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FMC UPDATE 10.8A and LCD DISPLAY UPDATES 1, 2, and 3

FMCS GUIDE



THIS PRODUCT ORIENTATION AND TRAINING DOCUMENT IS NOT A FLIGHT MANUAL.

Refer to the Boeing Airplane Company's 737 – 600/700/800/900 operations manual for operating instructions for the Flight Management Computer System.

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FLIGHT MANAGEMENT COMPUTER SYSTEM GUIDE



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Dates of issue for original and changed pages are:

Original 0 13 February 2009
..... 1 11 June 2010

Total number of pages in this publication is 592 consisting of the following:

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Abbreviations and Symbols

The following is a listing of the abbreviations and symbols used in this manual and in the FMCS display pages.

GLOSSARY OF ABBREVIATIONS AND SYMBOLS

<u>ABREV</u>	<u>DEFINITION</u>
°	Degree(s)
%	Percent
<	Selectable prompt indicator
or	
>	
A	At or Above (altitude reference)
A/T	Autothrottle
AA	Autoflight Annunciator
ABM	Abeam
ACARS	Aircraft Communications Addressing and Reporting System
ACT	Active
ADC	Air Data Computer
AI	Attitude Indicator
ADIRS	Air Data Inertial Reference System
ADIRU	Air Data Inertial Reference Unit
ADL	Airborne Data Loader
ADS	Automatic Dependent Surveillance
AFDS	Autopilot Flight Director System
AFN	ATS Facility Notification
AGL	Above Ground Level
ALT	Altitude
ALT NAV	Alternate Navigation (LCD CDU Update 2 and 3)
ALTN	Alternate
ANP	Actual Navigation Performance
AOC	Airline Operational Communication



GLOSSARY OF ABBREVIATIONS AND SYMBOLS

<u>ABREV</u>	<u>DEFINITION</u>
APP or APPR or APPRCH	Approach
APU	Auxiliary Power Unit
ARPT or ARPTS	Airport Airports
ARR	Arrival
ATA	Actual Time of Arrival
ATC	Air Traffic Control
ATM	Air Traffic Management
ATO	Along-Track Offset
ATS	Air Traffic Services
AUTO	Automatic
AVAIL	Available
B	At or Below (altitude reference)
BBJ	Boeing Business Jet
B/CRS or BCRS or BCS	Back Course
BIT	Built-In Test
BITE	Built-In Test Equipment
BRG	Bearing
C	Center or Centigrade
CAPT	Captain
CAS	Computed Airspeed
CDS	Common Display System
CDU	Control/Display Unit



GLOSSARY OF ABBREVIATIONS AND SYMBOLS

<u>ABREV</u>	<u>DEFINITION</u>
CG	Center of Gravity
CH	Channel
CI	Cost Index
CIAP	Common Instrument Approach Procedures
CLB	Climb
CLB-1	First Climb Derate
CLB-2	Second Climb Derate
CLR	Clear
CMU	Communications Management Unit
CO	Company
COMM	Communication
COND	Condition
CONFIG or CFG	Configuration
CORR	Correction (wind)
CP	Control Panel
CRC	Cyclic Redundancy Check
CRS	Course
CRZ	Cruise
CTR	Center
DB	Data Base
DBL	Data Base Loader
DCP	Display (ND) Control Panel
DEL	Delete
DES	Descent
DEP	Departure
DEST	Destination
DEU	Display Electronics Unit
DEV	Deviation
DFCS	Digital Flight Control system
DIR	Direct



GLOSSARY OF ABBREVIATIONS AND SYMBOLS

<u>ABREV</u>	<u>DEFINITION</u>
DIST	Distance
DL	Datalink
DME	Distance Measuring Equipment
DNTK	Downtrack
DTPY	Display
DTG	Distance-To-Go
DTK	Desired Track
DY	Day
E	East
E/D	End of Descent
ECON	Economy
ECU	Engine Control Unit
EEC	Electronic Engine Controller
EFC	Expected Further Clearance
EFF	Effective or Effectivity
EFIS	Electronic Flight Instrument System
ELEV	Elevation
ENG	Engine
ERR	Error
EST	Estimated
ETA	Estimated Time of Arrival
ETE	Estimated Time Enroute
EXEC	Execute
EXT	Extended
F	Fahrenheit
F-F	Fuel Flow
F/O	First Officer
FAC	Final Approach Course
FACF	Final Approach Course Fix
FAF	Final Approach Fix



GLOSSARY OF ABBREVIATIONS AND SYMBOLS

<u>ABREV</u>	<u>DEFINITION</u>
FANS	Future Air Navigation System
FCC	Flight Control Computer (AFDS)
FD	Flight Display
FL	Flight Level
FLT	Flight
FMA	Flight Mode Annunciator
FMC	Flight Management Computer
FMCS	Flight Management Computer System
FMS	Flight Management System
FO	Fly-Over (waypoint reference)
FPA	Flight Path Angle
FPM	Feet Per Minute
FPR	Flight Path Revision
FPTOS	First Principles Takeoff Speeds
FQIS	Fuel Quantity Indicating System
FR	From
or	
FRM	
FREQ	Frequency
or	
FRQ	
FT	Feet
G/P	Glide Path
G/S	Glide Slope (ILS)
GA	Go Around
GLS	Global Landing System
GMT	Greenwich Mean Time
GPS	Global Positioning System
GPWS	Ground Proximity Warning System
GS	Ground Speed
GSI	Glide Slope Intercept
GW	Gross Weight



GLOSSARY OF ABBREVIATIONS AND SYMBOLS

<u>ABREV</u>	<u>DEFINITION</u>
HDG	Heading
HF	High Frequency
HI	High
HR	Hour
HSI	Horizontal Situation Indicator
IAF	Initial Approach Fix
IAN	Integrated Approach Navigation
ID	Identifier
or	
IDENT	
IGS	Instrument Guidance System (approach type)
ILS	Instrument Landing System (approach type)
INBD	Inbound
INFO	Information
INIT	Initialization
INOP	Inoperative
INTC	Intercept
IRS	Inertial Reference System
ISA	International Standard Atmosphere
ISDU	Inertial Sensor Display Unit (IRS)
K	Thousands
KCAS	Calibrated Airspeed in knots
KT(s)	Knot(s)
L	Left
or	
LT	
LAT	Latitude, Lateral
LBS	Pounds
LCD	Liquid Crystal Display
LDDDB	Loadable Defaults Database
LIM	Limit



GLOSSARY OF ABBREVIATIONS AND SYMBOLS

<u>ABREV</u>	<u>DEFINITION</u>
LDA	Localizer–Type Directional Aid (approach type)
LMM	Locator Middle Marker
LNAV	Lateral Navigation or Lateral Guidance
LO	Low
LOC	ILS Localizer
LOM	Locator Outer Marker
LON or LONG	Longitude
LOP	Line–of–Position
LRC	Long Range Cruise
LSK	Line Select Key
LVL	Level
M	MACH Number or Meters or Magnetic North Heading
MAC	Mean Aerodynamic Cord
MACH	MACH number
MAINT	Maintenance
MAG	Magnetic
MAPP	Missed Approach
MASI	Mach/Airspeed Indicator
MAX	Maximum
MCDU	Multi-Purpose Control/Display Unit
MCP	Mode Control Panel
MDA	Minimum Descent Altitude
MEDB	Model/Engine Database



GLOSSARY OF ABBREVIATIONS AND SYMBOLS

<u>ABREV</u>	<u>DEFINITION</u>
MIN	Minimum or Minutes
MISAPP	Missed Approach
MMR	Multi-Mode Radio
MNVR	Maneuver
MOD	Modification
MON	Month
MSG	Message
MU	Management Unit (ACARS)
N	North
N_1	Low-pressure Compressor Turbine Rotor Speed
NAV	Navigation
ND	Navigation Display
NDB	Non-Directional Beacon (approach type) or Navigation Data Base
NFO	Non-Fly-Over (waypoint reference)
NM	Nautical Mile(s)
NO	Number
NPS	Navigation Performance Scales
OAT	Outside Air Temperature
OPF	Operational Flight Program
OFST	Offset
OP	Operational
OPS	Operational Software
OPT	Optimum or Optional
PBD	Point/Bearing/Distance (waypoint reference)
PDDDB	Performance Defaults Database
PERF	Performance
PFD	Primary Flight Display



GLOSSARY OF ABBREVIATIONS AND SYMBOLS

<u>ABREV</u>	<u>DEFINITION</u>
PLN(S)	Plan(s)
POS	Position
PPOS	Present Position
PREV	Previous
PROC	Procedure
PROG	Progress
QFE	Barometric Correction for Zero Elevation at Landing Field
QNE	Standard Day Sea Level Altimeter Setting reference table
QNH	Atmosphere Pressure at Sea Level or Destination Altimeter Setting reference table (corrected to Sea Level)
QRH	Quick Reference Handbook
QTY	Quantity
QUAD	Quadrant
R	Right
or	
RT	
R/C	Rate of Climb
RAD	Radial
RECMD	Recommended
RED	Reduced
REF	Reference
REST	Restriction
RNAV	Area–Navigation Approach (GPS approach type)
RNP	Required Navigation Performance
RTA	Required Time of Arrival
RTE	Route
RW	Runway
or	
RWY	



GLOSSARY OF ABBREVIATIONS AND SYMBOLS

<u>ABREV</u>	<u>DEFINITION</u>
S	South
SAT	Static Air Temperature
SEC	Second
SEL	Selected or Assumed OAT
SDF	Simplified Directional Facility (approach type)
SID(S)	Standard Instrument Departure(s)
SK-R	Skid Resistant
SP	Space
SPD	Speed
STAR	Standard Terminal Arrival Route
SUM	Summation
SUPP	Supplimental
SW	Software
T or TRU	True North Heading
T/C	Top of Climb (also see TOC)
T/D	Top of Descent (also see TOD)
T/O or TO	Take Off
T/R	Thrust Reduction
TACAN	Tactical Air Navigation
TAI	Thermal Anti-Icing
TAS	True Air Speed
TAT	Total Air Temperature
TEMP	Temperature or Temporary
TGT	Target



GLOSSARY OF ABBREVIATIONS AND SYMBOLS

<u>ABREV</u>	<u>DEFINITION</u>
THR	Thrust
TK or TRK	Track
TMA	Thrust Mode Annunciator
TMC	Thrust Management Computer
TOGA	Take Off – Go Around
TOC	Top of Climb (also see T/C)
TOD	Top of Descent (also see T/D)
TOW	Take Off Weight
TRANS	Transition
TRN	Turn
UPD	Update
V/B	Vertical Bearing
V/S	Vertical Speed
V1	Critical Engine Failure Velocity
V2	Takeoff Climb Velocity
VAR	Variation
VDEV	Vertical Deviation
VERT	Vertical
VNAV	Vertical Navigation or Guidance
VOR	VHF Omnidirectional Range Receiver
VREF	Vertical Reference
VR	Takeoff Rotation Velocity
VRNP	Vertical Required Navigation Performance
VSPDS	Computed Take Off Speeds
VTK	Vertical Track (Distance)
W	West
W/STEP	With Step (CLB)
WPT	Waypoint
WT	Weight
XTE	Cross–Track Error



GLOSSARY OF ABBREVIATIONS AND SYMBOLS

<u>ABREV</u>	<u>DEFINITION</u>
XTK	Cross-Track Distance
YR	Year
Z	Zulu Time (GMT)
ZFW	Zero-Fuel Weight
4-D FMS	Four-Dimensional Flight Management System



PREFACE

INTRODUCTION

Several versions of the GE Aviation Systems LLC (doing business as GE Aviation) FMCS software are currently in service. This guide covers the FMC Update 10.8A versions along with LCD CDU Updates 1, 2, and 3 of the FMCS display flight software. FMC Update 10.8A replaces Update 10.8.

MANUAL CONTENTS

Part 1 of this guide contains an introduction to the FMCS with some explanations of the concepts behind what it does, followed by an explanation of the FMCS display keyboard layout and usage.

Part 2 of this guide provides a description of the display pages and explains prompt usage and data fields.

Part 3 covers messages and corrective actions.

Part 4 consists of a detailed description of FMCS messaging.

HIGHLIGHTS

The following is a summary of the Update 10.8 flight software changes.

CHANGES AND ADDITIONS

Changes to Existing

- VNAV Armed Before Takeoff – improvements were made to the VNAV arming operation to provide dependable operation (FCOM OMB TBC-70).
- Engine Out Operation – improvements were made to the EO operation to provide more dependable operation (FCOM OMB TBC-68).
 - EO operation is inhibited when the ground speed is below 60 kts.
 - When the airplane levels off in cruise or the ALL ENG prompt is selected in climb, the new message ENTER EO CRZ SPD AND ALT is displayed to prompt the crew to enter appropriate cruise speed and altitude targets.



- Improved Software Reset – computer reset processing is improved to help prevent a complete FMC shutdown.
 - If the initial attempts to recover from a reset fail, the FMCS halts predictions and clears the COST INDEX on the PERF INIT page. VNAV disconnects, LNAV remains engaged and the new message INVALID VNAV – PERF is displayed to prompt the crew to re-enter the CI to restart predictions and allow VNAV to be reengaged.
 - If the reset occurs during a flight plan MOD, the MOD is erased, and the new message INVALID MOD PLAN is displayed. LNAV and VNAV remain engaged.
 - If the reset occurs before the flight plan is initially activated, the inactive flight plan is still deleted, but the new message INVALID INACTIVE PLAN is displayed.
- Model/Engine Database (MEDB) – the MEDB and the FMCS have been updated to incorporate the CMF56–7B26B2 enhanced engine thrust limits (also requires additional equipment updates).
- NDB Storage Capacity – the allotted memory area size for the 2907C1 computers is increased to 8 mega-words. Additional checking is put in place to prevent trying to crossload an 8 mega-word NDB into the 2907A4 computer when a mixed configuration is installed.

- In-Service Issues.

The U10.8 software update incorporates changes to address several issues reported during in-service operation including:

- The FMC DISAGREE message remains displayed until the disagreement is resolved.
- The software exception occurring when re-selecting approach after sequencing a procedure hold exit.
- The software exception occurring when selecting approach while a GSI is before the FACF.
- The software exception occurring when selecting a SID during a missed approach and the current active waypoint is the start of an ARC leg.
- The software exception when sequencing a double bypass on ARC legs.



- The software exception when creating the CRZ DES page for a long subsequent CRZ segment and there are no waypoints after predictions when reaching the new CRZ altitude.
- The software exception occurring when an ACARS RTE uplink contains data that is not found in the NDB, and ACARS special discos are listed as the last two waypoint positions in the flight plan, and the last LEGS page is accessed using the PREV PAGE key.

In addition, the following is a summary of software changes added with U10.8A.

- Update 10.8A software adds a new FMC Alerting message “FMC DISAGREE-VERTICAL”. In a dual FMC configuration, while VDEV (vertical deviation) is valid in at least one FMC prior to the approach environment, and the FMCs detect a disagreement of altitude error, mach, or airspeed, the new alerting level CDU message will be displayed. This message is inhibited when the “FMC DISAGREE” message is displayed.
- Update 10.8A incorporates changes to prevent the FMC ACARS data buffer from overflowing, resulting in FMC restarts.
- Update 10.8A software incorporates a change to prevent displaying the FMC DISAGREE message when not in the Approach phase and for certain vector/waypoint combinations.
- Update 10.8A software incorporates changes to eliminate three in-service reports of FMC restarts due to software exceptions caused by flight plan related issues.
- Update 10.8A software incorporates changes to eliminate a condition where only the position hold symbol is displayed on the right navigation display and the left displays the expanded hold.
- Update 10.8A software adds a correction to provide proper descent path predictions and guidance for Vertical Navigation (VNAV) operation into airports above 10,000 feet in elevation.
- For dual FMC installations, Update 10.8A software addresses a condition where an uplinked flight ID is not stored properly in the right FMC.



- Update 10.8A software will allow full climb (CLB) thrust after a derated takeoff thrust is uploaded by ACARS on airplanes that have the FMC PERF option code zero enabled.



AIRLINES SELECTABLE OPTIONS LIST

The following is a list of the FMC selectable software options. Many of the options listed require additional equipment, or have dependencies on other options, and may include changes to discrete inputs of the FMCs. Options are only activated when the option is enabled via the loadable Options Database, and wiring or equipment have been installed when required. In some cases, options are dependant on other options being enabled or disabled. Refer to Part 1 for a detailed description of each option.

- Available beginning with U10.0
 - ABEAM Waypoints
 - Alternate Destinations
 - Altitude/Speed Intervention
 - AOC Datalink
 - Certified Takeoff Speeds
 - Direct GPS Input
 - GPS Operational Mode Bit 1
 - GPS Operational Mode Bit 2
 - High Idle Descent
 - Manual Takeoff Speeds
 - Manual RNP Entry
 - Message Recall
 - Plan Fuel Entry
 - QFE Altitude Reference
 - Runway Offset/Runway Remaining in Feet
 - Runway Remaining
 - VNAV Altitude Enable



- Available beginning with U10.2
 - CDU Color
 - Geometric Path Descent
- Available beginning with U10.3
 - Engine Out SIDS
 - Optional Noise Gradient
 - Pilot Defined Company Route (CO–RTE)
 - Quiet Climb System

- Available beginning with U10.4A
 - ATC Message on Displays
 - ATS Datalink
 - Fixed Outputs ATS Test
 - GLS Procedures
 - Inhibit Gross Weight entry
 - Integrated Approach Navigation (IAN) (formerly Common Instrument Approach Procedures)
 - Missed Approach Color on CDU
 - Takeoff Derate Inhibit

- Available beginning with U10.5A
 - Default DME Update Off

- Available beginning with U10.6
 - Additional Fix Pages
 - Common VNAV
 - Cruise Speed Forward Propagation
 - Flight Plan Intent Bus Output
 - Manual Position Update



GEK 116823

- Available beginning with U10.7
 - Intent Data on Dedicated Bus
 - Takeoff Thrust Auto-Select



The UPDATE 2 MCDU adds two functional capabilities beyond performing as a normal MCDU.

- Provides an alternate navigation solution (requires the on-side GPS to be operational) regardless of the status of the FMC(s). The alternate navigation function added to this guide requires an FMCS display MCDU or FANS MCDU with FMCS display Update 2 software loaded, and the ALT NAV function enabled. The alternate navigation function also requires an ARINC 755 MMR to supply GPS inputs to the MCDU.
- Provides capability to up-load and display Graphical Weather Data Maps. This function requires an ACARS/Weatherman system be installed and the graphics capability to be enabled.

The UPDATE 3 MCDU includes the following functional capabilities.

- Provides an alternate navigation solution (requires the on-side GPS to be operational) regardless of the status of the FMC(s). The alternate navigation function added to this guide requires the new MCDU or FANS MCDU type FMCS display with FMCS display Update 3 software loaded, and the ALT NAV function enabled. The alternate navigation function also requires an ARINC 755 MMR to supply GPS inputs to the MCDU.
- Provides support for future lighted keyboard assembly designs without additional software changes.



PART 1-1

INTRODUCTION

WHY AN FMS?

The Flight Management System (FMS) combines the 737 aircraft avionics capabilities to ease workload and allow more time to safely managing the airplane. The main function is to generate continuous automatic navigation and guidance, as well as controlling and monitoring performance.

The Flight Management Computer System (FMCS) plays a vital role in performing this task. The most obvious components of the FMCS are the Liquid Crystal Display units (LCDs) located forward of the throttle controls. These FMCS display units provide the crew with the interface to monitor all aspects of the flight via several display pages, and aid making changes in the flight plan rapidly. When the ACARS option is installed on the airplane, flight plans and flight data may be uplinked saving the crew precious time prior to pushing back from the gate.

The FMCS is provided in two main configurations; single and dual Flight Management Computer (FMC) systems. A single system generally consists of one FMC and two display units. Dual systems are equipped with two FMCs working together, and two display units. One FMC flies the airplane (primary FMC) while the other (secondary FMC) performs the same computations for comparison, and is readily available to fly the airplane should the primary FMC fail. The display units support three functional modes (CDU, MCDU, FANS MCDU) and can be combined in various configurations to further increase the FMCS capability.

The FMCS performs its function using the main Operational Flight Program (OFP) and several internally stored databases. One database stores data equivalent to Jeppesen air navigation charts (permanent Navigation Database or NDB) and an airplane performance manual (performance or PERF Database). The information contained in these databases, combined with entries made by the crew provide the FMCS the data necessary to perform flight predictions from takeoff through the end of descent.

Not only does the FMCS provide fast and efficient data retrieval and calculations, but it can manage full-time flight-path (lateral, vertical, and speed) tracking, relieving the crew of menial tasks such as continual minor speed and heading adjustments that would otherwise consume a significant portion of time over the length of the flight.



WHAT CAN AN FMCS DO?

When the airplane's current location, a route (origin to destination airports and at least one along path waypoint), gross weight and fuel are entered into the FMCS, the FMCS computes accurate position data and guides the airplane from origin to destination using the most economical speed and altitude. The performance modes may also be changed to allow arriving sooner or later, and these changes may be made on the ground prior to takeoff or while in-flight.

HOW DOES THE FMCS DO THIS?

Utilizing a scheme of selections and data entries on the various display pages, the crew sets up the parameters and the route for the flight. From that point on, the FMCS continually computes the airplane position using inputs from the various navigation sensors in the airplane.

The FMCS provides a graphic display of the airplane position as well as other pertinent information on the different displays in the cockpit for the crew to monitor while it guides the airplane laterally and vertically, controlling steering, speeds, and altitudes via the Autopilot Flight Director System (AFDS) and the Autothrottle (A/T).

The crew can monitor the progress of the flight, make changes to the flight plan, and if desired, uncouple the FMCS, to fly the airplane manually or set control to the MCP settings. If the FMCS is uncoupled, all flight plan data is still updated and displayed for advisory information, and may be re-coupled at any time.

HARDWARE AND SOFTWARE OPTIONS

There are many hardware and software options available to the airline operators that allows the FMCS to be tailored to the individual airline's requirements and budgets.

HARDWARE OPTIONS

Three types of LCDs may be utilized in many combinations for any given airplane type; the Control Display Unit (CDU) (ref Figure 1-1), the Multi-Purpose Control Display Unit (MCDU), and the Future Air Navigation System (FANS) MCDU. All three displays pro-



vide a basic interface to operate the FMCS, while the MCDU and FANS MCDU provide a broader interface to not only connect to the FMCs, but also interface to other sub-systems within the FMS and provide ACARS and ADS message construction and handling.

AIRLINES SELECTABLE SOFTWARE OPTIONS

Selectable software options enable different capabilities and controls in the FMCS operation. The software options are contained in the loadable Software Options Database obtained from the airplane manufacturer. Two options are provided by default; Manual RNP Entry and Geometric Path Descents.

Note that many options change some of the prompts and data fields on specific display pages. These options are identified throughout this guide.

A complete list of the software options is provided at the end of the PREFACE, and a description is provided at the end of this section.

USING THE LCD

The following paragraphs provide an introduction into the LCD usage, and FMCS conventions. The arrangements of the front panels of the three types of LCD units are illustrated in Figure 1-1;

Sheet 1 covers the CDU configuration.
Sheet 2 covers the MCDU and FANS MCDU configurations.

Each LCD can be used independently or both simultaneously for the control and display tasks required in the course of a typical flight. When one of the two displays is being used to modify the active flight plan – the ability of the second display to perform the same function will not be inhibited.

Either display may be used to enter data. Data entered on one display will appear on the corresponding page of the other display when it is viewed (scratchpad entries will not be shown). In the event different entries are made in the same fields of a page, the last entry is the one used for the flight plan. It is highly recommended that data entry and plan modifications be carefully coordinated between the crew.



KEYS

The keys on the lighted switch panel of the LCD's perform various functions and may be broken down into functional groups.

Alphanumeric Keys

These are used to manually enter data and parameters into the FMCS. Pressing any alphanumeric key generates that character in the scratchpad. These keys include the characters A through Z, a period (.), and the numbers 0 through 9.

In the MCDUs, a space key (SP) is also included for ACARS and ATC datalink message building. This key position is not functional in the CDU and the cap is blank.

Function Keys

Function keys provide quick access to specific pages used to initialize the FMCS, access pages to monitor the flight status and progress, and incorporate flight plan changes. The following paragraphs provide a brief description of the function keys.

The following key is used on CDUs only:



DIR/INTC (Direct To/Intercept Leg)

Provides access to to the RTE LEGS page to allow construction of a path directly to any waypoint desired, or to intercept a leg to a waypoint. When the RTE LEGS page is displayed using this key, special prompts are available at 6L and 6R to facilitate these functions.

The following keys are used on CDUs and MCDUs:

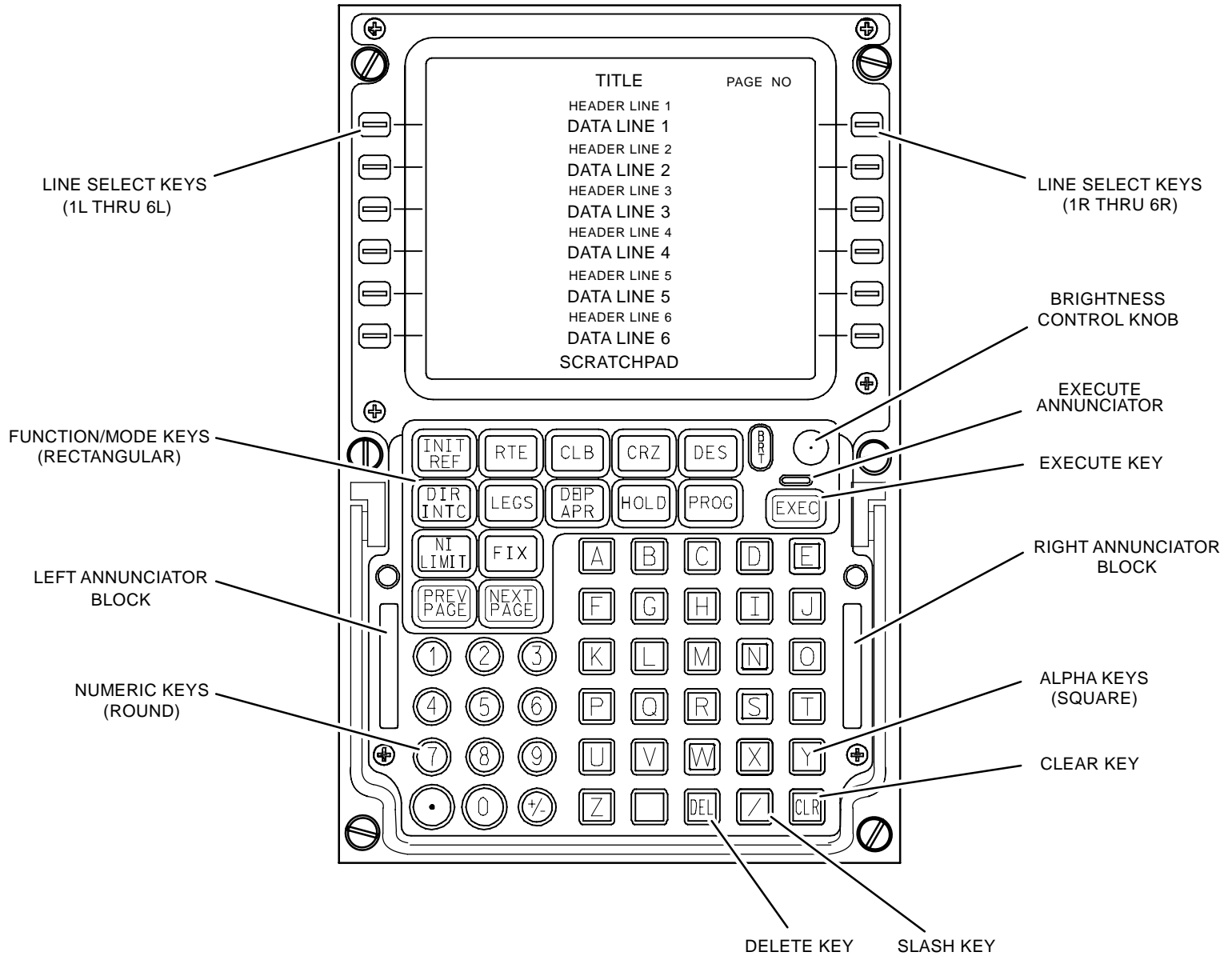


CLB (Climb)

Displays CLB page with alternate climb modes for assessment, selection, or modification. Cruise altitude is enterable, as is a speed/altitude restriction.



