Message	Level	Light	Aural	Condition
ALTITUDE ALERT	Caution	ALT ALERT	Beeper	Airplane has deviated from the selected altitude.
EICAS CONT PNL	Advisory			EICAS control panel is inoperative.
EICAS DISPLAY	Advisory			One EICAS CRT is inoperative.

Message	Level	Light	Aural	Condition
OVERSPEED	Warning	OVSPD	Siren	Airspeed has exceeded Vmo/Mmo.

N422LA through N526LA

PILOT RESPONSE	Warning		Siren	No crew activity has been detected for an extended period of time.
PILOT RESPONSE	Caution		Beeper	No crew activity has been detected for an extended period of time.
PILOT RESPONSE	Advisory			No crew activity has been detected for an extended period of time.

Intentionally
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