CDU

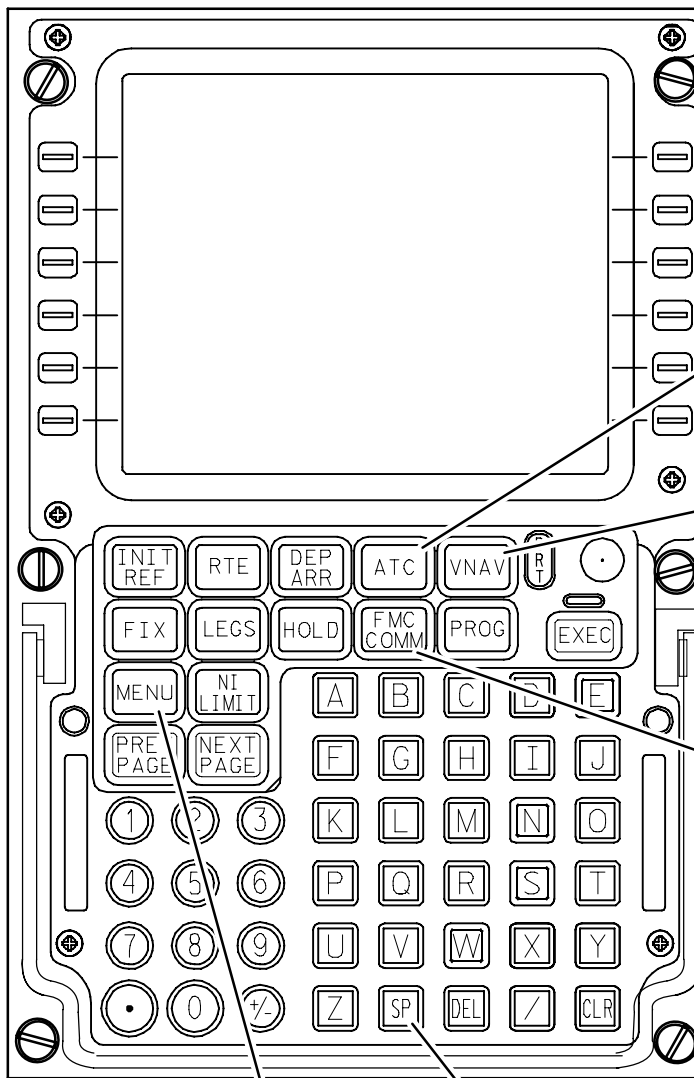
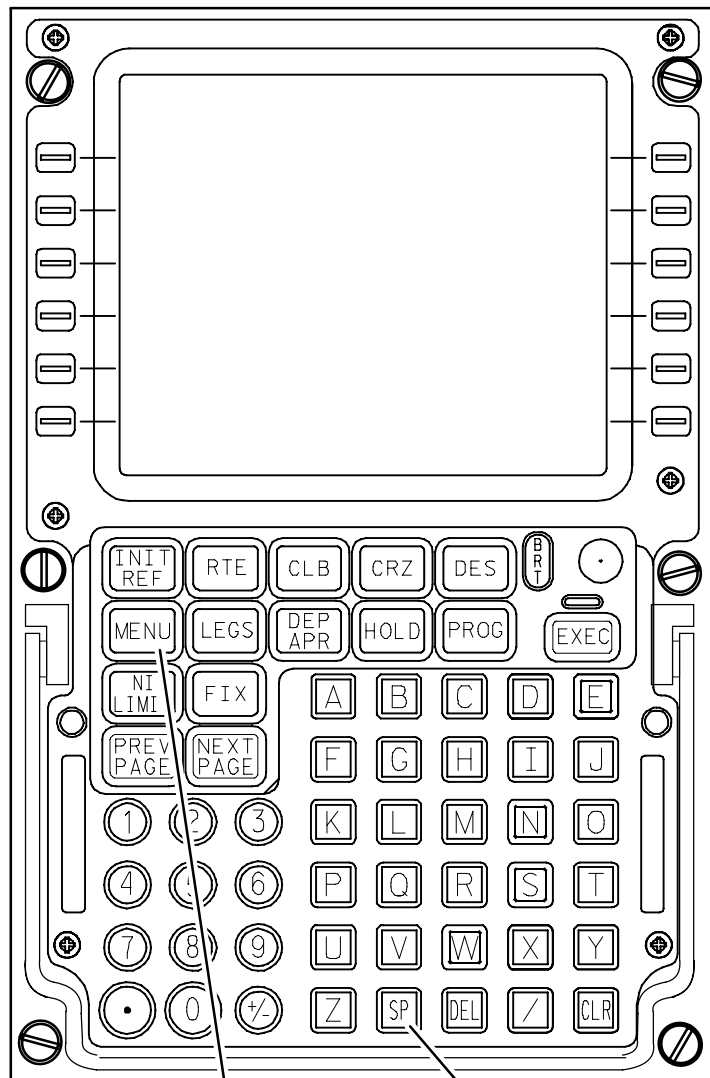


Liquid Crystal Display Units
Figure 1-1 (Sheet 1)



MCDU

FANS MCDU



ATC KEY FOR ACCESS TO THE ATC COMMUNICATIONS PAGES

VNAV KEY FOR ACCESS TO THE ACTIVE MODE PAGES

FMC COMM KEY FOR ACCESS TO THE COMMUNICATIONS CONTROL PAGE.

MENU KEY TO ACCESS THE MCDU MENU FUNCTION

SPACE KEY FOR ACARS AND ATC MESSAGE BUILDING

MENU KEY TO ACCESS THE MCDU MENU FUNCTION

SPACE KEY FOR ACARS AND ATC MESSAGE BUILDING

Liquid Crystal Display Units
Figure 1-1 (Sheet 2)

**CRZ** CRZ (Cruise)

Displays CRZ page with alternate cruise modes for assessment, selection, or modification. Information about optimum altitude, stepclimb savings, and turbulence penetration N1 targets are also available.

DES DES (Descent)

Displays DES page with alternate descent modes for assessment, selection, or modification. Target speed is enterable, as is a speed/altitude restriction. Flight path angle (FPA), vertical speed (V/S), and vertical bearing (V/B) information is provided for crew reference.

The following key is used on MCDUs and FANS MCDUs:

MENU MENU

Provides access to the MENU page which allows the MCDU to become the control/display unit for up to five other FMS sub-systems. Other sub-systems are manually enabled/disabled as required using the LOGON/HOLD/LOGOFF prompt selections on this page. When a sub-system is requesting use of the MCDU, the call annunciator will light to alert the crew.

The following keys are used on FANS MCDUs only:

ATC ATC Datalink

Provides access to the ATC Datalink interface when the ATC option is enabled.

FMC COMM FMC COMM (FMC Communication)

Provides access to the ACARS Datalink interface when the ACARS option is enabled.

VNAV VNAV (Vertical Navigation)

Displays the active performance page (CLB, CRZ, or DES) for the active phase and allows access to the other performance pages using



the NEXT PAGE and PREV PAGE keys. If none of the phases are active at the time the key is pressed, the display defaults to the CLB page.

The following keys are used on all three LCD types:



INIT/REF Initialization/Reference Index Key

Access initialization pages requiring completion for start-up of the flight plan while on the ground beginning with the POS INIT page. When all initialization pages are complete, the TAKEOFF REF page is displayed until takeoff. After takeoff (in the air), the APPROACH REF page is displayed.



RTE (Route)

Provides access to the flight plan, accepts flight plan modifications, and allows access to lateral offsets. Displays flight plan route for observation beginning with page 1, with the go-to waypoint in the first position.



N₁ LIMIT

Permits manual command of the active N₁ limit and selection of any reduced climb N₁ limits that may apply.



DEP/ARR (Departures/Arrivals Index)

Provides selectable access to the origin or destination airport arrival and departure procedures and runways. Can also be used to obtain procedural information about airports not listed in the flight plan.




LEGS (Route Legs)

Displays detailed data concerning each leg of the flight plan, for both the lateral and vertical paths. The display begins with the go-to waypoint in the first position.




HOLD

Allows planning or initiation of holds at a designated waypoint or at present position.

 FIX (Fix Information)

Displays the FIX page which provides range and bearing data, in radial/DME format, from the entered fix. Facilitates creation of fixes for use in flight planning.

 PROG (Flight Progress)

Displays current flight status information such as ETA, fuel remaining at waypoint and destination. Provides access to navigation radio tuning status, wind, and path errors.

Page Control Keys

Page control keys – provide a means to navigate through multiple-page displays as follows:

 NEXT PAGE

Each press displays the next page when multiple pages exist.

 PREV PAGE (Previous Page)

Each press displays the previous page when multiple pages exist.

When a display consists of multiple pages, the additional pages are displayed by using the NEXT PAGE or PREV PAGE keys. Multiple page displays wrap around from first page to the last page and vice versa (for example, pressing the NEXT PAGE key while on page 5/5 displays page 1/5).

Data Manipulation Keys

Data manipulation keys – provide capability to change, delete, move, and add data.

 LSK (Line Select Key)

There are twelve LSKs arraigned in two rows; 6 on the left of the display and 6 on the right of the display. Throughout the guide, the key corresponding to a data field in the display is identified by the line select key (LSK), the row position (1 through 6) and the side of the display (Left or Right).



The term “line select” or “line selecting” or “select” refers to using the LSKs.

These keys allow data to be moved from the scratchpad area to one of the writable fields on the displayed page or copied from a field to the scratchpad area. To copy information to the scratchpad, the scratchpad must be cleared prior to selecting the LSK. With data entered into the scratchpad, the data is transferred to the data field when the LSK is pressed.

 +/- (Change Sign Key)

The change sign key changes the sign of the data in the scratchpad from positive to negative and back again. May also be used to insert a hyphen for specialized data entries.

 CLR (Clear)

The clear key clears the scratchpad area of the display. A brief press of the clear key will back out one character at a time from the scratchpad. Holding the clear key for at least 1 second clears the entire entry. The clear key will also remove advisory and alerting messages, one message for each press.

 DEL (Delete)

The delete key is used to remove data from a display field (and thus a flight plan). Pressing the DEL key writes DELETE into the scratchpad. The delete process is then completed by line-selecting the data field to be removed. If the deletion is a valid one, the data field reverts to its default value (box prompts, dashes, or a system-generated value).

The system prevents invalid use of the delete key. Pressing the wrong LSK on a page having a parameter that should not be deleted displays INVALID DELETE in the scratchpad. The delete key must be pressed once for each parameter to be deleted. Pressing the delete key when the displayed page has no valid delete operation causes no response. The items listed below are the enterable data items which CANNOT be deleted. Instead of being deleted, these items must be changed by an overwriting entry from the scratchpad. System default values cannot be deleted.

– Configuration Identification page:

- Navigation Database effectivity date




- Position Initialization page:
 - REF AIRPORT
 - SET IRS POS
 - GATE
 - SET IRS HDG
 - GMT
- Ref/Supp Nav Data pages:
 - CLASS
 - EFF DATE
 - ELEVATION
 - FREQ
 - LATITUDE
 - LONGITUDE
 - MAG VAR
- Performance Initialization page:
 - COST INDEX
 - CRZ ALT
 - FUEL
 - GROSS WT
 - RESERVES
 - TRANS ALT
 - ZFW
- Takeoff Reference page:
 - OAT
 - V-SPEEDS
- Route page:
 - CO ROUTE
 - DEST
 - ORIGIN



- TO WAYPOINT
- Route Hold page:
 - INBD COURSE
 - LEG TIME
 - LEG DIST
 - TURN DIR
- Climb/Cruise pages:
 - CRZ ALT
 - TGT SPEED
- Descent Page:
 - TGT SPEED
- Descent forecasts Page:
 - CABIN RATE
 - QNH
 - TRANS LEVEL

The delete key also performs the long delete function used to suspend an ACARS uplink operation (MCDUs and FANS MCDUs). This is accomplished by pressing and holding the delete key for one second during the uplink operation.

 (Slash)

The slash key is used as a data field separator. Some pages contain fields with parameters displayed side-by-side. The slash informs the FMCS which field the data is intended for when selected to one of these fields. This is covered in more detail in Data Entry Rules.

Data Activation

 Execute key

The EXEC key is used to activate the initial flight plan or to incorporate changes into the active flight plan. When data entries have



been activated (by pressing the EXEC key when the EXEC annunciator is lit), the page status ACT appears in front of the page title.

If the active flight plan is being modified, the page status changes to MOD until the EXEC key is pressed.

Until the modification is made active, the FMCS uses the active flight plan, even though it is not displayed.

LIGHTED ANNUNCIATORS

There are five annunciators on the front panel of the LCDs (Ref Figure 1-1). These are defined as follows:

- EXEC – located just above the EXEC key on all LCDs.
 - Lights when the aircrew selects the ACTIVATE prompt prompt (LSK 6R) on the RTE or RTE LEGS page.
 - Lights when a change is made to the active flight plan.
 - Lights when all required inputs (BOX prompts) are entered into the PERF INIT page.
- DSPY (CDU) – Not Used.
- CALL (MCDU/FANS MCDU) – Indicates an FMS sub-system connected to the MCDU but not in control is requesting service.
- MSG (all) – Indicates an FMC alerting/advisory message or pending ACARS/ATC messages are queued in the LCD.
- FAIL (all) – FMC failure detected or FMC and IRS failure detected.
- OFST (all) – Indicates an offset path is being flown.

DATA ENTRY RULES

The crew enters desired data into the scratchpad area on the LCD by using one of two methods. New data may be manually entered using the LCD alphanumeric keyboard or existing data may be selected to the scratchpad using the line select keys.

Crew data entries are keyboard alphanumerics which are entered into the display scratchpad (bottom line) using the keyboard and line-selecting the adjacent data field using the appropriate LSK.



Duplicating or moving existing data is accomplished by pressing the LSK adjacent to the data with the scratchpad empty, which copies the data to the scratchpad. Pressing the LSK adjacent to the desired location moves the data to that line. Entries remain in the scratchpad when other pages are selected allowing information to be changed on different pages.

BOX PROMPT

Whenever the box prompt () appears on a display page, a data entry is required for that line. The number of boxes displayed in a box prompt corresponds to the maximum number of characters that may be loaded into the field. Box prompts cannot be deleted, however, the information entered may be overwritten.

DASH PROMPT

Fields where data entries are allowed but are not essential for basic FMC predictions, are indicated by the dash prompt (— — —). Dash prompt entries enable the FMC to provide the most accurate computation and prediction results. The number of dashes displayed in a dash prompt corresponds to the maximum number of characters that may be loaded into the field. Dash prompts cannot be deleted, however, the information entered may be deleted or overwritten.

SELECTION PROMPT

The selection prompts (< or >) are displayed on the outside of selectable controls. Two basic setups are used. The selection prompts displayed with toggle selections indicated the toggle is functional and may be selected at any time. In this case the selection prompt remains displayed as long as the function for the toggle is available. This type of selection prompt is most common with ON/OFF type toggles.

The second setup used is to indicate that an operation is available and may be selected. For some prompts, once selected, the selection prompt is blanked until the specified operation has completed, then re-displayed (example, ACARS REQUEST prompt). When the selection prompt is blanked, the LSK adjacent to the prompt is not functional. For other prompts such as the ERASE prompt, once selected, the selection prompt and the ERASE prompt do not re-appear until it is required again.



INVALID ENTRY

If an entry is attempted into a field which does not allow that entry, or if the entry is of the wrong format or out of range, an INVALID ENTRY message is displayed in the scratchpad.

SLASH KEY AND SLASH RULE

The slash key (/) is used to separate data entered as pairs in the same field, such as airspeed and mach number (280/.720), wind direction and speed (104/100), or airspeed and altitude (250/10000), among others.

When entering one component of a paired data field, the slash informs the FMC which field the entry is intended for. If slash is not used with a single entry, it will be inserted into the field nearest the line select key (i.e., the first entry for a pair on the left side of the display and the second entry for a pair on the right side of the display), most likely resulting in an INVALID ENTRY message.

ERASE

Whenever a modification is made to the active flight plan, an ERASE prompt appears. Selecting the ERASE prompt removes the modification and returns the display to the original active page.

ALTITUDE/FLIGHT LEVELS

Altitude or flight level is accepted by the system in various forms. Entries of low altitudes (below the transition altitude) are made with leading zeros to avoid confusion with flight levels; for example, 00300 or 0300 for 300 feet, and 00030 or 0030 for 30 feet.

Generally, if the entry is at or above the transition altitude, it will be displayed as a flight level; otherwise, it will be displayed in feet. Three exceptions to this rule are:

- TRANS ALT – the transition altitude is always displayed in feet.
- TRANS LVL – the transition level is always displayed as a flight level.
- ELEV – elevation is always displayed in feet.

ALTITUDE CONSTRAINTS AND WINDOWS

Altitude constraints are designated as AT, AT-or-ABOVE, AT-or-BELOW, and WINDOW. Entries follow the rules listed below:



- AT altitude constraints are entered and displayed as altitude or flight level without a suffix (18000 or FL230).
- AT-or-ABOVE altitude constraints are entered and displayed as altitude or flight level with an A suffix (17000A or FL230A).
- AT-or-BELOW altitude constraints are entered and displayed as altitude or flight level with an B suffix (14000B or FL230B).
- WINDOW altitude constraints are displayed as the lower altitude limit followed by the upper altitude limit (14000 FL230). Window constraints can only be accessed by selecting a procedure, and the WINDOW constraint is part of the procedure.

SPEED RESTRICTIONS AND CONSTRAINTS

The two speed restrictions are AT-or-ABOVE and AT-or-BELOW. These will only be allowed when they are designated in the NDB. Speed restrictions are entered or displayed as follows:

- AT-or-Above – speed with an A suffix.
- AT-or-Below – speed with a B suffix.

The speed constraint is AT. When the NDB does not specify one of the two speed restrictions, the AT constraint is used. The speed constraint is entered or displayed as follows:

- AT – speed without a suffix.

COLOR DISPLAYS

When the FMC Color Software Option is enabled, certain functions and data are highlighted using color in the displays. When the color option is not enabled, only the shaded-white is used for significant data and prompts.

Displays are colorized according the following guidelines.

- The following are displayed in large font **SHADED-WHITE** text.
 - ABEAM PTS prompt when selected (until executed or cancelled).
 - ACARS prompts (other than ACCEPT/REJECT) when selected and until message is delivered to the ACARS MU or



FMC is unable to deliver the down link to the ACARS MU (3 seconds minimum).

- EXIT ARMED prompt on the RTE HOLD page after EXIT HOLD prompt is executed.
 - LT ENG OUT or RT ENG OUT prompt on the ENG OUT CLB page when selected (these prompts work as a toggle).
 - MOD when it appears in the page title.
 - Modification entries manually entered or from ACARS uplinks (including entries which are propagated onto pages other than the page entered on) until executed or cancelled.
 - Navigation position selected on the POS SHIFT page (until executed or cancelled).
- Prior to activation, RTE, RTE LEGS, RTE DATA, and HOLD page titles are displayed in **CYAN**.
- The following are displayed in **MAGENTA** when the route is active:
- Active FMC waypoint on RTE, RTE LEGS, RTE DATA, RTE HOLD, and PROGRESS pages.
 - Active FMC target altitude on the RTE LEGS page.
 - AT when displayed speed/altitude or altitude is the current FMC target speed/altitude or altitude unless the displayed E/D ALT or speed/altitude is the result of a subsequent restriction on CLB and DES pages.
 - BEST SPEED when displayed speed is current FMC target speed.
 - CRZ ALT when displayed value is the current FMC target value.
 - E/D ALT when displayed altitude is active FMC target altitude.
 - QUAD/RADIAL on the RTE HOLD page when the hold is active.
 - INBD CRS/DIR on the RTE HOLD page when the hold is active.



- LEG TIME on the RTE HOLD page when the hold is active.
 - LEG DIST on the RTE HOLD page when the hold is active.
 - RTA SPEED when displayed speed is current FMC target speed or active speed restriction.
 - RTA time when displayed (RTA Mode active).
 - RTA WPT when it is the active waypoint.
 - SPD/REST or TGT SPD when displayed speed is the current FMC target speed. When CAS and MACH are displayed together, only the active measurement standard is displayed in magenta, i.e., in normal descent, the MACH value is displayed in magenta until the CAS/MACH transition point is reached, then the CAS value is displayed in magenta.
- The following are displayed in **GREEN** text.
- Actively tuned VOR, ILS, or DME data (frequency, station ID, and course) on NAV STATUS page, when the navaid is used in the navigation solution.
 - Active state (ON/OFF) of alternate navaids on the NAV OPTIONS page.
 - LANDING REF (QNH/QFE) toggle selected mode.
 - RW COND (DRY/WET SK–R) toggle selected mode(s).
 - TAKEOFF REF (QNH/QFE) toggle selected mode.
- Map pages are displayed in full color.
- All other data and headers not affected by specific colorization are displayed in white text.

MESSAGES

The system displays messages in the scratchpad of the LCD CDU which are worded to allow easy identification and corrective action if required. When a message is received, the MSG annunciator on the LCD CDU lights. High priority messages also cause the FMC annunciator on the AA to be lit. Any data displayed in the scratchpad has priority over messages. Messages are prioritized, with the highest priority message displayed first. DELETE is treated as a message.



Messages may be cleared by pressing the CLR key. Some messages will be cleared automatically when no longer appropriate.

Alerting and advisory messages are covered in detail in Part 3.

DUAL FMC CONFIGURATION

In a dual configuration the FMCS includes two interconnected FMCs operating as two independent navigators. Based on the position of the FMC source select switch, one FMC is the driver and decision maker (designated the primary FMC), while the other FMC is the follower (designated the secondary FMC).

The FMC source select switch has the following positions:

- NORMAL
- BOTH ON LEFT
- BOTH ON RIGHT

The following list shows which FMC each FMS sub-system is interfaced with based on the switch position. Note that in the NORMAL position all right sub-systems interface with the right FMC except for the right LCD.

LRU	FMC interfaces based on the switch position		
	BOTH ON L	NORMAL	BOTH ON R
A/T	FMC-L	FMC-L	FMC-R
ACARS MU	FMC-L	FMC-L	FMC-R
ADIRU-L	FMC-L	FMC-L	FMC-R
ADIRU-R	FMC-L	FMC-R	FMC-R
AUTOTHRTL	FMC-L	FMC-L	FMC-R
CDS-L	FMC-L	FMC-L	FMC-R
CDS-R	FMC-L	FMC-R	FMC-R
DLU	FMC-L	FMC-L	FMC-R
DME-L	FMC-L	FMC-L	FMC-R
DME-R	FMC-L	FMC-R	FMC-R
FCC-A	FMC-L	FMC-L	FMC-R
FCC-B	FMC-L	FMC-R	FMC-R



LRU	FMC interfaces based on the switch position		
	BOTH ON L	NORMAL	BOTH ON R
LCD-L	FMC-L	FMC-L	FMC-R
LCD-R	FMC-L	FMC-L	FMC-R
VHF NAV-L	FMC-L	FMC-L	FMC-R
VHF NAV-R	FMC-L	FMC-R	FMC-R

If a situation such as a failure of the primary FMC occurs, the source select switch position may be changed to put aircraft control with the remaining healthy FMC.

With respect to navigation, the primary FMC is the master. The navigation master is determined by the position of the FMC source select switch as follows:

SOURCE SELECT SWITCH POSITION	NAVIGATION MASTER	NAVIGATION FOLLOWER
NORMAL	FMC-L	FMC-R
BOTH ON L	FMC-L	FMC-R
BOTH ON R	FMC-R	FMC-L

The navigation master selects the nav aids for tuning, allocates nav aids to each FMC, determines the navigation update sensors each will use, and transmits the initial position to the IRS.

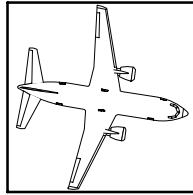
At power up, the FMCs synchronize themselves to the same initial position and any flight plan information loaded. Continuous monitoring and re-synchronization will keep both FMCs performing together.

During all phases of flight except approach, the FMCs work to resolve a disagreement without disrupting the crew. The disagreement is not annunciated and the FMCs continually work to resolve the problem. The FMCS will only drop to single FMC operation when absolutely necessary, and is most likely going to be caused by hardware failure.

If a disagreement in the FMCs navigation solutions exists when entering the approach environment, the message FMC DISAGREE is displayed on the CDS navigation displays, and in the LCD CDU scratchpad. The CDS displays remain operating normally, and LNAV and VNAV remain engaged. If this occurs during an FMC RNP approach, the crew must initiate GA unless suitable visual



references can be established and maintained to allow manual control throughout the remaining approach.



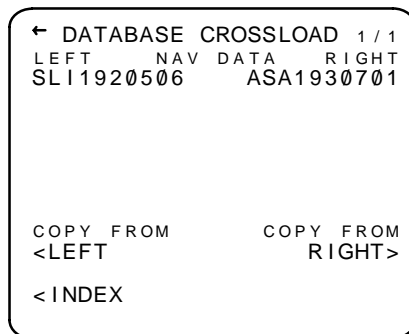
NOTE

The LCD CDU message can be cleared by the crew, however, this does not correct or remove the condition. The message is still valid and will remain displayed on the CDS displays.

While on the ground, any disagreement, including analog discrete inputs to the FMCs, will be indicated by the message FMC DISAGREE displayed on the CDS navigation displays, and in the LCD CDU scratchpad. The crew is required to investigate and determine a course of action to correct the disagreement. The corrective action may require intervention by the maintenance crew.

If the FMC operational software, navigation data, model/engine data, software option code data, or performance data do not compare between the two FMCs, the CROSSLOAD page is displayed (on ground only). Crossload may then be performed via manual selection on the CROSSLOAD page. These disagreements will not cause the FMC DISAGREE message to be displayed.

- DATABASE CROSSLOAD page displayed upon power up if navigation data is different:




- Select “update from LEFT” to crossload navigation data from left FMC to right FMC:



```
← DATABASE CROSSLOAD 1 / 1
LEFT      NAV DATA  RIGHT
SL11920506  ASA1930701
```

CROSSLOAD LEFT TO RIGHT

<CANCEL

- Follow the directions provided on the display if the desired crossload is from right to left.
- Press  to display CROSSLOAD IN PROGRESS:

```
← DATABASE CROSSLOAD 1 / 1
LEFT      NAV DATA  RIGHT
SL11920506
```

CROSSLOAD IN PROGRESS



SYSTEM DESCRIPTION

The basic Flight Management Computer System (FMCS) consists of a Flight Management Computer (FMC) and two Control Display Units. The FMCS display units can be a variety of the FMCS displays available to tailor the interface to the airline needs. The FMCS is integrated with other flight control systems to form the Flight Management System (FMS), capable of providing continuous automatic navigation, guidance, and performance management. These other systems are:

- A dual-channel Autopilot/Flight Director System (AFDS).
- A full regime autothrottle system (A/T).
- The Air Data Inertial Reference Systems (ADIRS).
- The Control Display System (CDS).
- An optional satellite Global Positioning System (GPS).
- An optional ACARS System.
- The Mode Control Panel (MCP).
- Cockpit Instrumentation displays (CDS).
- A GMT clock (captains clock).
- The Fuel Quantity Indicator System.
- Various navigation radio equipment.

The FMCS display function is available to any other ARINC 739 compatible system when connected to an MCDU.

The functional arrangement of the FMCS is shown in Figure 1–3. When interfaced with autopilot and autothrottle, the FMCS provides fully integrated flight management capability. Optimal performance computations, navigation, and guidance are provided from the beginning of climb–out to glide slope intercept or flaps greater than 15, with lateral and longitudinal autopilot coupling and automatic thrust control. The second FMC in a dual configuration provides redundant and independent navigation.

The FMC's OFP and databases can be loaded on board using an ARINC 615 data loader with the data loader switch set to FMC. In a dual FMC configuration, the source select switch must also be positioned correctly. After the primary FMC is loaded, the secondary FMC may also be loaded using the data loader, or by using the crossload function in the FMCS. Crossloading requires consid-



erably less time compared to using the data loader. When performing the crossload operation, the crossload is always performed from FMC-L to FMC-R.

FMCS SUB-SYSTEM INPUTS

Navigation and performance data are computed using inputs of:

From the IRS:

- Present position (latitude, longitude, and inertial altitude)
- Vertical speed (inertial)
- Ground speed components (north/south, east/west)
- Heading (magnetic and true)
- Roll and pitch angle
- Optional — GPS position (latitude, longitude)

From the Air Data System:

- Pressure altitude (uncorrected and baro-corrected)
- True Airspeed (TAS), Mach Airspeed (MAS), and Calibrated Airspeed (CAS)
- Total Air Temperature (TAT)
- DME slant range (from the DME interrogators)
- VOR bearing (from the VHF NAV receivers)
- Total fuel quantity (from the fuel summation unit)
- Pneumatic bleed status (from the Bleed Control Panels)

FMS SYSTEM CONTROLS AND DISPLAYS

The primary controls and displays associated with the operation of the FMCS are described below.

AFDS MODE CONTROL PANEL (MCP)

The arrangement of the MCP is illustrated in Figure 1-2. The FMCS interacts directly with only six of its controls:



- The LNAV selector switch
- The VNAV selector switch
- The altitude select control (ALTITUDE SEL)
- The course select control (COURSE)
- The altitude intervention switch (ALT INTV) (option)
- The speed intervention switch (SPD INTV) (option)

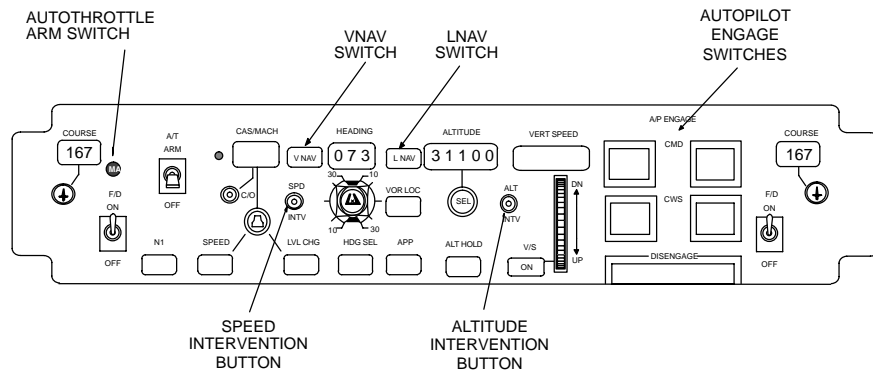
The LNAV and VNAV selector switches engage or disengage FMCS LNAV and VNAV guidance to the autopilot and autothrottle.

- The LNAV switch may be pressed at any time during takeoff, arming lateral navigation control. When the engagement criteria are met, the switch lights and LNAV is engaged. The airplane lateral path is flown to the FMC target path.

If LNAV is disengaged, the airplane path is flown to the MCP heading.

The ALTITUDE SEL control provides altitude data directly to the FMCS for VNAV mode control. The VNAV selector button may be depressed at any time prior to takeoff. This will arm the VNAV function. Vertical navigation will activate once the airplane is passing 400 ft AGL, and the FMC will control VNAV to the acceleration height (typically 1000 ft AGL), allow time for flaps retraction, and will then control the climb at the pre-selected climb rate.

The FMCS receives course data from the MCP COURSE selector to generate a selected course radial and its reciprocal for display on the ND when a VOR is being manually tuned.



AFDS MCP
Figure 1-2



AUTOTHROTTLE (A/T)

Autothrottle-coupled operations with the FMCS are controlled by command mode selection from the AFDS. Autothrottle coupling is enabled by the A/T ARM switch located on the AFDS MCP.

FLIGHT MODE ANNUNCIATOR (FMA)

The Captain's and First Officer's PFD displays an indication at the top of the active N_1 limit operating mode.

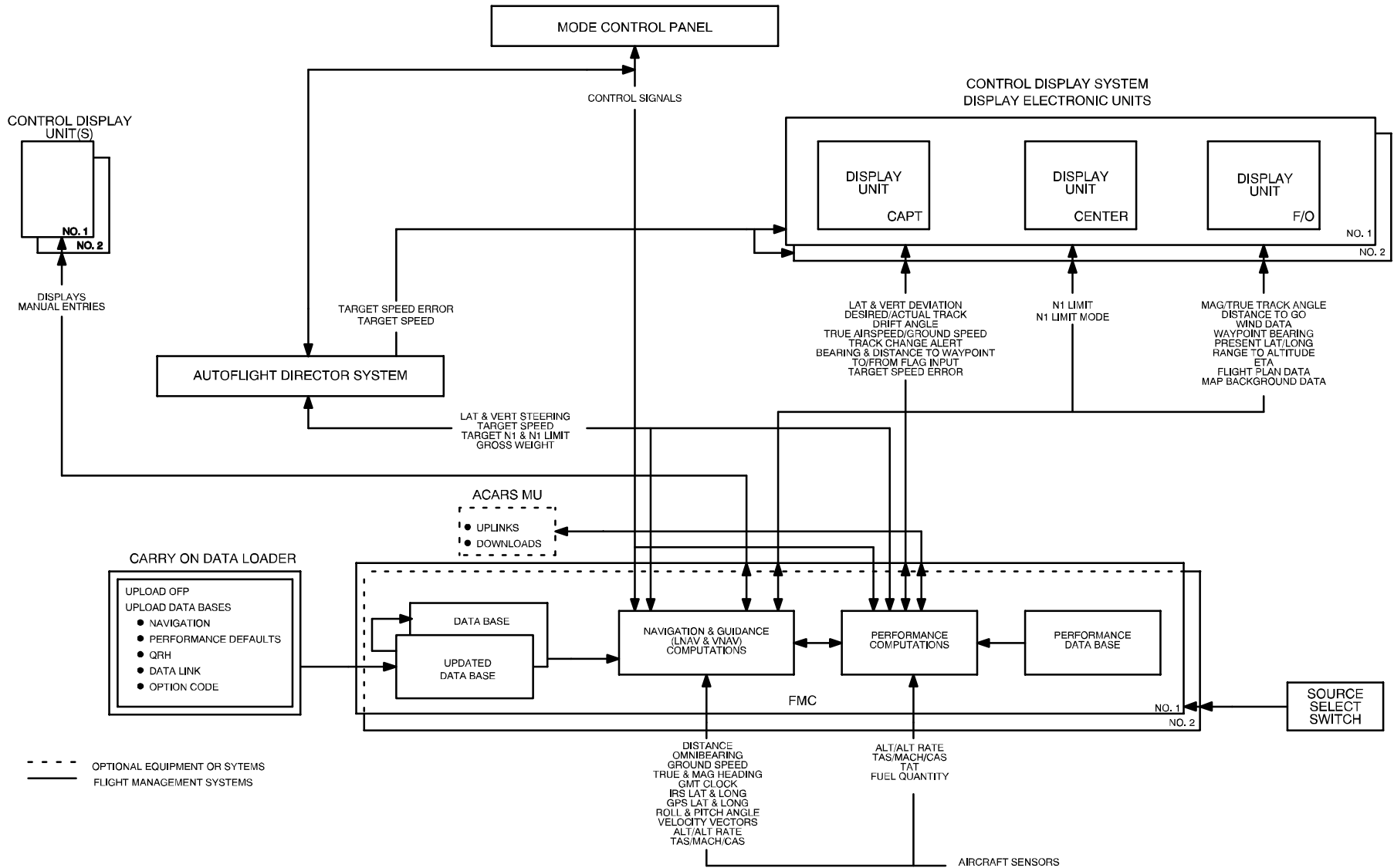
AUTOFLIGHT ANNUNCIATOR (AA)

While in the air, FMC failures and alerting messages light the amber FMC annunciator. Pressing the FMC alert switch turns off the annunciator.

If the annunciator is lit due to an alerting message, the message can be viewed in the FMC display scratchpad.

If the annunciator is lit due to an FMC failure, the following additional indications are provided:

- Dual configuration:
 - Right FMC fails:
 - The VTK flag is displayed on right ND and the map is blanked after approximately 30 seconds.
 - SINGLE FMC OPERATION message is displayed in both FMCS display scratchpad areas.
 - Left FMC fails:
 - The VTK flag is displayed on left ND and the map is blanked after approximately 30 seconds.
 - The FMCS display FAIL annunciator is lit and FMC is displayed in the screen (CDU Only).
 - The FMCS display displays the MENU page with the FMC prompt (LSK 1L) blanked (MCDU and FANS MCDU).



FMCS Functional Arrangement
Figure 1-3



- Both FMCs fail:
 - The VTK and MAP flags are displayed on both NDs and the map is blanked after approximately 30 seconds.
 - The FMCS display FAIL annunciator is lit and FMC is displayed in the screen (CDU Only).
 - The FMCS display displays the MENU page with the FMC prompt (LSK 1L) blanked (MCDU and FANS MCDU).
- Single configuration – See Dual Configuration Both FMCs Fail.

COMMON DISPLAY SYSTEM (CDS)

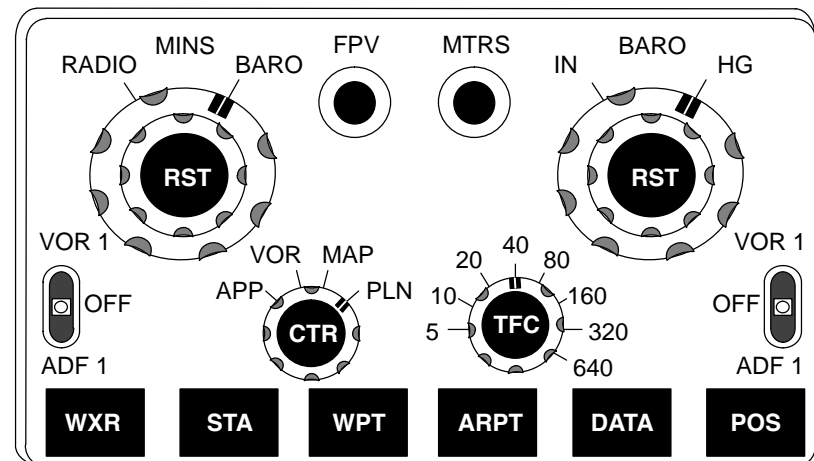
The CDS provides advisory data such as map display, weather radar information, radio altitude information, and automatic flight control mode annunciation.

The CDS consists of the following components:

- Common Display Control Panels (CDSCPs)
- Attitude Indicator (AI) displays
- Horizontal Situation Indicator (HSI) displays

The CDSCP (shown in Figure 1–4) provides selectable display modes and display options, and selectable range information to the FMCS. The FMCS provides flight-plan-related information to the CDS when the MAP or PLAN mode is selected on the CDSCP.

The information provided to the CDS from the FMCS consists of background and dynamic data. The FMCS specifies the data type to be displayed, its position, and symbology orientation viewed on the display (see Figures 1–5). Background data information is extracted from the Navigation Database and the flight plan. This flight plan information is identical to the FMC lateral flight plan.



Common Display System Control Panel
Figure 1-4

MAP mode symbol categories to be displayed by the FMCS must be selected on the control panel. Modifications made to the active flight plan using the FMCS are displayed in white, along with the active flight plan displayed in magenta, until executed. Once executed, only the active flight plan is displayed.

The background symbol information sent to the CDS is made up of the following:

- Flight Plan Route Data (ACT and MOD)
 - Waypoints
 - Route data
 - Runways
 - Holding Patterns
 - Altitude Profile Points (T/C, S/C, T/D, E/D, and airport speed restriction deceleration points)
- Alphanumeric Messages
- Tuned Nav aids
- Origin and Destination Airports
- Other Airports
- Selected Reference Points
- Nav aids (VORTAC, VOR, DME/TACAN)



- Waypoints (not in flight plan, but in NDB)
- Procedure Turns
- Procedure Holds
- Message annunciations to the crew



Typical Display in Map Mode
Figure 1-5

Dynamic symbol information consists of general navigation and guidance parameters and special data parameters. The dynamic symbol information that is sent to the CDS from the FMCS consists of the following:

HSI Display Information

- Dist to Go (to a waypoint)
- Estimated Time of Arrival
- Desired Track
- Waypoint Bearing
- Track Angle (True & Mag)
- Wind Speed & Direction



- Cross-Track Deviation
- Vertical Deviation
- Range to MCP Altitude
- Present Lat & Long
FMC, FMC Radio Position,
GPS, and IRS
- Lateral Offset Track
- Drift Angle
- Active Waypoint Name
- IRS Position Difference
- Display Bit

AI Display Information

- Ground Speed
- Flight Path Angle
- V_{REF} Speed (Speed Tape Option Only)
- V_1 Speed (Speed Tape Option Only)
- V_R Speed (Speed Tape Option Only)

INSTRUMENTS

Three types of instrumentation displays in the PFD are interfaced with the FMCS. They are:

- The Horizontal Situation Indicator (HSI).
- The Mach/Airspeed Indicator (MASI).
- The Attitude Indicator (AI).

Horizontal Situation Indicator (HSI) Display

When the FMC is coupled in LNAV and VNAV, it provides display outputs to both the Captain's and the First Officer's HSI displays for:

- The course pointer.
- The drift angle cursor.
- The lateral deviation bar.
- The vertical deviation pointer.
- The TO/FROM indicator flag.
- The ALERT annunciator, which provides a visible advisory prior to the FMC's automatic execution of a programmed lateral path change.
 - Lateral track changes are annunciated 10 seconds prior to initiation of the turn maneuver.
 - The ALERT annunciator will go out when the commanded lateral track change should begin.



- The distance to go in nautical miles to the next geographically fixed waypoint.
- The ground speed.
- Bearing to the next geographically fixed waypoint.
- True airspeed (optional).
- Descent and approach lateral and vertical deviations (optional)

Mach/Airspeed Indicator (MASI) Display

The FMC provides an output of target airspeed to the AFDS to position speed cursors on the MASI display whenever VNAV is engaged. The crew may override and disable the automatic cursor.

ATTITUDE INDICATOR (AI) DISPLAY

When the FMC is coupled in VNAV and the A/T is engaged in FMC SPD mode, the autothrottle provides a speed error signal to the fast/slow pointer which shows the difference between current speed and FMC target speed.

FMCS PERFORMANCE COMPUTATIONS

The essential difference between the Flight Management Computer System and conventional area navigation systems lies in the FMC's ability to provide optimal speed, thrust, and flight path guidance. This optimization is based upon sensor measurements of flight conditions and the operator's definition of flight cost factors, as done through the Cost Index (CI) which specifies the relative weighting of fuel saving and time-of-flight saving. Thus, climb, cruise, and descent optimization which assure the best possible return on trip cost can be employed without increasing flight crew workload.

The FMC provides speed and thrust targets for the selected flight phase and mode of operation, including thrust limits to protect the engines. The speed and thrust target and thrust limit data are transmitted to the autopilot and autothrottle systems to provide direct automatic control of the airplane's flight path.

COST INDEX (CI)

The crew can modify the speed and altitudes of the flight prior to takeoff, by entering CI into the PERF INIT page. The FMC will compute the parameters of the route based on this entry.



CI is a value derived from the airline operating cost per hour divided by the cost per pound (US) of fuel. The result is a number that can be entered into the PERF INIT page to allow the FMC to compute predictions for the route.

For those airlines using the metric system, the fuel weight must be converted to U.S. pounds to determine the CI.

The enterable values for CI are between 0 and 500, though the FMC may use different extremes when computing various parameters.

In the event an FMC experiences an unexpected software fault, CI is blanked and the crew must re-enter the value.

PERFORMANCE MODES

As a default, the system selects the ECONomy mode which uses the pilot entered CI to construct the most cost efficient altitude-speed flight profile.

Other performance modes may be selected on the individual flight phase pages of CLB, CRZ, and DES. In CRZ the long-range-cruise (LRC) selection commands a speed providing 99% maximum fuel efficiency (corresponding to a CI of 20 to 25 in the ECON mode, depending on altitude). For engine out (ENG OUT) conditions, the FMCS displays the maximum continuous thrust N_1 , maximum altitude capability and optimum airspeed based on maximum continuous thrust, minimum drag speed, and current gross weight. Vertical navigation (VNAV) mode cannot be engaged when the ENG OUT mode is active.

PERFORMANCE DATABASE

The system's performance database is contained in the permanent storage area within the Flight Management Computer. It consists of a detailed aerodynamic model, and a fuel flow and thrust model tailored to the airplane and engine configuration that the FMC is installed in.

The aerodynamic model includes:

- Basic high-speed drag polars.
- Target airspeeds for all operating modes and conditions.
- Buffet limit envelope.



- Values of the airplane's certified operating limits.
- Speed and altitude capability data required for engine-out operating conditions.

The thrust model includes:

- Fuel flow and thrust model for the type of engine installed on the airplane.
- Data used in the computations of fuel flow, thrust, engine limits and target values.
- Data used to compute corrections for the effects of air conditioning and anti-icing bleeds.
- Thrust targets for turbulence penetration are also provided as advisory information for the crew.

PERFORMANCE OPTIMIZATION

It is convenient to think of the performance advisory capability of flight management systems as an electronic operations manual. In at least one sense, that description applies to the FMCS, in that it provides flight planning and performance information that the crew would normally look up in the Airplane's Operations Manual. But the FMCS furnishes a great deal more information that cannot be obtained from the Operations Manual, nor, for that matter, from the Performance Engineer's Manual.

Climb speed schedules and Descent speed schedules for optimal operation of the airplane are determined largely as a function of the Cost Index. Cruise speed schedule is a function of CI, gross weight, cruise altitude, and headwind.

PERFORMANCE SELECTION FOR REQUIRED TIME OF ARRIVAL (RTA)

The Required Time of Arrival (RTA) advisory and control capabilities provide a performance speed schedule to arrive at a specific point at a specific time. Activation of the RTA performance function is made by entering a specified time and waypoint from the route on PROGRESS page 3. This selection will override any prior performance mode selections for climb, cruise, and descent up to the specified RTA waypoint. The target speed schedule to meet the RTA is derived by estimating the ECON mode CI that results in the ETA performance prediction equal to the RTA. Using the CI to



adjust the speed schedule for the flight phases involved insures optimal time compliance without exceeding the performance limits of the airplane. If the entered RTA can not be met using an allowable CI, the message RTA UNACHIEVABLE is displayed in FMCS display scratchpad.

While on the ground prior to takeoff, normal performance predictions compute time of flight to each waypoint based on the cost index entered on the PERF INIT page. CI values range from 0 for most fuel efficient trip, to the airplane maximum for the fastest trip. When an RTA is entered on a waypoint along the route, the FMC provides a takeoff time window (displayed on PROGRESS page 3) using a cost index of negative 40 to compute the earliest departure time, and the airplane maximum to compute the latest departure time (though the FMC uses a negative value for CI to compute an RTA or takeoff time window, the crew cannot enter a negative value for CI).

While in the air, the same CI values are initially used to compute the RTA window to the specified waypoint. As the flight progresses, the FMC may vary the CI used to compute the required speed targets to meet the RTA.

During flight, the ETA to the designated RTA waypoint is computed and compared to the RTA entered on PROGRESS page 3 to determine and display a time error. When the resulting time error exceeds the error tolerance, RTA computations will estimate a new CI, which in turn changes the target speed schedule.

The computed error tolerance is determined by the TIME ERROR TOLERANCE value entered on the PERF LIMITS page, and on the time remaining to the RTA waypoint. The PERF LIMITS page defaults to 30 seconds and allows the airline operators to specify a narrower tolerance as low as 5 seconds.

FLIGHT ENVELOPE PROTECTION

Cost-optimal flight profiles may require flying the airplane at or near the limits of safe structure and engine performance capabilities. Speed, thrust, and maneuvering performed by the FMC is regulated by a database system of limits to set boundaries that the FMC flight computations will not exceed. The FMC operational program has been specifically designed to assess the effects of actual flight conditions, computed performance targets, and crew data entries or requests, and continuously evaluate these variables with respect to the computed or programmed capabilities of the airplane and its



engines. Any condition that attempts to exceed the limits is annunciated to the crew.

The airplane's environmental (temperature/altitude), airspeed (V_{MO} and M_{MO}) limits and maneuver margin envelopes are continuously checked. N_1 limit data is used to check the target speeds and thrust commands. The maneuver margin to initial buffet can be either chosen by the airline operator (for FAA operators) or is limited to 1.3 g's (for CAA operators).

FMCS NAVIGATION

The FMCS incorporates both self-contained and radio-augmented navigation in the lateral and vertical planes. The system furnishes, as its basic navigational outputs, continuous real-time solutions for:

- airplane Position (latitude, longitude, altitude)
- Ground Speed
- Flight Path Angle
- Drift Angle
- Track Angle
- Wind Velocity and Direction

STORED NAVIGATION DATABASES

The FMC can store several navigation databases that are each identified with an effective date or is limited to the current flight.

Main Navigation Databases

The main Navigation Database (NDB) is assigned an effectivity date, and for convenience, two copies can be stored having consecutive activity dates. These are displayed for reference on the IDENT page. One database is the active navigation database (displayed on IDENT page 1, line 3R), while the second database (line 4R) is designed to replace the first when the ending date expires.

These databases are updated at intervals of 28 days and can be tailored to each airline's requirements.

The main navigation databases contain current information required for FMCS operation in a specified geographic area. It can include data for:



- Radio Navigation Aids
- Waypoints
- Airports and Runways
- Standard Instrument Departures (SIDs)
- Standard Terminal Arrival Routes (STARs)
- Enroute Airways
- Charted Holding Patterns
- Approach Procedures
- Approach and Departure Transitions
- Procedure Specified Navaids
- Precision and Non-Precision Approach Systems
- Terminal Gates
- Missed Approach Waypoints and Procedures
- Procedure Turns
- Procedure Holds
- Altitude Restrictions
- Speed Restrictions

Reference Navigation Databases

In addition to the content of the main navigation database, the FMC contains a reference navigation database. This is divided into the temporary and the supplemental navigation databases.

While on the ground, the crew may enter waypoint data into the supplemental (SUPP NAV DATA) storage area. Entries in the SUPP NAV DATA storage area are retained until deleted by the crew (or when re-loading the FMC). Once in the air, new entries cannot be made to this database.

While in the air, the crew has access to the temporary (TEMP NAV DATA) storage area. When waypoints that are not in the permanent or supplemental databases are created and entered into the flight plan, the waypoint information is retained in the temporary database storage area of the FMC. Entries into the TEMP NAV DATA storage area may be deleted by the crew, and are automatically cleared at flight completion.

The reference navigation database provides storage for 20 waypoints specifically for the TEMP Navigation Database, and 80 waypoints, 40 Navaid, and 7 airports that are shared by the supplemental and temporary navigation databases.



Pilot Defined Company Route Navigation Database

When the pilot defined company route option is available, the FMC can be loaded with up to ten pre-designed flight plans. Terminal procedures, airways, and airline defined waypoints can be saved.

DISPLAYED NAVIGATION DATA

Navigation data is displayed rounded off due to space restrictions in the display area. The FMC does not make use of these rounded off values when performing predictions and computation. The following table lists the display rounding factors used for display data.

<u>DATA ITEM</u>	<u>NEAREST INCREMENT</u>
Airport lat/long	1/10 minute
ILS lat/long	1 second*
Navaid lat/long	1 second*
Runway lat/long	1 second*
Waypoint lat/long	1 second*
Airport Speed Limit Alt	100 feet
STAR/APP Transition Level	100 feet
SID/STAR/APP Alt Restrictions	100 feet
SID/STAR/APP Heading/Course/Radius	1 degree
SID/STAR/APP Waypoint Distance	1/10 nautical mile
Company Route Cruise Alt	100 feet
Hold Pattern Inbound Course	1 degree
Localizer Bearing	1 degree
Navaid Elevation	20 feet
Runway Bearing	1 degree
Runway Length	50 feet
SID Transition Alt	100 feet

* ILS, Navaid, Runway, and Waypoint lat/long are displayed on the CDU to the nearest 1/10 minute even though they are stored to the nearest second in the Nav Database



DETERMINING OPTIMAL NAVIGATION CONFIGURATION

The FMC selects the navigation sensors that provides the best solution for airplane present position. This selection depends upon the availability and validity of outputs from the airplane's primary navigation sensors. The selection process is completely automatic and controlled by the FMC (primary FMC in a dual configuration). The basic sensor inputs required for the optimal data-mixing process are:

- Slant range measurements from DME interrogators (standard, frequency agile, or frequency scanning).
- Bearing data from either of the two VOR receivers.
- Baro-corrected and uncorrected pressure altitude and true airspeed from either one of the ADCs.
- Latitude, longitude, inertial altitude, inertial vertical speed, true heading, magnetic heading, and ground speed components from either of the IRSs.
- Latitude and longitude from an optional GPS interface or from a stand-alone GPS.

DME or VOR validity is determined by station geometry in relation to the computed present position and the reasonableness of the actual data received from the tuned nav aids.

The FMC selects and uses all valid available sensors for airplane state calculations, correcting the IRS data based on the following:

- GPS
- Multi-DME
- DME/VOR (co-located)
- LOC/DME (aligned with runway)
- LOC

POSITION DETERMINATION

The navigation processing consists of computations for both horizontal and vertical positions of the airplane. The vertical navigation process computes values of altitude and flight path angle (FPA) using data from the IRS and the air data computers, using GPS data as a comparison when data is available. While on the ground, FPA is assumed to be zero. The more involved process of horizontal navigation primarily consists of a filtering process using GPS, DME and VOR navigation data to correct the IRS position computa-

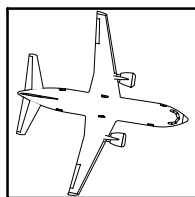


tions. The pilot can manually update the FMC to one of the FMC, GPS, or radio positions through selections on the POS SHIFT page as appropriate.

GPS data will be used first to update the airplane state estimates based on certification level, flight phase, and pilot selection. While in approach, and the FMCs are receiving valid data and performing GPS updating, the ILS radio update may be selected OFF by the crew.

For a dual FMC installation, the guidance position and velocity calculations are also based on the setting of the source select switch. In the NORMAL position the guidance position and velocity are a combination of each FMC's navigation position and velocity weighted by the corresponding navigation uncertainties. When the source select switch is set on BOTH ON L the left FMC's airplane state estimate is used for guidance. Conversely, when the switch is set on BOTH ON R the right FMC's state is used for guidance.

In a dual configuration, both FMCs compute the airplane position independently and compare the result against one another. If a disagreement is encountered, the primary FMC will continue to control the airplane while the secondary FMC continues to attempt to resolve the discrepancy. If the disagreement exists while entering the approach, the FMC DISAGREE message is displayed in the FMCS display scratchpads. The flight crew can clear the message and should make other checks to confirm their position.



NOTE

If the flight crew leaves the approach via missed approach and go-around, the message will automatically clear when the airplane is out of the approach environment. If the disagreement still exist when the approach is re-entered, the message will again be displayed.

RADIO MANAGEMENT

When the AUTO mode of VOR/DME tuning is selected, the FMCS is responsible for the selection and tuning of navigation aids that



can be successfully used to provide navigation solutions when combined with data from the IRS.

The best navigation aids are broadly defined to be the 10 navigation aids closest to the airplane's computed present position. In order to qualify as candidates for the best navigation aid list, these facilities must be within a range which is suitable for its class of operation and the present altitude of the airplane. With a dual FMC installation, the primary FMC controls the selection.

From the best navigation aid list, the FMCS determines the best navigation aid pair as a function of the line-of-position (LOP) crossing angle and the distance to the station and the horizon. The crossing angle of the LOPs must lie between 30 degrees and 150 degrees. The best navaid pair is defined as the combination which produces a crossing angle closest to the ideal value of 90 degrees. Re-evaluation of the best navaid pair will be performed every five seconds. In a dual FMC installation, the primary FMC performs the pairing operation and informs the secondary FMC which pairs to use. The primary FMC gets the 1st, 3rd, 5th, etc., pairs and the secondary FMC is assigned the 2nd, 4th, 6th, etc., pairs.

If one of the two DME interrogators has been switched to manual mode, the FMCS will attempt to use the manually tuned DME station and to find a complementary DME station that provides an acceptable LOP crossing angle. When this is not possible, the DME interrogator in the AUTO mode may be operated by the FMCS in a frequency-agile sub-mode (if agility DME is installed) in order to preserve the primary dual-DME navigation solution. When this occurs, the single AUTO mode DME interrogator will be tuned alternately to each of two DME stations, selected by the FMCS as the best pair, at intervals of 5 seconds; otherwise, the FMCS may operate in a VOR/DME mode.

At the crew's discretion, the NAV OPTIONS page 2 allows entry of two specific DME stations and two specific VOR stations to be excluded from the navigation solution. The crew also has the ability to turn DME and VOR updating on or off independently.

GPS NAVIGATION

The use of GPS data for navigation depends on the certification level, flight phase, and pilot inhibits. The certification level (with or without integrity) determines the GPS ratings; primary NAV source, supplemental NAV source, and advisory only.

As the primary NAV source, the GPS data is used in all flight phases and on the ground. Unless GPS updating is turned OFF on the



NAV OPTIONS page 2 or the data is invalid, the FMC will perform all navigation position updates using the GPS data. GPS updating will automatically resume when GPS UPDATE is turned back ON or when GPS data again becomes valid. When GPS data is the primary NAV source, the crew may also turn off localizer updating on the NAV OPTIONS page 2 when it is known or suspected that a localizer is not accurate enough to support this performance level.

With the supplemental rating, GPS data may be used if it is checked against other sole means certified navigation data sources. VHF is the sole means method while enroute domestic and in terminal areas; IRS is the sole means for oceanic. If VHF radio data is unavailable in terminal, approach, or enroute flight, GPS updating is allowed without affecting actual navigation performance. Otherwise the VHF data is used as a check of the GPS data. In an oceanic navigation flight environment IRS data is used for the check.

When GPS is set for advisory only, GPS data is only displayed for information and not used to determine the navigation position.

FMCS FLIGHT PLANNING

An entire flight can be preplanned well before push back from the gate, and except for the takeoff and final approach to the runway, can be automatically flown by the FMC as it sends its commands to the AFDS and autothrottle. A complete lateral flight plan may be selected out of the FMC's navigation database. The lateral routing may also be modified manually with assistance from the FMC's database search capability. The FMC accepts route entry and revisions via the FMCS display in a format compatible with air traffic control clearance language.

The vertical portion of the route can be automatically preplanned by the FMC using speed and altitude targets optimized for flight economy. As with the lateral plan, the crew can easily modify the FMC's default values to tailor the vertical segment schedules to the requirements of each flight.

NAVIGATION DATABASE SELECTION

Upon initial power-up, the FMC displays the system configuration on the IDENT page. This page is used to confirm that the particular FMC installed in the airplane has the correct airplane and engine configuration performance data in its memory. The crew can also confirm the applicability of the navigation database loaded into



the FMC and its effectivity date. Upon power-up, the FMC compares the navigation database effectivity date with the date from the GMT clock system. If the navigation database is not effective for the date received, the message NAV DATA OUT OF DATE is displayed in the FMCS display scratchpad. The main navigation database must be switched on the ground.

IRS INITIALIZATION

The airplane's Inertial Reference System's latitude and longitude may be initialized from the FMCS LCD CDU. If an IRS is in the ATT mode, the primary FMC can be used to initialize the IRS heading. The IRS position can be set using any of the following methods:

- Selecting the stored LAST POS on the POS INIT page when retained in the FMCS if the airplane has not been moved.
- Entering the ICAO identifier for the departure airport into REF AIRPORT, and selecting the position at LSK 2R to the SET IRS POS line.
- Entering the departure gate identifier in GATE (when the position is stored in the NDB) and selecting the position at LSK 2R to the SET IRS POS line.
- Directly entering the desired latitude and longitude.
- Select a position on the POS REF page and enter that position into the SET IRS POS line on the POS INIT page.

If the IRS position is more than 4 nm different from the origin airport position entered into the FMC, the message IRS POS/ORIGIN DISAGREE is displayed in the LCD CDU scratchpad. Verify the IRS position and check that the correct airport was selected on the DEPARTURES page.

When the FMC position does not match the selected runway position from the NDB, the message FMC POS/RW DISAGREE is displayed. Verify the correct runway is selected in the flight plan.

GMT OR LOCAL TIME SELECTION

The primary FMC receives and displays Greenwich Mean Time (GMT) from the pilots clock system. The FMC also estimates times at each of the planned route horizontal and vertical waypoints and at the destination. The clock input to the FMC may be GMT or local time, depending on which is used to set the airplane clock. To



ensure that the FMC has GMT time, the GMT hours can be entered when the clock input in use is set to a local non-GMT time zone. When GPS is available, the FMC can use GPS time.

FLIGHT PLAN DEFINITION

The flight plan comprises many pieces of information used by the crew and the FMCS to perform the Flight Management Function. A minimum flight plan is defined as an origin airport, at least one waypoint that is not part of the departure or arrival airport procedures, and a destination airport.

To refine the flight plan, additional waypoints, procedures, target speeds, altitudes, etc. can be added to create the desired path that the FMC will use to provide guidance to the airplane flight control systems and autothrottle.

Lateral Path Construction

The crew can create a string of lateral navigation waypoints that will make up the planned route in either of two ways:

- Manually enter each desired waypoint or airway segment.
- Load a flight plan via one of the automated functions (ACARS option, CO-RTE option, etc.).

The minimum path to which the automatic flight controls can be engaged consist of an origin, a destination, and at least one waypoint to define the basic route. Building the path begins with initializing the IRSs to the origin airport, and when desired the runway, on the POS INIT page. The origin and destination airports are then entered into the DEP/ARR INDEX page, and the desired SIDs, STARS, transitions, and runways are selected on the appropriate DEPARTURES and ARRIVALS pages.

Additional waypoints are then entered into the path between the two airports for further refinement and definition. Selecting the RTE LEGS page provides a detailed listing of the lateral path, and should be reviewed. By having the CDS in PLAN mode, each leg of the path can be reviewed using the STEP control prompt on the legs page to view each waypoint along the path in the center of the ND. Also note that when DISCOs appear in the plan, the RTE LEGS page and the CDS PLAN mode can aide in determining corrective action to close the path. Waypoints can be entered into the path using any of the naming/entry conventions.



As each route waypoint is entered, the FMCS searches the navigation databases to extract the necessary data to define the point. If a waypoint or airway is in one of the databases, the system checks to see that the route being constructed is made up of compatible entries. If a discontinuous set of route waypoints or interconnecting segments are entered, aeronautical charts should be referred to for an alternative to correct and clear the discontinuity.

Lateral offsets and holds may also be added to the path during path construction.

Vertical Path Construction

A vertical path is constructed along the lateral path from takeoff to the destination runway once the lateral path is entered. As the crew enters the lateral path, much of the vertical path is constructed automatically. The various navigation databases stored in the FMC contain altitude and speed restrictions as well as procedures which affect the vertical path. The crew need only enter the desired cruise altitude for the FMC to complete vertical path construction. The vertical path is divided into four general functions; climb, cruise, descent, MAPP/GA. Also note that the vertical path is also affected by the various FMC flight performance modes (economy, speed, long-range-cruise, etc.). During review of the lateral path on the RTE LEGS pages, the vertical speed and altitude constraints and restrictions can be checked at each waypoint. With the cruise altitude entered, the cruise waypoints are defined by the cruise altitude.

Flight Environment Boundaries

The FMC determines the boundaries of the flight environment to enable correct and consistent operation within each environment area. These boundaries are also used to determine when certain message are or are not to be displayed in the FMCS display scratchpad and on the PFDs. The boundaries are determined as follows:

- In approach – the FMC will consider itself to be in the approach environment when any of the following are true:
 - The airplane is within 2 nm of the IAF defined in the flight plan.
 - The airplane is below 2000 ft MSL and in descent mode.



- The active waypoint and history waypoint are approach waypoints from the same STAR.
- Exiting approach – the FMC will consider itself to be leaving the approach environment when either of the following are true:
 - The airplane is 3000 ft MSL above the DEST airport.
 - The airplane transitions out of the last waypoint of the missed approach procedure in the flight plan.
- Terminal – the FMC will consider itself to be in the terminal area when the airplane is below 15,000 ft MSL above the DEST airport and none of the approach criteria are true.
- Enroute – the FMC will consider itself to be in the enroute environment when none of the approach or terminal criteria are true and radio updating is available (GPS not considered).
- Oceanic – the FMC will consider itself to be in the oceanic environment when none of the approach or terminal criteria are true and radio updating is not available (GPS not considered).

Activating the Flight Plan

Once the lateral and vertical paths are entered, selecting the ACTIVATE prompt on the RTE page activates the EXECute key. Pressing EXECute activates the flight plan for the FMC to provide guidance to the airplane flight control systems and autothrottle.

For those airlines who have fixed flight plans stored in the FMC pilot defined company route database, or have flight plan uplink capability, the flight plan can be rapidly loaded into the FMC and activated. These methods load a complete set of lateral and vertical path parameters, and in an ideal situation, the crew is not required to make further entries. However, changes or corrections might be necessary, and it is advisable to review the plan as previously described.

When the LCD CDU Color option is available, all of the FMC route planning pages display the title in cyan until the plan is activated and EXECuted.

FLIGHT PLAN MODIFICATION

Until the planned route is activated and executed, it is simply that, a planned route. When the system has an active route, the dis-



plays associated with that route have an ACT status indicator in the title line of the page.

Modifications to any flight plan can be made at any time. When changes are made to an active flight plan, the ACT status indicator in the title line changes to MOD. The MOD status indicator remains until the changes are erased or activated. Lateral or vertical modifications can be inserted from the scratchpad into the RTE LEGS pages. The crews can also initiate step climbs or descents, or speed schedule changes directly on the CLB, CRZ, and DES performance displays (these will create a MOD condition until executed).

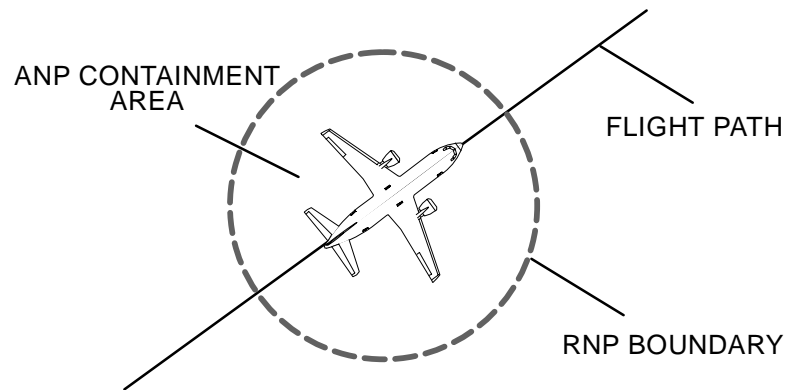
FMC GUIDANCE

The FMC incorporates flight path guidance and steering functions which work in unison to provide output commands to the airplane's autopilot, flight director, and autothrottle systems. These commands enable automatic flight path control and performance optimization in both the lateral and vertical plane.

LATERAL NAVIGATION PERFORMANCE

The RNP scribes a circle along the flight path in the lateral plane, around the airplane as shown in Figure 1-6. This represents the area that the airplane is required to fly within. The ANP is the computed position confidence factor representing where the FMC believes the airplane is with respect to the RNP containment area.

Deviations between the actual (FMC computed) navigation position (ANP) and required navigation performance (RNP) are allowed for short periods of time to allow the FMC to adjust and to prevent nuisance alerts.



Lateral RNP Boundary
Figure 1-6

The lateral ANP is allowed to exceed the lateral RNP for small periods of time before an alerting message (UNABLE REQD PERF-RNP) is issued and displayed. The RNP distances and default time-to-alert period used by the FMC for each flight environment are as follows:

<u>ENVIRONMENT</u>	<u>RNP (nm)</u>	<u>TIME-TO-ALERT</u> (sec)
OCEANIC	12.0	60
ENROUTE	2.0	30
TERMINAL	1.0	10
APPROACH	0.5	10

Airline operators may request a change to the time-to-alert defaults by requesting a custom loadable defaults database.

VERTICAL NAVIGATION PERFORMANCE

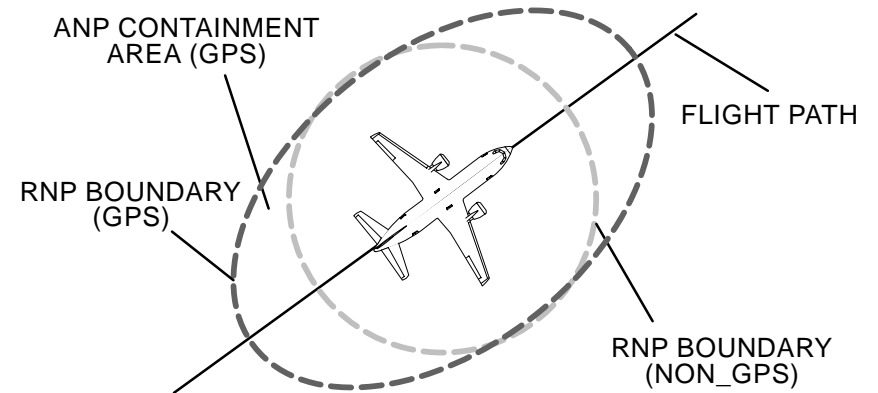
The vertical path ANP is determined by MACH speed and Baro-corrected altitude from both ADCs, therefore, it is important for the crew to enter a correct Baro setting into the FMCS (within seven feet) during system initialization.



GPS NAVIGATION PERFORMANCE

When GPS updating is being performed, the the along track RNP containment area is stretched out to compensate for GPS latency. The along track limit in front of and behind the airplane is RNP plus the distance the airplane can travel in two seconds at the current speed. The crosstrack distance remains the same (RNP) because latency does not have a noticeable affect in this plane. Figure 1-7 provides a pictorial representation of the difference. The extended RNP boundary in front of, and behind the airplane, will reduce the number of nuisance alerting messages.

When GPS data is available, it is used as a sanity check of the Baro-corrected altitude from the ADCs, which results in a correction factor for computing ANP.



Lateral RNP Boundary
Figure 1-7

WAYPOINT DEFINITION

The primary structure of a flight-planned route consists of a sequence of waypoints joined by a series of navigation legs or route segments. A waypoint is completely defined in terms of its latitude, longitude, and altitude, but in some cases these parameters may be affected by other operational variables.



The FMC implementation recognizes two distinct types of waypoints:

Fixed Waypoints

fixed waypoints are the most common and are defined by a fixed geographic position. Examples of fixed waypoints are:

- Locations of navigation aids, which define established airways.
- Defined intersections of enroute airways.
- Locations of airports, runway thresholds, nav aids, and other named waypoints.
- Pilot-entered waypoints are defined by one of the following:
 - Latitude and longitude.
 - Bearings from two named waypoints.
 - Bearing and distance from a named waypoint.
 - Along track offsets.

Floating Waypoints

Floating waypoints are those whose positions are dependent upon the airplane's operating state and external variables such as wind. Examples of floating waypoints are:

- The point at which a constant-heading leg intercepts a VOR radial.
- The point at which a constant-heading leg intercepts a DME arc.
- The point at which a climb profile flown on a constant heading or course passes through a specified altitude.
- The point at which a constant-heading leg intercepts a course to the next fixed waypoint.
- The point at which a constant-heading or course leg is manually terminated by the crew (usually part of a procedure representing ATC vectoring).

Waypoints not in the Nav database can be created on the REF NAV DATA, SUPP NAV DATA, RTE, and RTE LEGS pages.

The lateral flight plan is determined by fixed and floating waypoints and is computed by lateral guidance processes. The active TO



waypoint which is highlighted on the RTE LEGS and PROGRESS pages may be a fixed or floating waypoint. Floating waypoint identifiers are enclosed in parentheses.

In addition to the two types of waypoints previously discussed, the system takes into account in its profile predictions the existence of points of importance to the vertical performance calculations. These points are like the floating waypoints since they occupy positions dependent upon expected and actual operating conditions and external variables such as wind. These points do not appear on any of the RTE or RTE LEGS displays. They only influence the system by their “presence” being accounted for in time and distance predictions. Examples of these points are:

- Speed change — the point at which acceleration or deceleration to a new speed command or restriction begins.
- Transition altitude — The point at which QNE is used for altitude reference, rather than origin QNH. The term transition altitude level is used during the climb phase.
- Transition level — the point at which destination QNH is used for altitude reference, rather than QNE. The term transition level is used during the descent phase.
- Crossover altitude — the point at which the controlling target speed switches from CAS to Mach in climb and from Mach to CAS in descent.
- Intercept descent path — the point at which the projected early descent path intercepts the normal descent path.
- Top of climb (T/C) — the projected point where climb operation transitions to cruise.
- End of descent (E/D) — either the last waypoint with an “at ” altitude restriction in the flight plan route, or a point 1,000 feet above the destination airport runway if no waypoint is specified for termination of the descent.
- Top of descent (T/D) — the projected point where cruise operation transitions to descent. This applies to intermediate level-offs due to flight plan constraints.

INITIAL PATH CAPTURE

An initial path capture maneuver may be required when the FMC becomes coupled to the AFDS (MCP LNAV is engaged) or when the FMC is already coupled and the active flight plan is changed.



When the FMC is not coupled to the AFDS (LNAV is off), and a valid flight plan exists, path capture criteria are continually tested.

When the FMC is coupled to the AFDS (LNAV is on) and the flight plan is changed, path capture criteria are tested with respect to the new flight plan. If the FMC determines the path capture criteria cannot be met, the FMC will disengage itself from the AFDS and periodic testing will begin as described above.

The path capture criteria are as follows:

- When the present airplane track crosses the leg to be captured at an intercept angle of greater than 8 degrees or less than 90 degrees, the track is maintained until the leg is captured by FMC lateral steering control.
- When the track crossing is less than 8 degrees, the FMC rolls the airplane to an 8 degree intercept angle and maintains until the leg is captured by FMC lateral steering control.
- When the predicted intercept point is so close to the leg's termination waypoint that the turn at the waypoint cannot be calculated, a new path is calculated direct to the waypoint (instead of maintaining present track). If the direct path does not allow calculation of an acceptable path, control is turned over to the FMC normal steering control to steer to the flight plan path.
- When the present airplane track does not cross the leg to be captured or its backward extension, or crosses at an intercept greater than 30 degrees with the airplane within 3 nautical miles of the desired leg, then the path capture is turned over to the FMC normal steering control to steer to the flight plan path.
- When the intercept is less than or equal to 8 degrees outside 3 nm, or less than or equal to 30 degrees inside 3 nm crosstrack, lower initial steering gains are used.

If none of the above criteria are satisfied and an attempt to use the INTC function is made, the message NOT ON INTERCEPT HEADING is displayed in the FMCS display scratchpad and MCP engagement of the FMC flight plan will not be permitted until a correction is made.

For path descent operation, the maximum descent flight path angle for predicting interception of the vertical reference path is 7 degrees for airplane operation above the airport speed restriction altitude plus 1,000 feet, and 6 degrees below this altitude. If the predicted late descent path with these limitations does not intercept the vertical reference path without violating an altitude constraint, the mes-



sage DES PATH UNACHIEVABLE is displayed in the FMCS display scratchpad. Longitudinal steering is also constrained by these limits when vertical speed commands to the AFDS are being generated.

The vertical speed steering commands at path capture or at the vertical flight path transitions are acceleration-limited so as to produce a normal acceleration of not more than 0.1g.

HEADING GUIDANCE

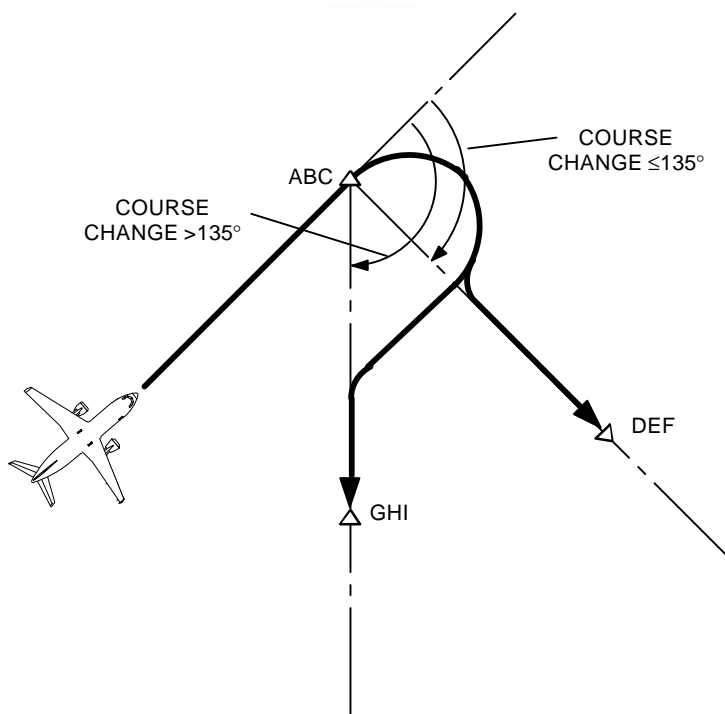
Most navigational legs are defined in terms of great circle tracks between the airplane's computed present position and a waypoint. There are, however, some flight plan procedures which require constant-heading legs to be flown. Such procedures are most often found in terminal-area operations. When such legs exist in a flight plan, the constant heading to be flown is distinguished by the suffix HDG appended to the displayed heading (i.e., 203° HDG).

Waypoint Transitions, Leg Switching, and Path Capture Criteria

In defining the guidance maneuver requirements for leg-to-leg transitions at waypoints, the lateral guidance recognizes two basic types of transitions:

- Fly-over (FO) transitions, which require the airplane to pass directly over the waypoint's geographic position (Ref Figure 1-8).
- Non-fly-over (NFO) transitions, in which the airplane is not required to pass over the waypoint position (Ref Figure 1-9).

Maneuvering requirements are also dictated by the magnitude of the course change involved in the transition. The geometry of the transition turn is illustrated in the following figures showing the maneuvers required for both fly-over and non-fly-over transitions.

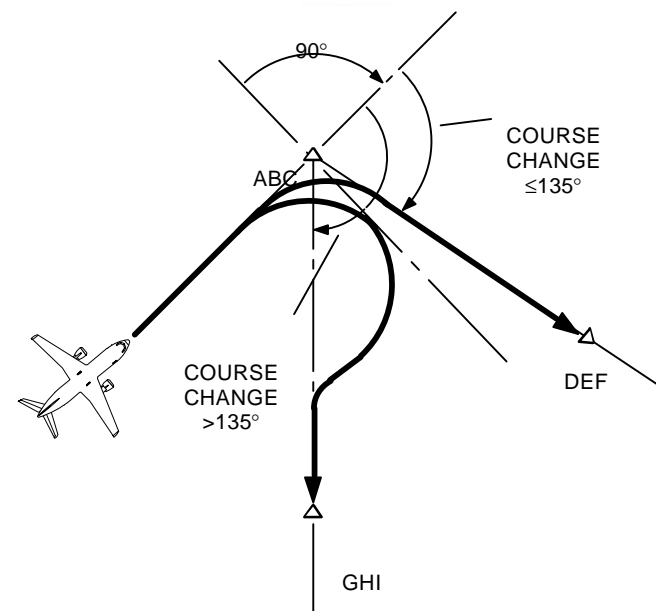


Waypoint Transition Turn Geometry Fly-Over (FO)
Figure 1-8

Fly-over transitions occur only in terminal area procedures (SIDS/STARS), not during the enroute phase of flight. Note that the turning maneuver required for a transition involving a course change of 135 degrees or less differs considerably from that required for a course change greater than 135 degrees.

Transition switching point criteria are determined by the FMCS for NFO transitions to provide a roll lead-in point on the inbound leg to the waypoint. This produces a smooth, coordinated turn that intercepts the outbound leg without overshoot. In those cases that involve large course changes (greater than 135 degrees), the subsequent path capture maneuver required to complete this path or any of the FO transition paths is subject to a 45-degree path-intercept limitation.

During normal en-route turns with LNAV engaged, the FMC computes the bank angle as half of the course change onto the new track, limited to a minimum of 8 degrees and a maximum of 23 degrees. Bank angle limiting does not apply to en-route fixed radius turns, AF/RF legs, and procedure turns.



Waypoint Transition Turn Geometry Non-Fly-Over (NFO)
Figure 1-9

During NFO turns of less than 135 degrees in areas with airspace limitations, the bank angle limitation may result in violating the airspace limitation. When the FMC determines this will occur, the LNAV BANK ANGLE LIMITED message is displayed in the scratchpad.

PROCEDURE TURNS

A procedure turn path is constructed based on the geometry limitations provided in the navigation database, predicted winds, and an airplane speed of 170 kts. The FMC performs predictions for the procedure turn 5 minutes prior to the transition onto the turn entry waypoint. In cases where the turn maneuver cannot be accomplished at the prescribed leg length (exceeding maximum excursion distance), the FMC predicts a path using the minimum leg length. If the minimum leg length construction still exceeds the maximum excursion distance (this may happen during periods of high winds), the minimum turn path is flown and the UNABLE PROC AIRSPACE message is displayed in the scratchpad.



VERTICAL PROFILE DISENGAGEMENT

If a PATH Descent is being flown, VNAV will not be available in the following circumstances:

- When the Glide Slope Intercept waypoint is reached, ILS Glide Slope is armed, and the intercept waypoint is not a hold entry fix.
- When the active leg has a vertical slope, the Cross-Track Error is twice RNP, and LNAV is not engaged.

If an air mass Descent is being flown, VNAV guidance will continue until the End-of-Descent altitude.

HOLDING

As an airline option, the FMC navigation database may contain definition data for all of the published enroute holds in the geographic area covered by the database. Published hold procedures may be selected and incorporated directly into the active flight plan for automatic hold entry when the airplane reaches the designated hold fix waypoint. In addition, the system includes provisions that allow the crew to construct impromptu holds at any selected waypoint in the flight plan, or at the airplane's present geographic position (PPOS).

The parameters that determine the FMC's definition of a hold pattern are illustrated in Figure 1-10. The fundamental variables are:

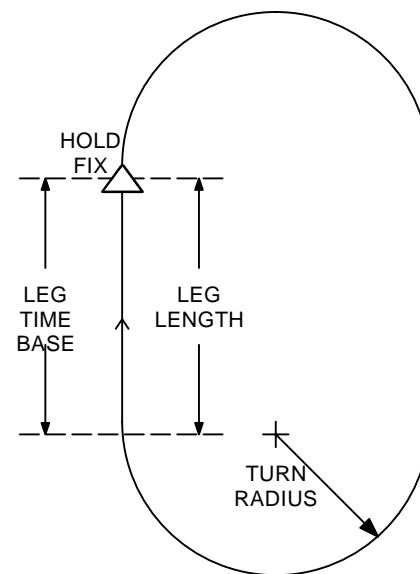
- Hold fix waypoint (entry/exit waypoint)
- Inbound hold course
- Hold turn direction
- Hold leg length or time

The hold fix position may be any fixed waypoint or the airplane's present position at the time of engagement of the hold. The inbound course, turn direction, and leg length or time may be obtained from the navigation database if there is a published hold for the designated hold fix waypoint. If not found in the database, the FMC will assume a right-hand turn and will establish a default value for leg time determined by the altitude.

Normally the leg time is expressed in terms of the time in minutes required to fly the inbound leg. The altitude of the airplane determines the leg time that will be set. The leg time threshold is 14,000 feet (1 minute below/1.5 minutes above). Climbing or descending through this altitude will automatically result in an updated



leg time until the hold waypoint is the go-to waypoint. The leg time will not be automatically updated when manually entered on the HOLD page.



Hold Pattern Definition
Figure 1-10

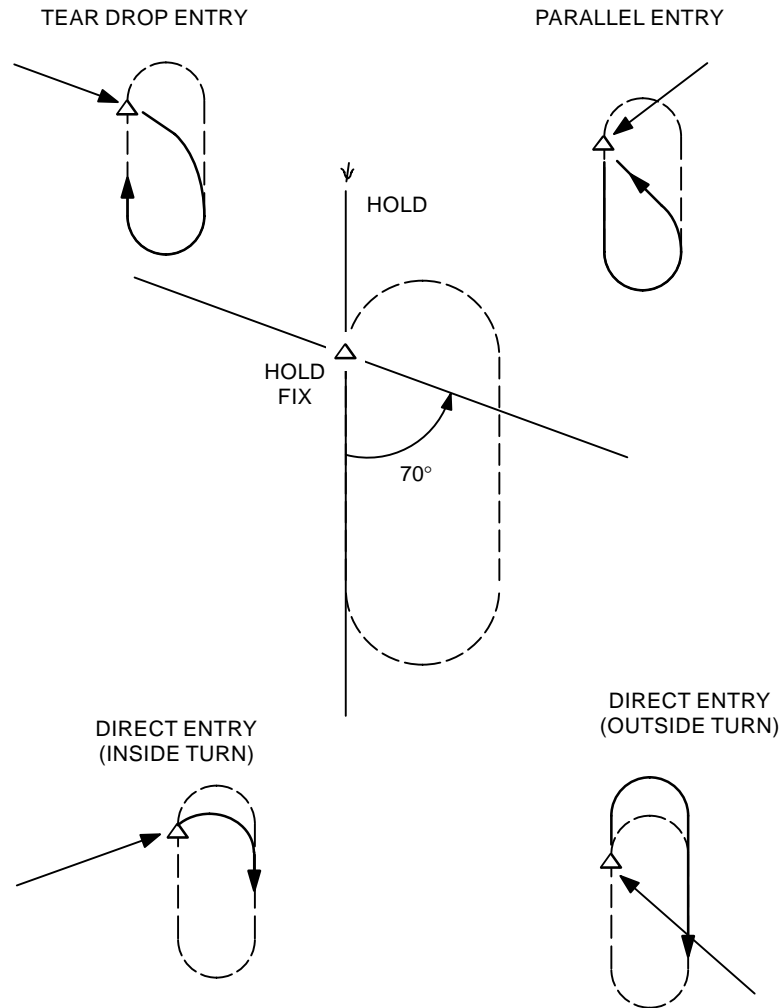
Alternatively, leg length may be expressed as a distance in nautical miles; this form is defined as the distance between the point at which the airplane rolls out on the inbound leg and the holding fix, as shown in Figure 1-10. These variables can also be entered manually to alter the preplanned default pattern. The leg length will not be automatically threshold updated when manually entered on the HOLD page.

Constant radius turns and a best holding or pilot-entered speed schedule determined by the FMC are used in flying the holding pattern. The offset distance (turn radius) on the holding side of the pattern is determined by the maximum speed in the turns at each end of the pattern, taking wind into account, and by the maximum bank angle used to construct the path. Additionally, the offset distance is further limited to internally stored ATC holding pattern limitations.

Entry into the holding pattern is automatically controlled by the FMC, and the entry procedure is dependent upon the airplane's initial inbound course to the holding fix. The FMCS's prepro-



grammed guidance routines for the entry are based upon the FAA's 70-degree sector decision criteria, as shown in Figure 1-11.



Fly-Over (FO) Hold Entry
Figure 1-11

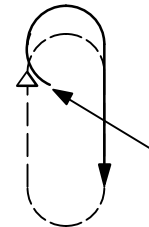
Three minutes prior to entering a hold with LNAV engaged, and while flying the hold, the FMC computes the bank angle of the hold turns and compares it to the bank angle limits of a minimum of 8 degrees and a maximum of 23 degrees. If the min/max limits are exceeded, the UNABLE HOLD AIRSPACE message is displayed in



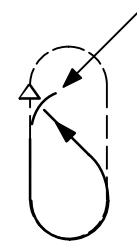
the scratchpad. Bank angle limiting does not apply to procedure holds.

The entry and exit hold points for parallel and direct hold entries are computed as Fly-By (FB) waypoint when ever possible to help maintain airspace limits on the holding side of the hold. The crew flies the airplane by the hold fix on the holding side and establishes the hold.

DIRECT ENTRY
(OUTSIDE TURN)



PARALLEL ENTRY



Fly-By (FB) Hold Entry
Figure 1-12

Each pass over the hold fix waypoint thereafter treats the hold fix as a Fly-Over waypoint. Upon exiting the hold, the hold exit waypoint will be a Fly-By waypoint, unless a Fly-Over waypoint is required by a procedure. The FMCS will always generate a path that keeps the airplane on the hold side of the hold exit waypoint.

Exiting the hold may be accomplished by one of several methods. The normal method is to select the EXIT HOLD prompt on the active RTE HOLD page and pressing EXECute. Another method is to select a down track waypoint and perform a Direct-To function. In either case, the airplane will fly the remainder of the hold pattern to the hold fix waypoint, then continue flying the active route.

The active hold may be MODified while flying the hold. Leg time, leg direction, leg length, and turn direction may be edited at any time. The new hold is displayed along with the current hold, and the EXIT HOLD prompt remains displayed.



If no action is taken, the current hold is exited and the new hold becomes active when the hold fix waypoint becomes the active waypoint.

If the EXIT HOLD prompt is selected prior to entering the new hold, the new hold is deleted, the original hold is displayed and will be flown. Pressing the EXIT HOLD select function again will arm the hold exit, terminate the original hold, then proceed to flying the active flight plan course.

DIRECT TO FUNCTION

The active flight plan may be modified at any time by entering a direct-to waypoint to divert the airplane to a different waypoint. When the direct-to waypoint is not in the active flight plan however, a discontinuity is inserted into the flight plan. It is then necessary to redefine the remainder of the flight to the selected destination, removing the discontinuity. When the direct-to waypoint is one of the future waypoints in the active route, the FMC reassigns this waypoint as the new go to waypoint and eliminates all of the waypoints between PPOS and the go to waypoint.

DESCENT

The FMC automatically attempts to build a path descent to the last waypoint or altitude constraint in the active flight plan. The actual path the FMC constructs will depend upon the available waypoints, speed restrictions, altitude constraints, and default settings entered. The flight crew has the option of selecting a speed descent if desired. This must be manually selected on the DES page.

Descent Modes

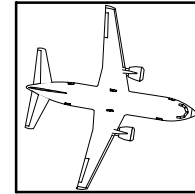
There are two basic descent modes available to the flight crew; Path and Speed, with options to create variations. The ECON modes can be pre-planned anytime before the start of the descent.

- ECON PATH or SPD DES – standard path or speed descent
- nnnKT PATH or SPD DES – manually entered path or speed descent
- RTA PATH or SPD DES – required time of arrival path or speed descent



Path Descent Construction

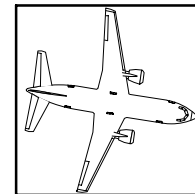
The FMC attempts to build an idle thrust path from the last point in the flight plan that is assigned an altitude constraint to the current cruise altitude.



NOTE

The last point in the flight plan could be the IAF, the MAP, E/D, the runway threshold crossing height, the last waypoint in the flight plan before a discontinuity, or the last waypoint in the descent entered in the flight plan.

If the idle thrust path causes conflicts with altitude constraints between two consecutive waypoints in the descent, the FMC will construct a gradient path between the two waypoints.



NOTE

When the FMC determines that the gradient path built is too shallow to be properly flown at idle thrust, the FMC will control the throttle to guide the airplane through that segment.

Any time a flight plan leg in the descent is assigned a vertical angle in the NDB, the FMC will construct the full descent vertical path using that angle.

Speed Descent Construction

During a speed descent, the FMC computes target speeds for the autothrottle to control to, and the autopilot uses pitch changes to control the airplane. The autothrottle may receive an N1 limit target, be set to idle, or be armed to allow the pilot to manually adjust the thrust. The FMC generates a reference vertical path and the primary navigation indicator is the VNAV DEV markers displayed on the PFDs.



Anytime a leg in the descent path with an NDB assigned vertical angle is encountered during the speed descent, the FMC will capture the leg, change the descent mode to PATH, and continue with path guidance.

FMC Vertical Deviation Indication

While in descent with vertical deviation markers displayed, a disagreement in FMC altitude, Airspeed, or MACH speed that can not be resolved between the FMCs results in the FMC DISAGREE – VERTICAL message being displayed to make the pilots aware of this condition. This message will also be displayed during commanded decelerations when the cause is an altitude error.

If the message is displayed upon entering a commanded deceleration segment, and the cause was Airspeed or MACH speed, the message is blanked during the deceleration. If the disagreement between the FMCs is not resolved upon leaving the deceleration segment, the message is again displayed.

This message is not displayed when the FMC DISAGREE message is active.

Approach Only Geometric Descent

When an airline operator employs this option, only approach and approach transitions will be constructed using the geometric computed gradient legs method. The remainder of the descent path will be constructed using the standard idle path method.

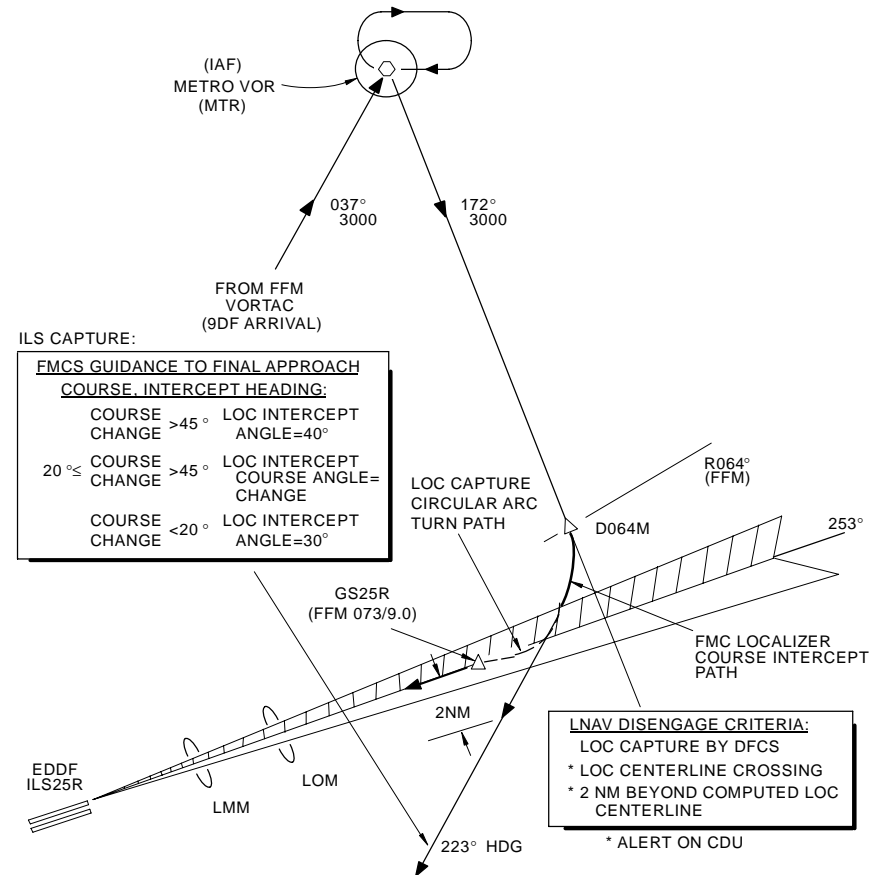
APPROACH INTERCEPT CRITERIA

The FMC flight plans most commonly terminate with transitions to an ILS approach procedure. Assuring the capture of the ILS localizer assumes a high degree of importance in the definition of the last few waypoints in the flight plan.

The first waypoint of the approach transition may be the last waypoint in a Standard Terminal Arrival Route, and is frequently designated as the Initial Approach Fix (IAF). The bulk of the final approach tasks are handled by the autopilot and autothrottle, guided by the ILS localizer and glideslope signals. The FMC positions the airplane to allow the best capture the ILS.



In Figure 1-13, the airplane departs the IAF on a course for way-point D064M. The FMC turns to a 223-degree heading leg from D064M to intercept the localizer course as defined in the navigation database. The FMCS maintains the 223-degree heading leg as shown, instead of turning to final approach course. This provides a 30-degree course cut for AFDS localizer capture. Assuming that localizer capture is accomplished, the autopilot disconnects LNAV and the airplane turns inbound to the runway heading under the sole control of the ILS-coupled autopilot (illustrated with a dashed



Typical FMCS Approach Transition
 ILS or Localizer Procedure
 Figure 1-13





path). A fixed waypoint GS-25R is generated by the FMC (GS-xxx, where xxx is the selected runway) at the predicted glide slope intercept point, where the center of the glide slope beam passes through glide slope intercept altitude. This point is assigned a default speed restriction of 150 kts and VNAV discontinues guidance at this waypoint or when flaps extend beyond 15 degrees, whichever occurs first.

If the localizer is not captured, LNAV guidance continues to steer the airplane on the 223-degree intercept leg until missed capture is detected. Missed capture is detected by the occurrence of either of the following conditions before LOC ENGAGE is signalled by the autopilot:

- FMCS detects crossing of the localizer centerline.
- FMCS computes cross-track deviation of 2 nautical miles beyond the expected location of final approach course.

When missed capture is detected, the FMC sets VNAV invalid, sets LNAV invalid, displays the message MISSED CAPTURE in the FMCS display scratchpad, and blanks all predictions on any remaining waypoints in the planned route. The missed approach must now be initiated.

If a runway or approach has not been selected for the destination airport, a PATH descent is available to the last waypoint in the descent path. Automatic entry into descent is enabled by dialing down the MCP altitude before T/D is reached. An early descent can be started by dialing down the MCP altitude, selecting the DES NOW prompt on the descent page, and executing.

To manually select the SPEED descent mode, select the SPEED prompt on the DES page and EXEC, which will display the ECON SPD DES page. SPEED descents follow the displayed MACH/CAS schedules and the airport speed restrictions, as well as any speed and/or altitude constraints assigned to the waypoints. SPEED descents end at an altitude 1000 feet above the ARPT elevation or the last waypoint altitude constraint if lower.

If D064M and the heading leg to intercept were not part of the approach, but instead the 172-degree course was continued to intercept the localizer course at an 81-degree angle, the FMCS would establish a 40-degree intercept angle starting at an FMC computed point for the turn to final approach to facilitate AFDS capture of the localizer.

When an instrument approach is not selected, and a runway at the destination airport is in the active flight plan, the FMCS will permit



a runway extension waypoint to be defined at a selected distance (1 to 25 miles with 0.1 nm resolution) before the runway threshold, along the runway centerline heading. This final approach waypoint is identified on displays as RX-yyy, where yyy is the runway identifier (an extension for runway 34R is RX-34R). The crew is then allowed to enter an FPA between 2.00 degrees and 5.50 degrees. If an FPA is not entered, the FMC will compute the predicted path using the default FPA value of 3.00 degrees. A variety of non-precision approach procedures may be available to the crew at some airports.

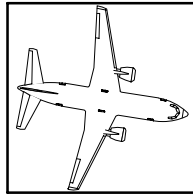
INTEGRATED APPROACH NAVIGATION

The Integrated Approach Navigation (IAN) function is an option that allows flying the airplane using ILS look-a-like approach procedures for non-precision approaches when the Common VNAV option is enabled. This includes the use of common crew procedures, autopilot/FD approach modes, MCP interactions, and monitoring the FMC computed vertical and lateral deviations displayed on the PFD. For compatibility with precision approaches, the PFD deviation scales and pointers are the same as for precision approaches.

The FMC IAN approach capability augments the current ILS approach capability. In normal operation, the pilot selects the desired approach on the ARRIVALS page, tunes the appropriate NAV radio frequency on the VHF NAV Radio Control Panel, and enables the capture of the final approach by selecting the MCP APP button. This sequence allows a single set of crew procedures to be used for all approaches.

If the NAV radio is not tuned to the correct frequency, the crew is alerted via CDU messages. In this case, the approach modes may not match the crew's intention. If an ILS frequency is tuned for an approach that does not reference a localizer, then the FCC will revert to ILS approach modes.

FMC IAN approaches should not be used if altitude constraint adjustments are to be applied to any altitudes specified by the approach procedure for FAC or any of the waypoints between FAF and the runway.

**NOTE**

All of the equipment involved are required to be updated to IAN capability, and be enabled, to use this function.

The IAN function is enabled when all of the following conditions are met:

- The approach type (see below) is stored in one of the FMC navigation databases, and selected on the ARRIVALS page.
- The NAV radio tuning and G/S selections are one of the following:
 - The NAV radio is not tuned to an ILS.
 - or
 - The NAV radio is tuned to an ILS frequency and G/S is selected OFF.
- QNH is selected on the APPROACH REF page when the QFE Reference option is available.
- The final approach leg into the missed approach waypoint has a non-zero FPA.
- The airplane is within 50 nm of T/D, or within 150 nm of the missed approach waypoint, or is in descent.

The types of approaches allowed will depend upon the G/S selection on the APPROACH REF page and NAV radio tuning. With the NAV radio tuned to the appropriate Navaid (not ILS frequency), the FMC supports RNAV, GPS, VOR, and NDB types of non-localizer procedures. With a localizer-based approach selected on the ARRIVALS page and an ILS frequency tuned, ILS, IGS, LOC, BCS, LDA, and SDF types of localizer approach procedures are available.

For BCS, IGS, ILS, LOC, LDA, and SDF, the front course is the localizer front course. All other approaches use the inbound course to the missed approach point. The front course is referenced to magnetic or true north depending on the destination airport reference point and the position of the MAG/TRUE switch.



For non-localizer approaches, the FMC generates lateral and vertical deviations that are displayed on the PFD and sent to the AFDS. When localizer type approaches are selected, the FMC generates the vertical deviations only. Lateral deviations are provided by the localizer. In both cases, the vertical deviations are also sent to the GPWS for terrain awareness.

The FMA displays A/T control mode, the roll control mode, and the pitch control mode. When an IAN approach is selected, the roll and pitch annunciators display the FMC modes as follows:

- A non-localizer FMC IAN type approach annunciates FAC and G/P.
- A localizer type approach (G/S selected OFF) annunciates LOC and G/P for front course.
- A localizer back course approach (G/S selected OFF) annunciates B/CRS and G/P.

The PFD displays FAC and G/P when these modes are engaged, and the approach data block (located above and to the left of the artificial horizon display) indicates:

- First Line – displays:
 - Approach identifier.

or

 - ILS identifier/MCP selected course.
- Second Line – displays:
 - FMC IAN missed approach waypoint and distance from PPOS.

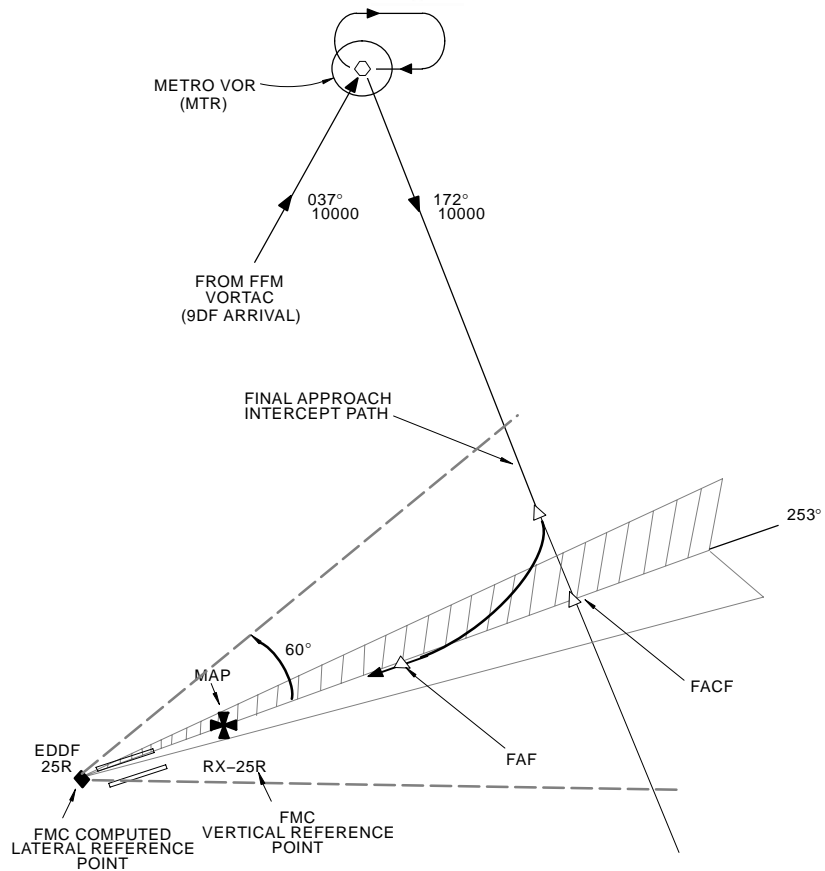
or

 - DME and distance.
- Third Line – displays:
 - FMC – when the FMC is the source of the lateral and vertical deviations.

or

 - LOC/ G/P – when an ILS front course or localizer back course is selected and the FMC is only providing vertical deviations.

The example in Figure 1-14 shows that the FMC flies a descent path along the 172 degree radial to the final approach course fix. The FMC then computes pseudo vertical and lateral reference points to steer to during the final approach.



Typical Non-Precision Procedure
Figure 1-14

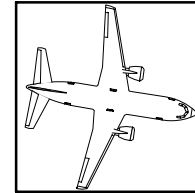
The vertical reference point in this example is a runway extension (from the NDB procedure) selected into the flight plan, that is assigned an AT altitude constraint (this is also the missed approach point). The vertical angle is the shallowest computed angle at the MAP altitude constraint that does not violate the NDB FPA, and provides a vertical path that is at or above all altitude constraints from the FAF to the MAP.

The lateral reference point is then determined as a point 9000 feet beyond the vertical reference point along the runway centerline. The area 60 degrees either side of the runway centerline, referenced to the FMC computed lateral reference point, becomes the valid lateral region.



When the airplane is within 25 nm of the missed approach point, the FMC begins computing lateral and vertical deviation to be sent to the A/P, GPWS, and the PFD.

The airplane is then steered onto the final approach intercept path to the inbound course, steering to the lateral and vertical reference points toward the runway. If during the approach, the lateral ANP exceeds RNP for more than 10 seconds, the UNABLE REQD NAV PERF-RNP message is issued, the IAN deviation pointers on the PFD are blanked, and the IAN approach is invalidated.



NOTE

When the IAN deviation pointers are blanked or full scale deviation is indicated, GA should be initiated unless suitable visual reference points are available to complete the landing.

With the A/P engaged in FAC and G/P (FMC IAN approach), the A/P status indication displayed on the PFD is SINGLE CH. Once the airplane is committed to landing and is below 100 feet radio altitude, the status indication changes to flashing amber AUTOPILOT.

During the approach, the FMC sends the following information to the CDS:

- Lateral and vertical deviations
- Approach identifier
- Missed approach waypoint identifier
- Map display latitude and longitude
- Map display altitude constraint (if a window constraint, the lower altitude is displayed)
- Inbound course to the missed approach waypoint
- Descent flight plan angle to the missed approach waypoint altitude constraint
- Runway identifier



- Runway latitude and longitude
- Runway elevation
- Runway length
- Runway azimuth (in respect to true north)
- Decision gate 1 elevation
- Decision gate 2 elevation

MISSED APPROACH

The guidance function includes the provision to execute missed approach procedures for approaches which include them in the navigation database and are entered into the flight plan. Lateral and vertical guidance is provided throughout execution of the procedure. The FMC initiates missed approach procedure guidance automatically under the following conditions:

- While in descent and any of the following occurs:
 - Activation of the TOGA switch.
 - Go-Around thrust limit selected while in N1 autothrottle mode and below the MCP altitude.
 - Below MCP Altitude, a climb rate greater than 600 fpm, go-around thrust limit selected, and flaps retracting from 30–15 or 15–1.
- When direct-to a waypoint in the missed approach procedure (other than the missed approach point itself) is selected.
- Sequencing a missed approach waypoint and the flight plan contains additional waypoints in the missed approach path.

Once GA is initiated, all descent altitude constraints are replaced by predicted altitudes, and the original destination airport is set as the new origin airport. This allows the crew to select a SID while executing the missed approach to exit the terminal area. If a SID is selected, the current go-to waypoint in the missed approach is retained, a discontinuity is inserted, and the SID follows.

Missed approach can also be manually constructed by adding waypoints after the runway. Activation and operation are identical to the missed approach criteria defined above.

FMCS STEERING

In normal fully automatic mode of operation, the FMC provides both lateral (roll) and longitudinal commands to the autopilot, from its



initial engagement at the start of the climb profile to the point in the final approach at which ILS localizer and glideslope interception normally occurs. The system also provides corresponding thrust limits to the autothrottle system, thus ensuring that the airplane follows the computed flight profile throughout the trip with minimal crew attention. Engaging LNAV, allows the FMC to control the airplane to the desired lateral track for the route. Engaging VNAV allows the FMC to control the airplane to the desired vertical profile. Alternatively, the profile may be flown without autopilot/flight director or autothrottle by using the FMCS display and the lateral and vertical deviation displays provided by the FMC on the primary flight displays as references. The cursors in the Mach/Airspeed indicators are driven to the FMC target speed only when the VNAV mode is engaged.

BASIC AUTOPILOT AUTOTHROTTLE INTERFACE WITH FMCS

The guidance outputs furnished by the FMC can be used to fly the airplane manually via instruments and information provided on the FMCS displays, or the FMC can be coupled directly to the autopilot and autothrottle systems to provide fully automatic control and steering of the airplane.

AUTOTHROTTLE ARMING

The A/T ARM switch is located on the MCP. If the autothrottle is armed, the autothrottle switch will remain in the armed position when VNAV engages. The autothrottle will be directed to control to-target airspeed, limit N_1 , retard to idle, or arm as determined by the AFDS.



LNAV/VNAV ENGAGEMENT

LNAV and VNAV can be manually engaged or armed for automatic engagement at the appropriate height.

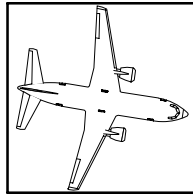
Manual Engagement

LNAV can be manually engaged after the airplane flies through 50 feet AGL to begin FMCS controlled lateral guidance. VNAV can be manually engaged after the airplane flies through 400 feet AGL to begin FMCS controlled vertical guidance.

Automatic Engagement

Automatic engagement of LNAV and VNAV can be used with derated or reduced thrust takeoffs, Quiet Climb operation, and will function in the event of an engine out condition during takeoff.

LNAV and VNAV can be armed prior to takeoff, and they will automatically engage at the appropriate heights.



NOTE

LNAV and VNAV armed prior to takeoff requires CDS and AFDS updates.

This requires the following setup to accomplish arming:

- The heading of the first leg in the flight plan must be within 5 degrees of the runway heading to arm LNAV prior to takeoff.
- The PERF INIT page must be completed to arm VNAV prior to takeoff.
- The engines must be running and providing status to the FMS.
- The MCP SPD must be set to V_2 .

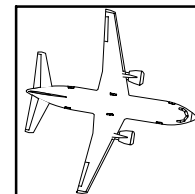
Once the above requirements are met, the LNAV and VNAV switches on the MCP can be pressed to arm them. The crew can arm LNAV, or VNAV, or both. The armed status is annunciated on the PFD with white LNAV and/or VNAV.

At takeoff and prior to the acceleration height (displayed on TAKE-OFF REF page 2), the FMC will set the speed target to $V_2 + 20$ kts until the acceleration height.



At 50 feet AGL, LNAV will engage (LNAV switch on MCP will light) and the FMC will begin guidance to the active path.

At 400 feet AGL, VNAV will engage (VNAV switch on MCP will light) and the FMC will begin guidance to the vertical profile.



NOTE

LNAV and VNAV will disconnect anytime the Source Control Switch position is changed.

ALTITUDE SELECTION

The altitude set into MCP provides altitude alerting for all autopilot operations. The MCP altitude (MCP ALT) also serves as a limiter for FMC-coupled operations. The displayed altitude will be captured by the flight director system. During VNAV operation, the FMC will not fly through or away from the selected MCP ALT.

ALTITUDE INTERVENTION

The Altitude Intervention option provides two different modes of operation of the Altitude Intervention function. This option affects the annunciation displayed on the AI display when the airplane has leveled off at the MCP altitude (i.e., ALT HOLD and VNAV engaged). VNAV ALT is displayed with the option enabled and ALT HOLD is displayed with the option disabled. The option also affects the actions required to initiate or resume a climb or descent from a hold at the MCP altitude. With the VNAV ALT option enabled, the action required is to set the MCP Altitude to a new altitude, and then press the Altitude Intervention pushbutton. With the VNAV ALT option disabled, the required action is to set the MCP Altitude to a new altitude, and then re-engage VNAV (selecting the new MCP altitude causes VNAV to disengage).

Altitude intervention provides the pilot with the ability to perform the following operations using the Altitude Select knob and the Altitude Intervention pushbutton on the MCP. Note that altitude intervention will not delete the altitude constraints for approach waypoints.



- Delete the next altitude constraint while in climb or descent.

To delete the next altitude constraint, the MCP altitude is set above/below (for climb/descent respectively) the next altitude constraint and the Altitude Intervention pushbutton is pressed. This operation can be performed with or without VNAV engaged. An altitude constraint on a waypoint which represents a leg terminated at an altitude, cannot be deleted using Altitude Intervention.

- Increase the cruise altitude while in climb or cruise phase.

This is done by setting the MCP altitude above the cruise altitude and pressing the Altitude Intervention pushbutton. To do this in climb, there must not be an altitude constraint remaining in the climb phase. Attempting to raise the cruise altitude above the maximum allowable cruise altitude using Altitude Intervention will not change the cruise altitude and will result in the message MAX ALT FLXXX displayed in the FMCS display scratchpad. This operation can be performed with or without VNAV engaged. Cruise altitude cannot be lowered using Altitude Intervention.

- Resume a climb/descent after holding an MCP altitude while in climb or descent (requires VNAV ALT option).

To resume a climb or descent from the altitude hold at the MCP altitude, the MCP altitude is set above or below (respectively) the hold altitude and the Altitude Intervention pushbutton is pressed. This operation can only be performed with VNAV engaged.

- Initiate a CRZ CLB or CRZ DES

To initiate a step climb, the MCP altitude must be above the current cruise altitude (but below the maximum allowable cruise altitude) and then press the altitude intervention button. As described for increasing the cruise altitude while in climb or cruise phase, the cruise altitude is set to the MCP altitude.

To initiate a transition to descent phase, the MCP altitude is set below the cruise altitude and the Altitude Intervention pushbutton is pressed.

For the airplane to automatically climb or descend in response to resume climb or descent, or initiate step climb or transition to de-

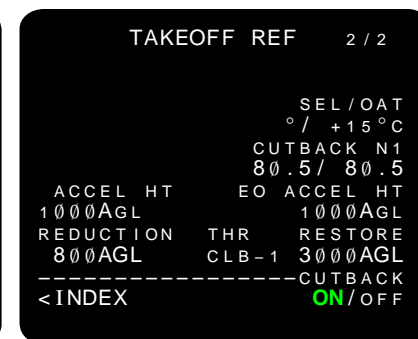
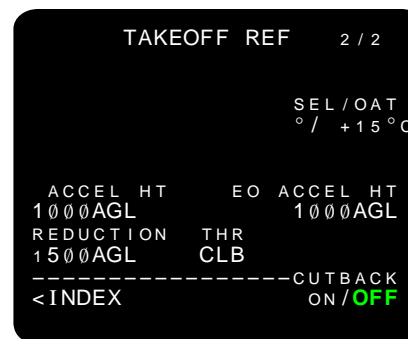


scent, the autopilot must be engaged (CMD) and VNAV must be selected. With F/D only (and VNAV selected), the F/D bars will command climb or descent as appropriate.

QUIET CLIMB SYSTEM

The FMCS Quiet Climb System (QCS) option supports operations at airports with noise abatement requirements in effect. With the QCS enabled, the FMC can provide automated operation by reducing and restoring thrust levels at preselected altitudes. The automated system also helps the crew pay more attention to the remaining takeoff workload instead of watching altitudes, thrust modes, and throttle settings.

The QCS is initialized after the initial FMCS setup is complete. On the TAKEOFF REF page 2, the initial REDUCTION height AGL (5L) is displayed. CUTBACK N1 (3R), selected climb rating (5C), and RESTORE height AGL are blank. When all required inputs are available, the CUTBACK toggle (LSK 6R) is displayed in the OFF condition. By selecting CUTBACK ON, the CUTBACK N1 limit is computed to provide a minimum thrust cutback for a climb gradient of 1.2%, and the RESTORE height is displayed. The climb mode selected on the N1 LIMITS page is also displayed in location 5C. The thrust REDUCTION height and RESTORE height may be changed by the flight crew when required.



With VNAV/LNAV armed and AT/AP coupled, the QCS will automatically perform the thrust changes at the set REDUCTION and RESTORE heights. To cancel the QCS operation, the pilot can press the TO/GA switch on the control head and control the thrust manually.



If the FMC has all data inputs and is not able to calculate a cutback N1, the message CUTBACK UNAVAILABLE is displayed in the FMCS display scratchpad.

If the performance option ONE is enabled, the FMC will automatically select the highest climb rating that will satisfy the throttle reduction requirement at the thrust reduction height transition. The selected rating is set here and on the N1 LIMITS page.

If the Optional Noise Gradient option is enabled in conjunction with QCS, a 0% climb gradient is used when computing the CUTBACK N1.

ENGINE OUT OPERATION

When EO mode is active, predicted ETAs, RTAs, and T/C are not displayed on the ND. Waypoint fuel, ETA, all PROGRESS page performance predictions, and all LEGS page performance predictions are blanked. Any RTAs in the flight plan are ignored.

EO mode is disengaged as soon as the airplane slows below 60 kts ground speed either on an aborted takeoff or when landing with EO mode engaged.

EO DURING TAKEOFF

The FMCS uses engine operational status and ground speed to determine when to engage EO mode. While on the ground, the EO mode is prevented whenever the ground speed is below 60 kts to allow the crew to perform single engine taxi and split throttle operations.

If an engine out condition occurs on takeoff and after 60 kts ground speed, the FMCS will determine the EO speed target as follows:

- If the current speed is less than V_2 when the EO event occurs, V_2 will be the EO speed target.
- If the current speed is between V_2 and $V_2 + 20$ when the EO event occurs, the current speed will be the EO speed target.
- If the current speed is above $V_2 + 20$ when the EO event occurs, $V_2 + 20$ will be the EO speed target.

This speed is maintained until the EO acceleration height is reached.

At the EO acceleration height, the FMCS switches to the lower of the flaps extended placard speed or $V_{REF} + 70$ until flaps are fully



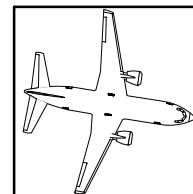
retracted. After flaps are retracted the FMCS will maintain the $V_{REF} + 70$ target for the rest of the climb.

If the flaps are retracted prior to reaching the EO acceleration height, the EO target speed will remain in affect to the EO acceleration height unless the crew sets the MCP speed to the $V_{REF} + 70$ target and initiates a level change.

On the CLB page, select the inoperable engine to allow the FMCS to account for bleed on the active engine.

On the CRZ page, enter new CRZ ALT and CRZ SPD targets compatible with one engine operation for the airplane's current environment and configuration.

When the FMCS CRZ ALT is reached, the airplane levels off at the FMCS CRZ SPD target. The FMCS then resets the operating mode to all engine, restoring predictions using two engine target speeds.



NOTE

When the FMCS restores the all engine mode or the crew selects the ALL ENG prompt on the CLB page with an engine still not running, the FMCS displays the ENTER EO CRZ SPD AND ALT message to remind the crew if they have not done so already.

EO AFTER TAKEOFF

If an engine out condition occurs after takeoff, the crew will have to manually select an engine out on a VNAV page and enter EO target altitude and speed.

OVERVIEW

After a flight plan has been entered into the FMC and a departure runway has been selected, LNAV can be armed on the ground if the MCP heading and the track and course of the first leg in the flight plan are within 5 degrees of the runway heading. VNAV can also be armed at this time.



Once in position on the runway, initiate the takeoff by pressing the TOGA switch. If LNAV was not previously armed, it may be activated any time after weight is off the nose wheel to provide roll commands to the AFDS. LNAV will engage at 50 feet AGL and begin lateral guidance. When the airplane is at 400 feet AGL, VNAV will engage and control the airplane to the pre-planned vertical profile.

Climb control is automatically initiated after liftoff. The airplane will climb at the MCP SPD plus 20 knots until the acceleration height (default is 1000 feet AGL). The FMC speed target then changes to the lower of the extended flaps placard speed or 230 knots. The airplane will nose down slightly providing time for flaps retraction. Once flaps are fully retracted, the speed target is set to the pre-selected climb rate entered into the FMCS.

Raise the altitude in the MCP ALTITUDE window as ATC clearances permits. The AFDS will level off the airplane at the lower of MCP altitude or the FMC displayed altitude restriction. If the selected altitude is above the present altitude and VNAV is engaged, the FMC requests the AFDS to control to the FMC airspeed with the elevators. At the same time, the AFDS requests the autothrottle to switch to N_1 mode, controlling thrust to FMC climb N_1 limit.

As either MCP or FMC altitude is approached, the AFDS transitions to altitude acquire, and then to altitude hold configuration. At the point where the altitude acquisition sequence engages, the AFDS requests the autothrottle to go into a speed mode, controlling to the FMC speed.

Step climbs in cruise, or from an intermediate level off in climb, are performed much as the normal climb. If the airplane is level at MCP ALTITUDE (but not at an FMC restriction altitude), increase the value in the ALTITUDE window; this action disengages VNAV and puts the autopilot in ALT HOLD. Press VNAV and the airplane will begin the climb as described above. If the airplane is level at FMC altitude (assuming MCP ALTITUDE was set above the FMC value), the AFDS continues with VNAV remaining engaged.

There are two types of FMC descents: an airmass or SPEED descent and a PATH descent. Both LNAV AND VNAV must be engaged to fly an automatic PATH descent, while only VNAV is necessary to fly a SPEED descent.

PATH descents are normally initiated and flown automatically by the FMC. An early PATH descent may be initiated, causing the airplane to descend 1,000 feet per minute until it intercepts the planned idle path and then picks up the normal descent.



To enable automatic capture of a descent path, set the MCP ALTITUDE lower than the current cruise altitude. Upon reaching the top-of-descent point, the FMC requests the AFDS to control to FMC vertical speed, requests the autothrottle to retard the throttles to idle, and then enters the ARM mode. In PATH descent, the FMC will control to the earth-fixed referenced path, but it is the crew's responsibility to control speed. Upon reaching the next level segment, the AFDS will transition through an altitude acquisition to an altitude hold configuration and the autothrottle will begin controlling to FMC speed. If the airplane levels at an MCP ALTITUDE not corresponding to a level path segment, decrease the MCP ALTITUDE further (causing VNAV to disengage) and press the VNAV switch on the MCP. As in the climb, leveling off at some FMC-commanded altitude prior to reaching E/D ALT will not disengage VNAV.

Early descents can also be initiated by dialing down the MCP altitude, selecting the DES NOW prompt on the ECON DES page, and executing. The particular descent path can be achieved by the use of other airplane flight control systems at the discretion of the crew. During the descent, the AFDS autopilot follows the FMC speed with the control on the elevators, while the autothrottle retards the throttles to idle and arms. Level-off occurs at MCP ALT, at intermediate FMC altitude constraints, or at the end-of-descent (E/D) altitude for speed descents. Upon lateral sequencing of the glide slope intercept waypoint, the FMC causes VNAV to disengage.

A cruise-descent is performed at the rate of 1000 FPM descent, with the autopilot controlling the vertical speed by means of the elevators and the autothrottle controlling the target speed.

At the end of the flight (weight on wheels and less than 20 knots), the FMC clears the route information and any temporary navigation data from the flight after transitioning to the on the ground state. Upon shutdown, last reported IRS and FMC positions, and any flight fault data are stored for access when the system is again powered up.



SELECTABLE OPTIONS DESCRIPTIONS

The following pages provide a description of the operator selectable options for the FMCS OPS. The heading includes which update the option was introduced in and when changes were made to the option (other than changes to correct the option's functionality). The options are listed alphabetically.

ABEAM WAYPOINTS (U10.0)

ABEAM Waypoints – when performing a Direct-To modification, this option retains existing waypoints from the active flight plan along the Direct-To leg when the ABEAM PTS prompt is selected. All waypoints that are less than 100 nm away are transferred to the new path along with wind data. ABEAM points are named using the first three letters of the parent waypoint and a two digit sequence number. In the unlikely event that more than 99 points are named, the name switches to two letters and a three digit sequence number.

ADDITIONAL FIX PAGES (U10.6)

Additional Fix Pages – expands the FIX INFO pages to a maximum of six pages (standard page count is maximum 2).

ALTERNATE DESTINATION (U10.0)

Alternate Destination provides a list of five of the nearest airports from PPOS from the NDB. Selecting an alternate destination results in the FMC re-computing predictions for the flight from PPOS to the selected alternate destination.

ALTITUDE/SPEED INTERVENTION (U10.0)

- Altitude Intervention allows initiating a step climb or descent while in cruise, or to resume a climb or descent after a hold at FMC or MCP altitude. Altitude intervention will no longer delete altitude constraints on approach waypoints.
- Speed Intervention is initiated by pressing the MCP SPEED INTERVENTION pushbutton to allow overriding the FMC's



commanded speed. This will cause the MCP's speed window to be set to the commanded FMC speed. Changing the MCP speed to the desired speed, and pressing the speed intervention button again causes the FMC to control the plane to the MCP speed.

AOC DATALINK (U10.0)

AOC Datalink provides AOC datalink messages to be sent and received via the ACARS datalink.

ATC MESSAGE ON DISPLAYS (U10.4)

ATC Message on Displays displays "ATC MESSAGE" on the CDS via the NAV Advisory messages.

ATS DATALINKS (U10.4)

ATS Datalink provides ATS ADSF reporting. This option now supports European domestic airspace operations, and includes entering the maximum uplink delay time on the LOGON/STATUS page.

CDU COLOR (U10.2)

CDU Color allows display pages on the FMCS display to be in color. The rules for color displays are outlined elsewhere in this guide.

COMMON VNAV (U10.6)

Common VNAV provides commonality with other Boeing FMS equipped aircraft types. Removes all selectable SPEED prompts, and the PATH and SPEED mode designations on all descent pages. VNAV SPD is then used as the speed on elevator mode for over-speed reversions, and VNAV will remain engaged under these conditions.

DEFAULT DME UPDATE OFF (U10.5A)

Default DME Update Off initializes the DME update to OFF at power up and at flight completion. During the flight, the crew may turn on the DME updating.



DIRECT GPS INPUT (U10.0)

The direct GPS input option allows the FMCs to receive GPS data directly from the MMRs.

ENGINE OUT SIDS (U10.3)

Engine Out SIDS searches for EO SIDS for the active waypoint in the Navigation Database and includes them in the flight plan. All EO SIDS prior to the active waypoint are ignored. All EO SIDS after the active waypoint are loaded, and a lateral discontinuity is not generated.

FIXED OUTPUTS ATS TEST (U10.4)

Fixed Outputs ATS Test adds light and chime annunciation tests to the FIXED OUTPUTS maintenance page.

GEOMETRIC PATH DESCENT (U10.2)

Geometric Path Descent allows flying along a computed gradient path from one altitude restriction to the next during descent. The NDB Gradient may be maintained via edits on the FMCS display, including inserting waypoints and deleting altitude restrictions on the gradient legs. This descent mode is always available after U10.6 OPS Update.

GLS PROCEDURES (U10.4)

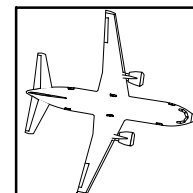
GLS Procedures allows pilot selection of Global Landing System approaches.

GPS OPERATIONAL MODES (U10.0)

The GPS Operational Modes options allow the airlines to select between four modes of GPS operation. The crew may select to



inhibit or enable GPS updating from the NAV OPTIONS page. If GPS updating is inhibited at flight end, the FMC will re-enable it.



NOTE

This option uses two option codes to implement the four operational modes.

- GPS with Integrity – GPS data is used as the primary input for navigation updating for all non-procedure segments of the flight plan.
- GPS without integrity – GPS data is used in the navigational update providing the data is consistent with the Nav aids in use (terminal, approach, enroute), or the IRS position (oceanic).
- GPS Advisory – GPS data is made available to the crew but is not used in navigation updating.
- GPS Disabled – GPS data is not displayed for the crew and is not used in navigation updating.

GROSS WEIGHT INHIBIT (U10.4)

Gross Weight Inhibit prevents the entry or deletion of Gross Weight (GW) in field 1L of the PERF INIT page. The crew must enter or uplink Zero Fuel Weight (ZFW).

HIGH IDLE DESCENT (U10.0)

The High Idle Descent option results in the FMC automatically constructing a descent path based on the engines set to high idle for the entire descent. The T/D is placed farther from the destination airport to compute a more gradual path.

INTEGRATED APPROACH NAVIGATION (U10.4)

Integrated Approach Navigation (IAN) – (formerly Common Instrument Approach Procedures) allows FMS RNAV approaches and



other non-precision approaches to be flown in an ILS-look-alike manner using common flight crew procedures. For this option to be implemented, the autopilot and cockpit display system must also be IAN compatible.

INTENT DATA ON ACARS (U10.6)

Intent Bus on ACARS is intended to support European flight trials. The FMS provides intent data on the ACARS bus, for evaluating the use of 4-D FMS trajectory intent predictions. The RTA function is used in conjunction to provide a time-based ATM environment.

INTENT DATA ON DEDICATED (U10.7)

The Intent Data on Dedicated option has the FMCS output the intent data on the FMC-10 ARINC 429 data bus.

MANUAL POSITION UPDATE (U10.6)

Manual Position Update allows the flight crew to update the FMCs position by manually entering a waypoint position. The FMCs will re-initialize to that entered waypoint and then resume normal position updates.

MANUAL RNP ENTRY (U10.0)

Manual RNP Entry allows the flight crew to manually enter an RNP value on the POS SHIFT page.

MANUAL TAKEOFF SPEEDS (U10.0)

The Manual Takeoff Speeds option requires the crew to manually select or enter the takeoff speeds on the TAKEOFF REF page.

MESSAGE RECALL (U10.0)

Message Recall provides a list of alerting, advisory and ACARS active messages on the FMCS display MESSAGE RECALL page.



Entry error and data loading messages are not maintained in the list, and when a message is no longer active, it is removed from the list. The list is automatically cleared at the end of the flight with the exception of FMCS configuration messages.

MISSED APPROACH ON MAP IN DIFFERENT COLOR (U10.4)

When the crew enters an missed approach path to the flight plan, the missed approach path is displayed on the ND in cyan until the missed approach is actually activated.

OPTIONAL NOISE GRADIENT (U10.3)

Optional Noise Gradient performs with the quiet climb operation using an optional gradient from the MEDB.

PILOT-DEFINED COMPANY ROUTE (CO-RTE) (U10.3)

The Pilot Defined Company Route (CO-RTE) option provides the following capabilities:

- Load the Flight Plan Navigation Database (FPND) from disk using the Flightstar software, and retrieve any routes and waypoints stored in the FPND while onboard the aircraft.
- Save up to 10 routes in a Supplemental database using the FMCS display onboard the aircraft. The saved routes are retained by the FMS until manually deleted. Terminal procedures, airways, and user defined waypoints can be saved. Certain restrictions apply; manually entered HOLDS and Altitude/Speed Restrictions are not retained.
- Allows the Enroute portion of a flight plan displayed on the FMCS display to be reversed. This creates a MOD flight plan with the Origin and Destination points reversed along with any airways and enroute waypoints. Certain restrictions apply; terminal procedures, manually entered HOLDS, and Altitude/Speed Restrictions are not retained.

PLAN FUEL (U10.0)

Plan Fuel Entry allows the flight crew to enter a planned fuel quantity on the PERF INIT page to provide advanced computations of gross weight or zero fuel weight. The planned fuel entry is cleared



and the header is blanked at engine start, while in the air, or after a new gross weight is entered. Once blanked, the computations are based on total fuel.

QFE ALTITUDE REFERENCE (U10.0)

QFE Altitude Reference allows the flight crew to select either QNH or QFE altitude reference for the landing altitude reference on the PFD, using the TAKEOFF REF and APPROACH REF pages.

QUIET CLIMB SYSTEM (U10.3)

The Quiet Climb System supports noise abatement procedures during the climb phase by providing a quiet climb cutback N1 target between a pre-programmed thrust reduction altitude and the restoration altitude. The default gradient for computing thrust reduction and restoration altitude is provided in the Model/Engine Database (MEDB) and may be changed through the Loadable Performance Defaults Database, manually changed at the FMCS display, or uplinked via ACARS.

RUNWAY OFFSET/RUNWAY REMAINING IN FEET (U10.0)

The Runway Offset/Runway Remaining in Feet option changes the entry for the Runway Remaining option to feet instead of hundreds of meters. The runway offset entry is changed to feet instead of meters.

RUNWAY REMAINING (U10.0)

The Runway Remaining option allows the crew to enter the runway length remaining on the TAKEOFF REF page. The normal entry is in hundreds of meters (1000 to 9900).

When the TOGA Update function is used in combination with this option, the FMC position is updated each time the TOGA button is pressed (ground speed must be less than 60 kts).

If the Runway Offset/Runway Remaining In Feet option is used in conjunction with this option, the runway length is entered in feet (3300 to 33000).

SPEED PROPAGATION (U10.6)

Speed Propagation allows a manually entered CAS or MACH TGT SPD entered on a CRZ page to be propagated onto the DES page



TGT SPD to prevent sudden speed changes at top-of-descent, and also allows ATC assign speeds to be rapidly entered while still in CRZ.

TAKEOFF DERATE INHIBIT (U10.4)

Takeoff Derate Inhibit prevents Takeoff Derate selections on the N1 LIMIT page. These areas are blanked and disabled.

TO THRUST AUTO-SELECT (U10.7)

Takeoff Thrust Auto-Select option allows the FMC to automatically select a default takeoff thrust rating for the selected origin/runway pair in the flight plan when the flight plan is EXECuted.

- The airport/runway combination must be stored in the loadable defaults database. Airline-designated pairs (250 maximum) may be pre-defined and loaded into the FMC by obtaining a custom LDDB.
- A new set of display pages titled TO THRUST SETTINGS are added. These pages will display the airport ID, the runway, and the assigned thrust rating for that combination (called a record). Access is made using the NEXT PAGE key on the FMCS display keypad while the N1 LIMITS page is displayed. After an auto-selection is made, the selected record is highlighted.
- If a flight plan MOD is performed (manually or by uplink) that changes the runway, the takeoff thrust auto-select function is repeated when the flight plan mod is EXECuted. The takeoff thrust is updated to the new runway.
- The flight crew can over write this selection.
- A new alerting message (VERIFY TAKEOFF THRUST) is displayed in case of a conflict between the auto-selected takeoff thrust rating and the airplane/engine configuration model in the MEDB.

VNAV ALT ENABLE (U10.0)

VNAV Altitude Enable holds VNAV engaged when the MCP altitude is raised during climb, or lowered during descent.



ALTERNATE NAVIGATION FUNCTION

The alternate navigation function is available in the MCDUs when they are loaded with the LCD operational program Update 2 or Update 3. This function also requires GPS input for operation. Update 2 is currently only installed on the Boeing Business Jets.

ALTERNATE NAVIGATION SUB-SYSTEM INPUTS

The MCDU provides a solution in the lateral plan and a backup navigation source that will continue to send guidance data to the ESAI should the FMC fail.

The MCDU's source of velocity and position data is from the on-side GPS receiver. Without this input, the alternate navigation pages are not available. The receiver provides the following data:

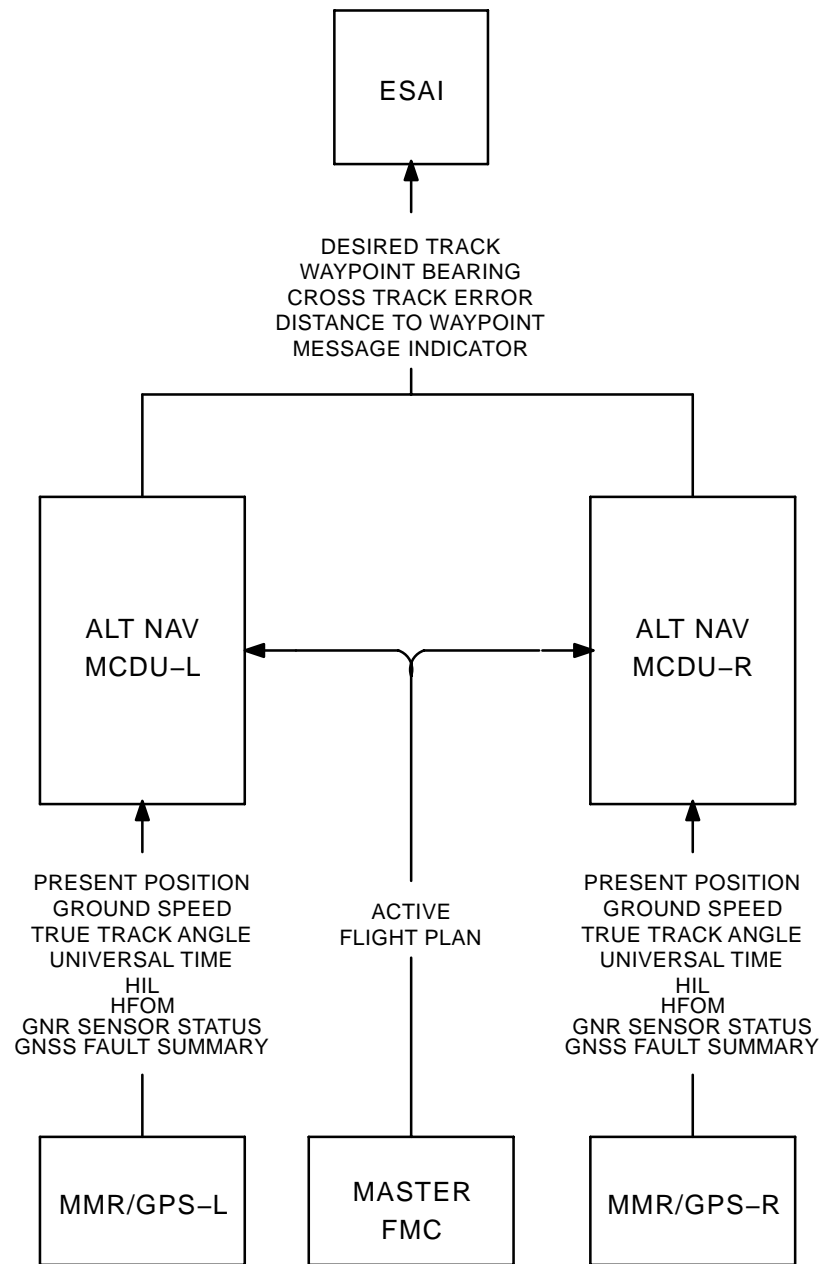
- Present position (LAT/LON)
- Ground speed
- Track angle (true)
- Universal Time
- Horizontal Integrity Limit (HIL)
- Horizontal Figure of Merit (HFOM)
- GNR Sensor status
- GNSS Fault Summary data

Figure 1-15 illustrates the functional layout of the alternate navigation system.

ALTERNATE NAVIGATION OPERATION

The alternate navigation function operates in the background providing there is a GPS input (from the on-side GPS).

- With the FMC(s) operational, the MCDU operates as a regular MCDU with the FMC(s) providing the navigation solution and guidance.
- With the FMC(s) operational and the alternate navigation function enabled, the MCDU maintains an alternate independent navigation solution which may be viewed at any time (displayed on the alternate navigation pages), to cross-check other sub-systems. The FMC(s) still provide the navigation solution and guidance.



Alternate Navigation Functional Arrangement
Figure 1-15



- If the primary FMC fails, and the alternate navigation function is enabled, the MCDU can continue to provide guidance information to the ESAI and HSI's providing the route is cross-loaded to the MCDU prior to the FMC failing.
- The alternate navigation function is not available if the MCDU determines that the on-side GPS data is not valid, or the receiver is not communicating data.

ALTERNATE NAVIGATION KEYBOARD OPERATION

The MCDU responses to particular keystrokes differently when the alternate navigation pages are displayed. Only the differences are covered here.

The following keys may be used as usual while the MCDU is displaying the alternate navigation pages:

- EXECute
- PREV PAGE and NEXT PAGE keys
- Line select keys
- Alphanumeric keys (including CLR, SP, /, •, and +/-)

The function and mode keys operate as follows:

- The MENU key will always display the MENU page while displaying FMS pages or alternate navigation pages.
- While displaying FMS pages – function and mode keys operate as a normal MCDU.
- While displaying the alternate navigation pages and the FMC(s) are operational – pressing any of the function or mode keys will exit the alternate navigation page and display the selected FMS page.
- While displaying the alternate navigation pages and the FMC(s) are not operational – the function and mode keys are non-operational.

ALTERNATE NAVIGATION PAGE ACCESS

The alternate navigation pages are manually selected for display at any time using the ALT NAV prompt (LSK 6L) on the MENU page.



ALTERNATE NAVIGATION SYSTEM CONTROLS AND DISPLAYS

The primary controls and displays associated with the operation of alternate navigation function are described in the following paragraphs.

ALTERNATE NAVIGATION CONTROL/DISPLAY UNIT

The primary unit that provides the alternate navigation function is the LCD MCDU with Update 2 or Update 3 operational program loaded. The alternate navigation MCDU is identical in appearance and operation to the other versions of MCDUs when displaying the normal FMC pages, performing the alternate navigation function in the background.

RECEIVER INPUTS

In order to perform the alternate navigation function, the MCDU must have inputs from the on-side ARINC 755 MMR receiver to obtain velocity and position data required for guidance output data. Without this input, the alternate navigation function will not operate.

ELECTRONIC STANDBY ATTITUDE INDICATOR

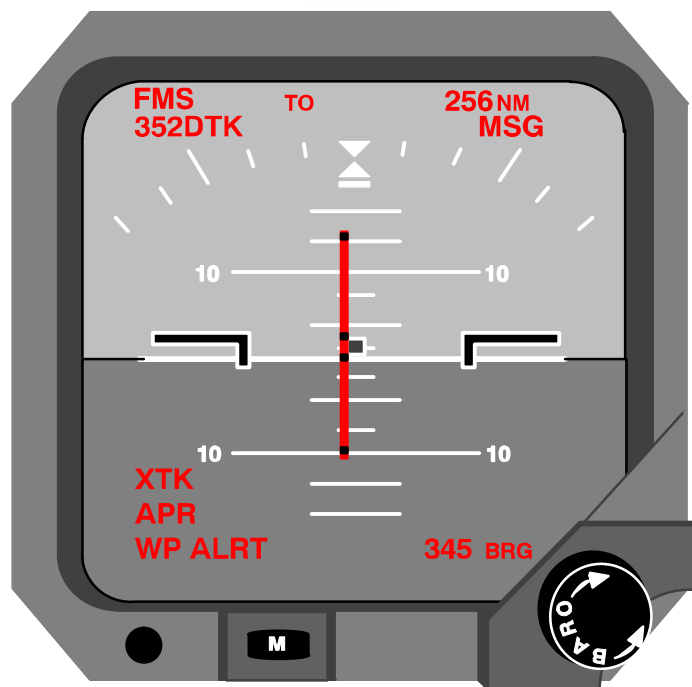
When the MCDU is displaying the alternate navigation pages, display outputs to the Electronic Standby Attitude Indicator (ESAI) (ref Figure 1-16) are used to provide lateral path guidance. The MCDU drives the on-side display to present the crew with basic up-to-date route position.

The MCDU controls the following:

- The lateral deviation bar.
- The ALERT annunciator (provides visual advisory approximately 10 seconds prior to a lateral path change, and goes away when change should occur).
- Distance to go in nautical miles to the next geographically fixed waypoint.
- Ground speed.
- Bearing to next geographically fixed waypoint.

MCDU NAVIGATION

The MCDU is capable of performing self-contained navigation in the lateral plan only. The unit displays basic navigation outputs which are continually updated with data from the supplying receiver.



Electronic Standby Attitude Indicator
Figure 1-16

These outputs include; aircraft Position (latitude, longitude, altitude), ground speed, and track angle. The alternate navigation function does not account for or incorporate wind data.

ALTERNATE NAVIGATION MCDU FLIGHT PLANNING

ALTERNATE NAVIGATION FLIGHT PLAN DEFINITION

The alternate navigation route is an abbreviated version of the FMC flight plan. It may only contain those contiguous waypoints defined by great circle legs (maximum of 60 waypoints) from the lateral path. The crew must also keep in mind that the alternate navigation function does not account for wind data.

Waypoint identifier names, latitude data, and longitude data formats use the same convention as for the FMC flight plan.



ALTERNATE NAVIGATION LATERAL PLAN CONSTRUCTION

The crew may construct the alternate navigation route using either of two methods; manual entry or crossloading.

An entire lateral route may be loaded manually into the MCDU using the alternate navigation WPT DATA and alternate navigation LEGS pages. Standard waypoint identifiers and corresponding latitude and longitude data is entered in the alternate navigation WPT DATA pages. The route is entered on the alternate navigation LEGS page. As each entry is made, the MCDU verifies that the entry is valid.

The FMC flight plan must be active before it can be crossloaded to the MCDU. Once active, the crew may crossload by selecting the alternate navigation prompt on the MENU page. When the alternate navigation LEGS page is displayed, select the CROSSLOAD prompt. After the crossload is complete, the execute light will illuminate. Executing the alternate navigation route will then cause all projected values to be displayed and the alternate navigation route to be activated.

The waypoints must be defined by a fixed geographical position. Examples are:

- Locations of enroute nav aids along established airways.
- Defined intersection points of enroute airways.
- Mandatory reporting points at the transition boundaries between flight information regions.
- Locations of named fixed points such as:
 - Airports
 - Runway threshold points
 - Airport nav aid stations
 - Fixed named waypoints.
- Procedure-generated waypoints defined by a course from a fix to a distance from the fix, or a DME distance.
- Crew-entered waypoints defined by latitude and longitude.

ALTERNATE NAVIGATION PLAN MODIFICATION

Modifications to the alternate navigation route may also be made if necessary. Modifications are performed in the same fashion as for



the FMC flight plan. Once the complete route is entered and activated, the FMC will update the alternate navigation route as each waypoint in the FMC flight plan is sequenced.

Modifications may only be entered on the alternate navigation LEGS and alternate navigation WPT DATA pages. The alternate navigation PROGRESS page is for information display only (just as is the FMC RTE PROGRESS page).

The MCDU is now ready to provide lateral guidance to the ESAI if an unexpected FMC failure occurs.

ALTERNATE NAVIGATION GUIDANCE

ALTERNATE NAVIGATION PATH COMPUTATIONS

The (lateral) alternate navigation route lists the sequence of fixed waypoints to be used for computing a lateral path to fly. The TO waypoint is the current active waypoint and is listed first (and highlighted) on the alternate navigation pages. For each of the waypoints, the MCDU computes the lateral path profile to provide the following display data:

- True course to the TO waypoint.
- True course out of each down-path waypoint.
- Distance from the preceding waypoint.
- Estimated time of arrival to the next waypoint (providing ground speed is greater than 100 knots).

ALTERNATE NAVIGATION WPT TRANSITIONS, LEG SWITCHING, AND PATH CAPTURE

In defining the guidance maneuver requirements for leg-to-leg transitions at waypoints, the MCDU only recognizes non-fly-over (NFO) transitions. The MCDU handles these transitions the same fashion as the FMC, however, because the waypoint sequencing logic in the MCDU is much simpler, a waypoint may not be sequenced at the same time as the FMC. If this occurs, simply select the next desired waypoint in the alternate navigation route to the go-to position and execute the modification.

DIRECT-TO FUNCTION

The Direct-To function may be initiated in the alternate navigation route at any time. The execution of a direct-to modification can be used to divert the aircraft directly to a desired waypoint.



If the desired waypoint is not in the active route, it will be inserted into the route.

If the desired waypoint is in the active route, it will be moved to the go-to position, and any waypoints between the original go-to waypoint and the selected go-to waypoint will be deleted from the route.



PART 2

NORMAL OPERATION

This section provides a step-by-step example of a flight to help illustrate the layout of the FMCS display pages and to provide an explanation of the data found on each page. The main flight pages are in the sequence used for normal initialization and for the flight. The support pages follow the flight pages and are in alphabetical order.

Each display page provides a quick reference page set for those who are familiar with the FMCS, followed by a detailed description of the page(s).

WHERE TO BEGIN

The FMCS may be displaying several different pages when the flight crew enters the cockpit (assuming the FMCS is operating properly);

- If a CDU type LCD is installed, pressing the INIT REF key displays the POS INIT page. Select the INDEX prompt (LSK 6L) to display the INIT/REF INDEX page, then select the IDENT prompt (LSK 1L) to display the IDENT page.
- If an MCDU type LCD is installed, the display may have the MENU page showing. Selecting the FMC prompt (LSK 1L) displays the IDENT page the first time it is selected. If the POS INIT page is displayed, follow the sequence above.

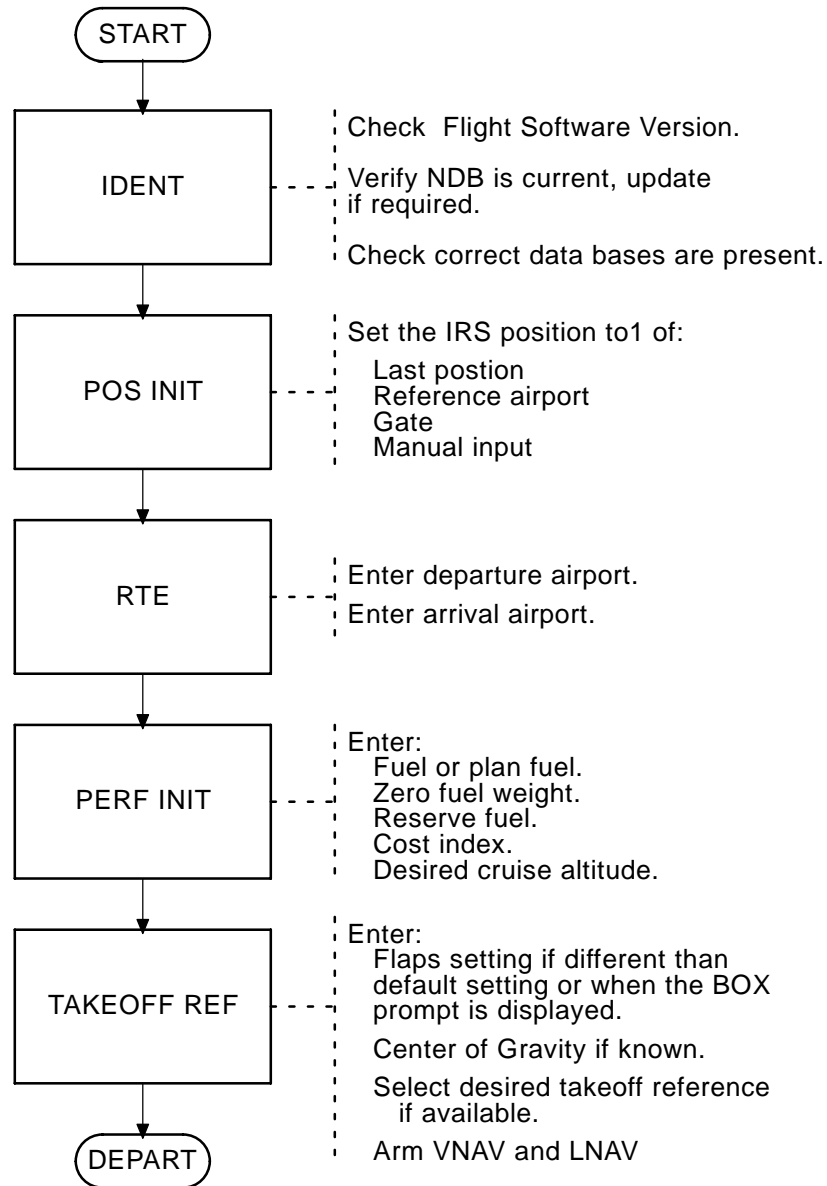
INITIALIZATION

When on the ground, the FMCS provides a logical progression of display pages for initializing the system. It does this by placing a prompt for the next logical page required at the bottom right position of displays (LSK 6R). Pressing the LSK next to the prompt will display the next required page for initialization entries. When initialization is complete, pressing LSK 6R adjacent to the TAKEOFF prompt will display the TAKEOFF REF page with the PRE-FLT STATUS line changing to PRE-FLT COMPLETE after the required inputs are complete.



The INIT REF key is another aid to maneuver through the pages. When pressed, it will display one of the initialization pages if they require data entries or selections to be made in preparation for flight. The first page normally displayed is the POS INIT page. Once all the initialization pages for takeoff are completed, pressing the INIT REF key displays the APPROACH REF page.

Figure 2-1 provides a flowchart style pre-flight sequence chart to show the minimum required initialization process.



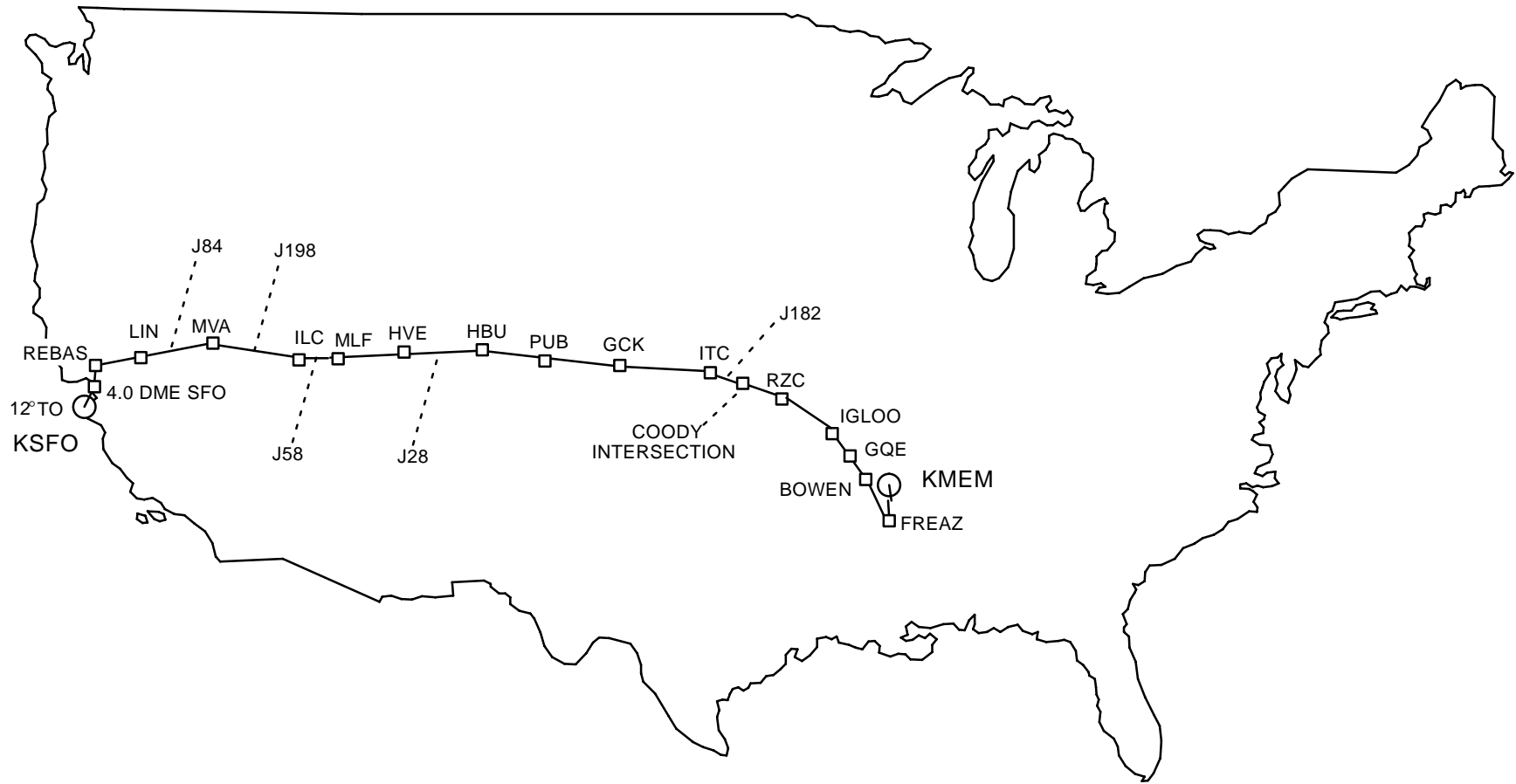
FMCS Minimum Pre-Flight Initialization Sequence
Figure 2-1



SAMPLE FLIGHT

To help illustrate the operation of the FMCS, a sample flight was set up from San Francisco California to Memphis Tennessee. Figure 2-2 shows the lateral route and Figure 2-3 shows the vertical route.

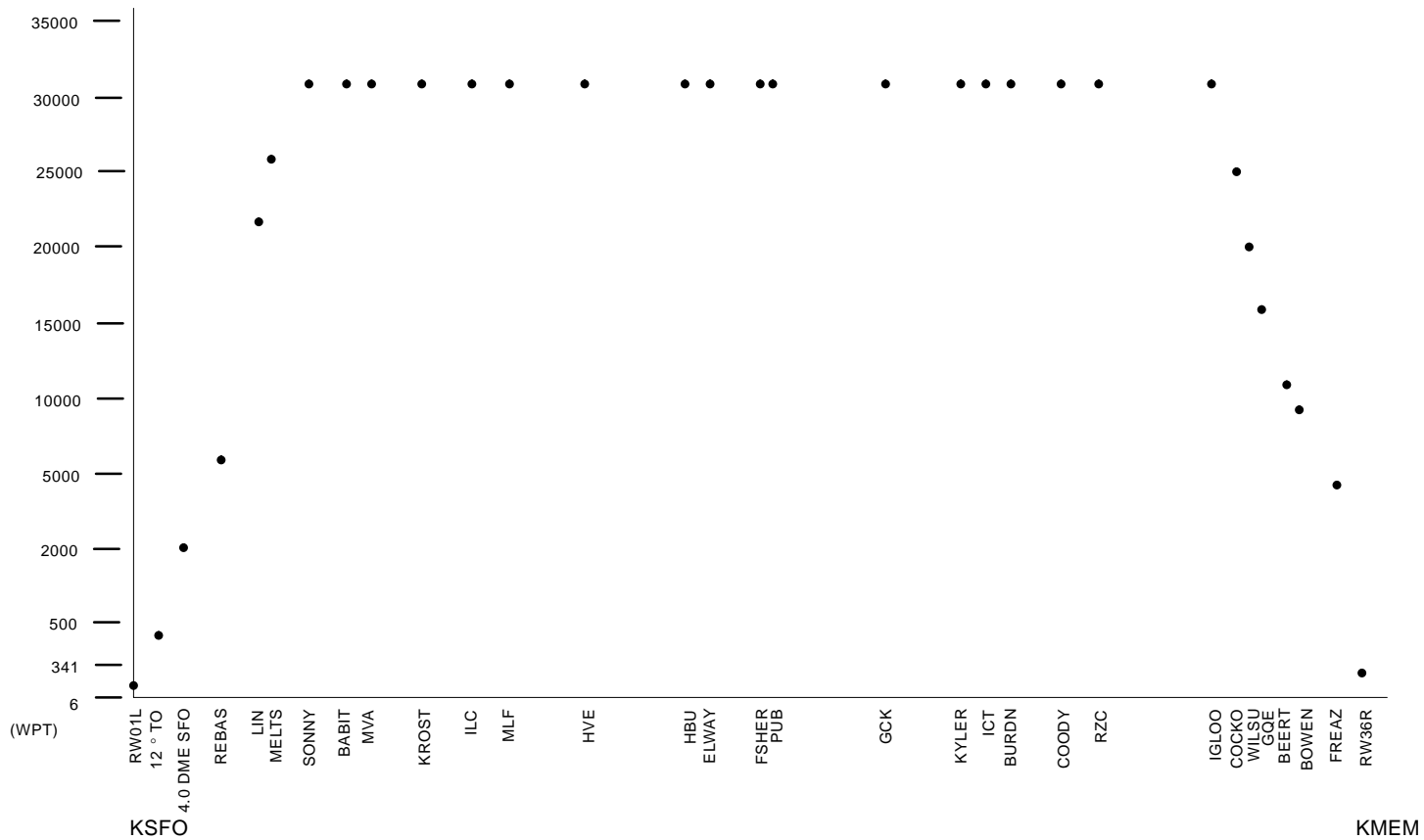
The pages that follow use the data from the sample flight to help illustrate how the FMCS works.



KSFO to KMEM Lateral Path
Figure 2-2



(ALTITUDE)



KSFO to KMEM Vertical Path
Figure 2-3



IDENT

The Configuration Identification page is generally checked once in the beginning to verify the current airplane and FMCS data, and allow the flight crew the opportunity to change the navigation database prior to takeoff.

PAGE ACCESS

- INIT/REF INDEX page IDENT prompt (LSK 1L)

```

IDENT                1 / 2
MODEL                ENG RATING
737-700              20K
NAV DATA            ACTIVE
JEP4100601 MAY06JUN02/10
                    JUN03JUN30/10
OP PROGRAM
549849-020 (U10.8A)
                    SUPP DATA
                    NOV 14/09
<INDEX              POS INIT>

```

No required entries

Current effective Nav Database date (LSK 3R) may be line selected to the active database line (LSK 2R) only when on the ground. Doing so clears any previously selected flight plan entries.

Verify:

- Airplane model
- Active Navigation Database selection
- FMC operational program number and update ID
- Engine thrust rating in pounds

PAGE 2

```

IDENT 2 / 3
PERF DEFAULTS
DEFAULT 05P
SW OPTIONS
DEFAULT 08O

DATALINK CONFIG
DEFAULT 06D
MODEL / ENGINE DATA
BCG-01J-05

<INDEX POS INIT>

```

This page identifies the databases that have been loaded for the Performance, Software Options, QRH Takeoff Speeds, Datalink Configuration, and Model/Engine Databases. Some are options and may not be displayed if the airplane is not configured for them.

PAGE 3

```

IDENT 3 / 3
FLIGHT PLAN NAV DATA
11OCT-16:30
05OCT-09:00

<INDEX POS INIT>

```

When the Pilot Defined Co-Route option is enabled, page 3 is available. When a flight plan has been loaded into the Flight Plan Navigation Database, the date and time stamp is displayed, otherwise this page is blank.



DETAILED OPERATION

The Identification page is displayed automatically at power-up, or when selected from the IDENT prompt (LSK 1L) on the INIT/REF INDEX page. This page provides aircraft and software configuration information and allows the flight crew to change between the available navigation databases (inhibited for one update cycle in two cycle updates). Those who use a single update cycle will not see the second block availability in the line next to LSK 3R.

Selecting the next available navigation database can only be performed while the airplane is on the ground. When the navigation databases are changed, all entered route data, performance data, and takeoff speeds are deleted.

IDENT page 1 displays the following:

- Aircraft model.
- Engine rating.
- Navigation database identification and effectivity dates (both current and next block when loaded).
- Operational program number.
- Supplemental database effectivity date.
- Page access prompt (6R) provides access to the remainder of the preflight sequence. The prompt will change according to which initialization pages require completion. The POS INIT is the first page in the sequence, but if it has already been completed, another page is displayed.

Selection of either the INDEX or POS INIT prompts may be made at any time.

IDENT page 2 displays the following databases in the order listed:

- Perf Defaults – the performance defaults database (PDDDB) is displayed when a database is loaded. This may be the default database or a customized database for the airlines. ■
- SW Options – the software options database is required to utilize the different options available to the airlines. The default database supplied provides the Manual RNP Entry option. ■
- QRH T/O Speeds – the Quick Reference Handbook Takeoff Speeds database is displayed when a database is loaded. This may be the default database or a customized database for the airlines. This database must have the option enabled to be used. ■



- Datalink Config – the datalink configuration database contains the ACARS configuration file required to use the ACARS system. This may be the default database or a customized database for the airlines. This database must have the option enabled to be used.
- Model/Engine data – the model/engine database (MEDB) provides aircraft and engine combination performance data required to operate the NG 737s. A default database is not provided and each airplane requires the correct database.

The databases are displayed only when the database is loaded in the FMC. When they are not loaded and a default database is not available, the header and database line are blank, but their position is preserved.

When custom databases are not loaded, the following defaults are listed:

- Performance Defaults – DEFAULT05P
- Software Options – DEFAULT08O
- Datalink Configuration – DEFAULT06D
- The MEDB for U10.8A is BCG-01J-05

IDENT page 3 displays the date and time stamp of company route flight plans loaded into the FMC. This page is only displayed when flight plans are loaded and the pilot defined company route option is available.



Selecting Alternate Nav Data Base

An effectivity date change can only be made on the ground.

```

IDENT 1 / 3
MODEL ENG RATING
737-700 20K
NAV DATA ACTIVE
JEP4100601 MAY06JUN02/10
JUN03JUN30/10
OP PROGRAM
549849-020 (U10.8A)
SUPP DATA
SEP 17/09
<INDEX POS INIT>
NAV DATA OUT OF DATE

```



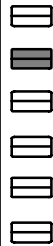
Press LSK 3R to transfer alternate database effectivity dates to the scratchpad.



```

IDENT 1 / 3
MODEL ENG RATING
737-700 20K
NAV DATA ACTIVE
JEP4100601 MAY06JUN02/10
JUN03JUN30/10
OP PROGRAM
549849-020 (U10.8A)
SUPP DATA
SEP 17/09
<INDEX POS INIT>
JUN03JUN30/10

```



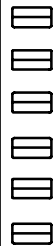
Press LSK 2R to transfer alternate data base effectivity dates from the scratchpad to the active line.



```

IDENT 1 / 3
MODEL ENG RATING
737-700 20K
NAV DATA ACTIVE
JEP4100601 JUN03JUN30/10
MAY06JUN02/10
OP PROGRAM
549849-020 (U10.8A)
SUPP DATA
SEP 17/09
<INDEX POS INIT>

```






The old data base effectivity dates are automatically moved down.



POS INIT

The FMCS is used to initialize the ADIRUs through various entries on the LCD. The Position Initialization page is the first page in the sequence to initialize the FMCS for departure. The ADIRU may be initialized to the departure airport, to the gate where the airplane is parked, or to the intended runway.

PAGE ACCESS

- On the ground and any ADIRU is in align mode, press 
- INIT/REF INDEX page POS prompt (LSK 2L)
- IDENT page POS INIT prompt (LSK 6R)
- TAKEOFF REF page POS INIT prompt (LSK 4L)
- POS REF page 
- POS SHIFT page 

The POS INIT page when the ADIRUs are set to align mode.



Box prompts: Enter a position longitude and latitude.

- Enter present position via:
 - Keyboard entry.
 - Line select LAST POS if available and correct.



- Line select REF AIRPORT or GATE after they are entered.
- Line select Transfer data from POS REF page.

The POS INIT page when the ADIRU(s) is/are set to attitude mode.

Dash prompts:

- The GATE may be entered (if it is in the data base) to provide gate latitude and longitude.
- SET IRS HDG is displayed when an ADIRU fails in the air. When it is brought back up in the attitude mode, the current magnetic heading is entered into the scratchpad and selected to the dash prompt (LSK 5R). Update the magnetic heading for that ADIRU every 30 minutes.

```

      POS INIT           1 / 3
                        LAST POS
                        N37°37.0 W122°22.0
REF AIRPORT
-----
      GATE
-----

GMT-MON/DY  SET IRS HDG
1325.0Z 10/27      ---°
-----
<INDEX                ROUTE>

```



DETAILED OPERATION

The position initialization page allows the aircrew several options for aligning the ADIRUs to an initial position. When one or both of the ADIRUs require initialization, the SET IRS POS field displays the BOX prompt. When the desired position is selected to the BOX prompt (LSK 4R) the position is sent to the ADIRU(s). Prior to attempting to align the ADIRUs, verify they are set to align mode.

If a response is not returned to the FMC within 5 seconds, the message ENTER IRS POSITION is displayed, which will be cleared after the ADIRUs are updated.

The SET IRS POS and corresponding data field (line 4R) will not be displayed when the ADIRU is in NAV, ATT, or OFF. The REF AIRPORT data field (line 2L) and SET IRS POS data field (line 4R) will clear when the aircraft is airborne.

NOTE: If clock input is invalid, GMT must be entered.

If clock input is valid, only the hours may be entered to update the FMC time to local time.

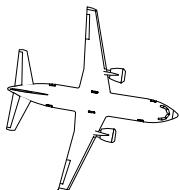
The GMT legend and Zulu are always displayed regardless of the time zone used for reference.

Date can not be edited.

There are three basic methods for setting the ADIRU position:

- LAST POS may be used if available and the aircraft has not been moved significantly since post-flight shutdown.
- The REF AIRPORT (plus a GATE number if available) contained in the navigation data base
- Manual entry of latitude and longitude

These methods are depicted on the next few pages.



NOTE

When copying positions to the scratchpad line, spaces and degrees signs are omitted.

When manually entering a position to the scratchpad line, spaces, decimal points, and degrees signs may be omitted.



Using LAST POS to align the ADIRUs:

When the display has a valid position in line 1 (LAST POS at LSK 1R), it may be selected to the scratchpad, then selected to the SET IRS POS BOX prompt (LSK 4R). Only use this method if the airplane has not been moved significantly.



```

POS INIT          1 / 3
                LAST POS
N37°37.1 W122°22.5
REF AIRPORT
-----
GATE
-----
                SET IRS POS
                □□□ °□□ .□ □□□□ °□□ .□
GMT - MON / DY
1325.8z 10/27
-----
< INDEX          ROUTE >
N3737.1W12222.5

```

Press LSK 1R to copy the FMCs last valid computed position into the scratchpad.



Press LSK 4R to transfer the LAST POS latitude and longitude to the SET IRS POS line.

```

POS INIT          1 / 3
                LAST POS
N37°37.1 W122°22.5
REF AIRPORT
-----
GATE
-----
                SET IRS POS
                □□□ °□□ .□ □□□□ °□□ .□
GMT - MON / DY
1325.8z 10/27
-----
< INDEX          ROUTE >
N3737.1W12222.5

```



```

POS INIT          1 / 3
                LAST POS
N37°37.1 W122°22.5
REF AIRPORT
-----
GATE
-----
                SET IRS POS
                N37°37.1 W122°22.5
GMT - MON / DY
1325.8z 10/27
-----
< INDEX          ROUTE >

```

Within a few seconds, the ADIRS is aligned.

```

POS INIT          1 / 3
                LAST POS
N37°37.1 W122°22.5
REF AIRPORT
-----
GATE
-----
                GMT - MON / DY
                1325.8z 10/27
-----
< INDEX          ROUTE >

```

Using the departure airport to initialize the ADIRUs. When the departure airport is entered into the REF AIRPORT DASH prompt (LSK 2L), the airport position is displayed in 2R.



Selecting LSK 2R, then LSK 4R (SET IRS POS) will align the ADIRS to the airport position.

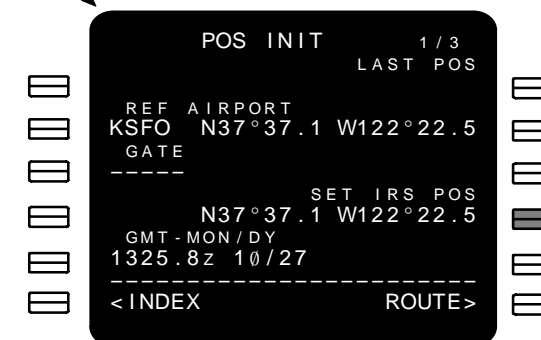
Enter the departure airport then press LSK 2L.

K S F O



Press LSK 2R to copy the REF AIRPORT latitude and longitude to the scratchpad.

Press LSK 4R to transfer the REF AIRPORT latitude and longitude to the SET IRS POS line.



Within a few seconds, the ADIRS is aligned.



When the desired location latitude and longitude are known, they may be entered and used to align the ADIRUs.

N 3 7 3 7 1 W 1 2 2 2 2 5

```

  POS INIT 1 / 3
  LAST POS
  REF AIRPORT
  -----
  GATE
  -----
  SET IRS POS
  □□□ °□□ .□ □□□□ °□□ .□
  GMT - MON / DY
  1325.8Z 10/27
  -----
  <INDEX ROUTE>
  N37371W122225
  
```

```

  POS INIT 1 / 3
  LAST POS
  REF AIRPORT
  -----
  GATE
  -----
  SET IRS POS
  □□□ °□□ .□ □□□□ °□□ .□
  GMT - MON / DY
  1325.8Z 10/27
  -----
  <INDEX ROUTE>
  N37371W122225
  
```

```

  POS INIT 1 / 3
  LAST POS
  N37°37.1 W122°22.5
  REF AIRPORT
  -----
  GATE
  -----
  GMT - MON / DY
  1325.8Z 10/27
  -----
  <INDEX ROUTE>
  
```

Within a few seconds, the ADIRUs are aligned.





POS REF

The Position Reference page displays the longitude and latitude position reported by the FMC, each IRS (when in the NAV mode), the reference GPS (if installed), and the combined radios. This page also displays the FMC computed ground speed and the IRS ground speed. POS REF values may be line selected to the scratchpad for use on the POS INIT page as a reference position to the IRS alignment function.

FMC POS displays the FMC composite position, which may deviate from the individual primary or secondary FMC position.

PAGE ACCESS

- POS INIT page  key.

- POS SHIFT page  key.

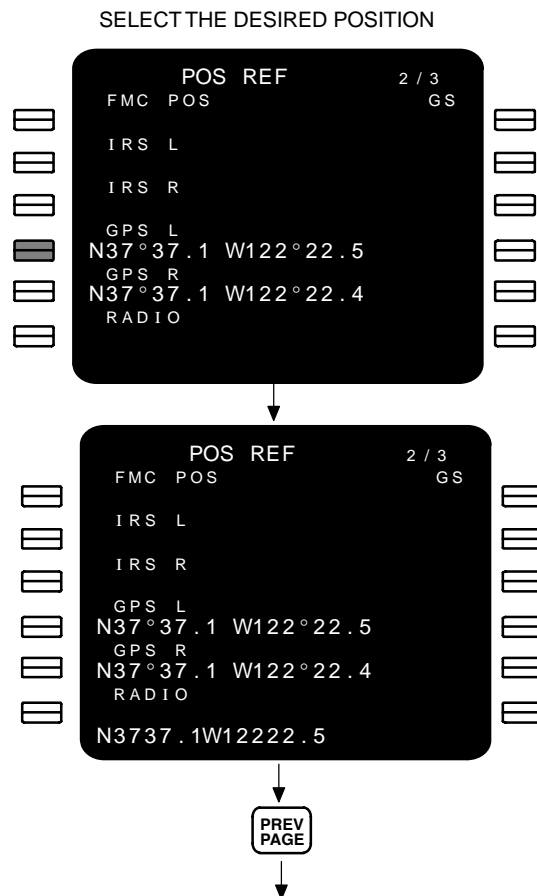
POS REF			2 / 3
FMC POS			GS
N37°37.1	W122°22.5		0 KT
IRS L			
N37°37.3	W122°21.8		0 KT
IRS R			
N37°37.1	W122°22.6		0 KT
GPS L			
N37°37.1	W122°22.5		
GPS R			
N37°37.1	W122°22.4		
RADIO			

When a sub-system is not available, the corresponding data line is blanked.



DETAILED OPERATION

- FMC POS – displays the composite position computed by the FMC. This position is used for guidance
- IRS L and IRS R – each line displays the associated IRS computed position when the IRS is in NAV Mode.
- GPS L and GPS R – when the GPS option is available, each line displays the associated GPS position when it is available.
- RADIO – displays the current radio position computed by the FMC. This line is blank until the FMC can select radio position inputs to compute a radio position.
- GS – displays the current computed ground speed.





ENTER THE POSITION TO
SET IRS POS

```

      POS INIT                               1 / 3
                                LAST POS
REF AIRPORT
-----
GATE
-----
                                SET IRS POS
                                □□□°□□.□ □□□□°□□.□
GMT - MON / DY
1325.8z 10/27
-----
< INDEX                               ROUTE >
N37371W12225
  
```

Within a few seconds,
the ADIRUs are aligned.

```

      POS INIT                               1 / 3
                                LAST POS
                                N37°37.1 W122°22.5
REF AIRPORT
-----
GATE
-----

GMT - MON / DY
1325.8z 10/27
-----
< INDEX                               ROUTE >
  
```

NEXT
PAGE

```

      POS REF                               2 / 3
FMC POS                                GS
N37°37.1 W122°22.5                    0KT
IRS L                                  0KT
IRS R                                  0KT
N37°37.1 W122°22.5                    0KT
GPS L                                  0KT
GPS R                                  0KT
N37°37.1 W122°22.4
RADIO
  
```




RTE

The Route page is the second page in the sequence to initialize the FMCS for departure. This page defines the beginning and end points of the flight plan. When the origin and destination airports are entered along with one other waypoint located between the departure and arrival procedures, the route can be activated, and the FMCS will fly point-to-point providing minimum advisory information.

Pages 2 and after will sequentially list the waypoints in the route and the method of arriving to that waypoint. Waypoints may be added or deleted to refine the flight plan.

With the color selectable option, the title line of all inactive route pages are displayed in cyan.

PAGE ACCESS

- Press  key
- POS INIT page ROUTE prompt (LSK 6R)
- TAKEOFF REF page ROUTE prompt (LSK 4R)
- DEPARTURES page ROUTE prompt (LSK 6R)
- ARRIVALS page ROUTE prompt (LSK 6R)
- Selection of a route from SELECT DESIRED RTE page

Blank Route Page 1





Selecting the RTE page after completing the POS INIT page places the origin in the scratchpad for selection to the origin dash prompt. The destination (DEST) BOX prompt must be entered via the keyboard and selected to line 1 right (LSK 1R).

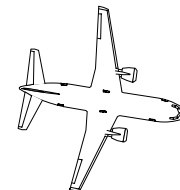
Page 2 and subsequent pages will list the flight plan in sequential order.

Blank Route Page 2



While in flight, line 1 will display the go-to waypoint. As each waypoint in the route transitions, the next waypoint is moved up to the line 1 position.

When the route is activated and executed, the active indicator (ACT) appears in the title line (and if the color option is used, the cyan title changes to white).



NOTE

Use the DEPARTURES and ARRIVALS pages to select the departure and arrival procedures.

Some pilots find it easier to enter the route from the RTE LEGS page instead of this page. It makes no difference, however, using the RTE LEGS page may take more time.



DETAILED OPERATION

The route information may be entered using several different methods, including information entered or selected on other pages.

```

RTE
ORIGIN          1 / 3
KSFO            DEST
               KMEM

RUNWAY
01L
-----
ACTIVATE>
    
```

```

RTE
VIA            2 / 3
CUIT2.LIN     TO
               LIN
J84           MVA
J198          ILC
J58           MLF
J28           ICT
-----
ACTIVATE>
    
```

```

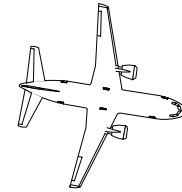
RTE
VIA            3 / 3
J182          TO
               RZC
RZC.GQE3     BOWEN
DIRECT       FREAZ
DIRECT       RW36R
-----
ACTIVATE>
    
```

Page 1

- ORIGIN (1L) – The origin airport may be entered as follows:
 - After entering the REF AIRPORT on the POS INIT page, the departure airport identifier will be displayed in the scratchpad when the RTE page is selected. Simply select it to the ORIGIN (LSK 1L).



- The origin airport identifier may be entered manually using the keyboard and selecting it to the ORIGIN. Anytime an origin airport is entered, all current route entries are removed.



NOTE

While in flight, transitioning to the missed approach waypoint will cause the destination airport identifier to be placed in the ORIGIN field.

- DEST (1R) – the destination airport identifier is required for the FMC to perform VNAV and performance predictions. The destination airport is entered through the keyboard and selected to the DEST field (LSK 1R).
- RUNWAY (3L) – displays the selected runway from the DEPARTURES page after the departure procedure is selected. The runway may also be manually entered through the keyboard and selected to the RUNWAY field (LSK 3L). If the entered runway is not compatible with the procedure listed in line 1 on page 2, the message RUNWAY N/A FOR SID is displayed.

The prompt located at LSK 6R will change with the progress of the initialization process:

- ACTIVATE – displayed when the route contains an origin airport, a destination airport, and one waypoint between the departure and arrival procedure. The route does not have to be activated immediately. The complete set of desired waypoints may be entered first.

Once the route is activated, the ACT indicator is added to the title line. Any changes from that point on are route MODs and must be executed to add them to the flight plan. The ACTIVATE prompt is no longer displayed.

- PERF INIT – displayed on the ground after the route is activated and the PERF INIT page has not yet been completed
- TAKEOFF – The takeoff prompt is displayed on the ground after the route is activated and performance initialization pages



are completed. This is the last initialization page requirement prior to being ready for takeoff.

Pages 2 through last

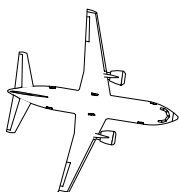
Initial route loading;

- VIA (1L – 5L) – entries made to these fields depend on the position of the fields when the route is being loaded.
- The first line is the last waypoint of the departure procedure selected on the DEPARTURES page.

If a runway is entered prior to selecting a SID, and the SID is not compatible with the runway, a discontinuity (DISCO) is displayed in the first line followed by the selected SID and must be corrected.

- Departure, arrival, and approach procedures are selected on the DEPARTURES and ARRIVALS pages or loaded via loading a company route or ACARS/ATC datalink (selectable options).
- If an entry is made in the TO field while the VIA field displays the DASH prompt, DIRECT will be displayed.
- An approach identifier that contains a missed approach will automatically enter the missed approach ID into next line.
- Any route data entries or selections made on other pages, loaded datalink route data, or loading a stored route are reflected on these pages.
- Route changes made during flight are reflected on these pages.

When entering waypoints in the TO column (right side) using an airway in the VIA column (left side), the entry waypoint and the exit waypoint need to be specified or a disconnect is displayed in the list.



NOTE

All of the waypoints along the airway are included on the RTE LEGS pages when the entry and exit waypoints are entered here.

PILOT-DEFINED COMPANY ROUTE OPTION:

The company route option allows a flight plan to be loaded into the FMC from the stored Flight Plan Database in the FMC.

- Enter company route identifier in the scratchpad or select the desired flight plan from the flight plans list and select it to the CO ROUTE (LSK 2L).

```
RTE 1 / 3
ORGIN KSFO DEST KMEM
CO ROUTE SFOMEM01
RUNWAY 01L
-----
<SAVE
ROUTE LOADED ACTIVATE>
```

- Review the plan after its loaded.
- Select ACTIVATE (LSK 6R) to accept or re-enter the origin to erase.
- Press key when flight plan is complete.

If the flight plan database contains saved routes with the same name, the SELECT DESIRED RTE page is displayed. Review the list of flight plans and select the one required. After selection, the display returns to this page.

REVERSE FLIGHT PLAN OPTION:

The REVERSE prompt (LSK 5R) is displayed when a minimum flight plan exists.



Selecting the REVERSE prompt will reverse the flight plan according to the following rules:

- Creates reversed flight plan with discontinuity preceding the first fix (in-air) or direct-to first fix (on-ground).
- Reversed flight plan will not contain the following:
 - Terminal area procedures
 - Speed and altitude constraints
 - Holding patterns
 - Lateral offsets
 - RTAs
 - Company route identifier
 - Abeam points
 - Manually entered CRZ winds



ALTERNATE DESTINATIONS OPTION:

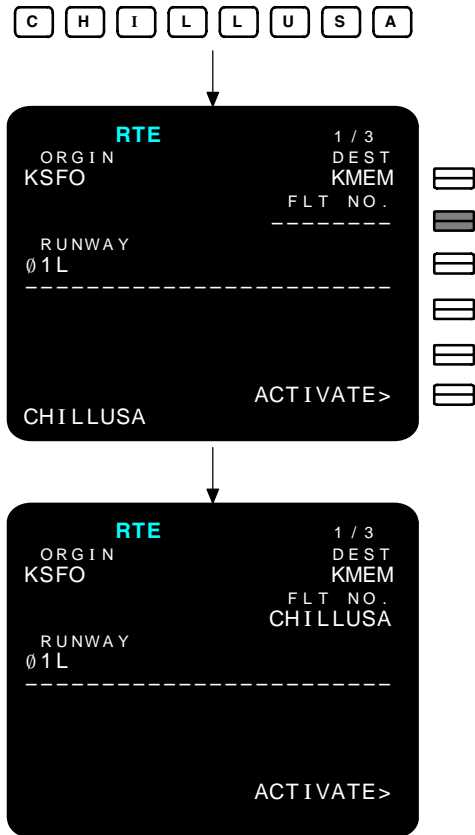
The ALTN DEST prompt (LSK 6L) provides access to the ALTER-NATE DESTINATIONS page to allow review for possible flight plan destination modifications.





FLIGHT NUMBER OPTION:

The flight number option allows entry of the flight number into the route page, and once entered, is also included in the PROGRESS page header, and all ACARS/ATC downlinks.



Enter the flight number into the scratchpad and select it to the dash prompt (LSK 2R). The flight number may be up to eight alphanumeric characters in length.

LATERAL OFFSET OPTION:

The lateral offset option provides a quick, easy method of inserting offsets into the flight plan.




When the offset option is operational, the prompt selection at line 6R includes the OFFSET prompt while in the air. This displays the LATERAL OFFSET page where the offset track parameters are entered.

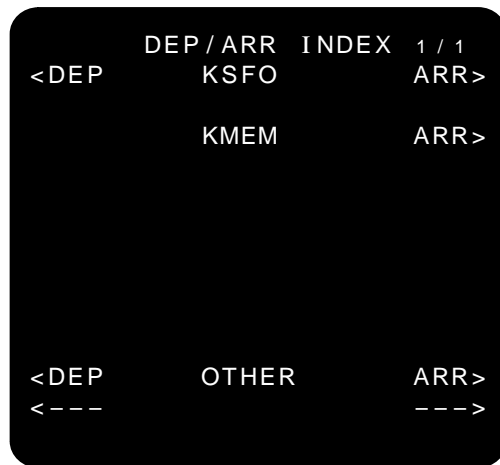


DEP/ARR INDEX

The Departures and Arrivals index page provides access to the departure and arrival airport pages to obtain procedures located in the navigation databases. The aircrew can also view information on other airports that are not part of the current flight plan.

PAGE ACCESS

- Press  key
- DEPARTURES page INDEX prompt (LSK 6L)
- ARRIVALS page INDEX prompt (LSK 6L)



DEP prompts provides access to airport departure procedures and runways located in the navigation databases.

ARR prompt provides access to the airport arrival procedures and runways located in the navigation databases.

Departures and arrivals pertain to the airport listed in the center column of the display.

Other airport departure and arrival procedures may be viewed using the OTHER DEP and ARR DASH prompts (LSK 6L and LSK 6R)



DETAILED OPERATION

This page provides an index to the DEPARTURES and ARRIVALS pages for the selected origin and destination airports. Other airports contained in the navigation databases may also be called up and viewed on the display.



Initialization Selections

The following prompts are used to rapidly obtain the departure and arrival airports procedures to add to the flight plan. The prompts to the left and right of the display pertain to the airport identifier listed in the center on the same line as the prompts.

- DEP (LSK 1L) – selecting this prompt will display the DEPARTURES (origin airport) page to allow selection of the available procedures and runways located in the navigation databases.
- ARR (LSK 2R) – selecting this prompt will display the ARRIVALS (destination airport) page to allow selection of the available procedures and runways located in the navigation databases.

Additional Selection

- ARR (LSK 1R) – in addition to being able to view the departure procedures for the origin airport, the arrival procedures may also be viewed for reference.
- Other Selections – when it is desired to review the procedures for any other airport listed in the navigation databases;
 - Enter the desired airport identifier into the scratch pad.
 - Select it to the DEP prompt in line 6 (LSK 6L) to review the departure procedures and runways for that airport.
 - Select it to the ARR prompt in line 6 (LSK 6R) to review the arrival procedures and runways for that airport.

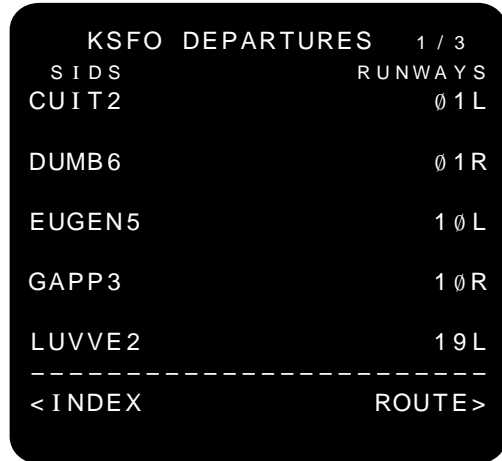


DEPARTURES

The Departures page provides an alphabetic listing of the SIDs and runways available for the selected airport (identified as part of the title line).

PAGE ACCESS

- DEP/ARR INDEX page DEP prompt (LSK 1L or LSK 6L)



- Select from the listed SIDs and transitions from the left side choices, then select from the listed runways on the right side choices.



- Selected items are identified as selected with “<SEL>”.
- After activation and execution of the route, the “<SEL>” identification changes to the active “<ACT>” indicator.



DETAILED OPERATION

Upon entering the Departures page, the display is basically divided into two columns, with the available SIDs for the selected airport (included in the title line) listed on the left, and the runways for the selected airport listed on the right. The list is in alphabetical order and may continue on for several pages depending on the size of the airport.

Select the desired SID by pressing the LSK adjacent to that line.

KSFO DEPARTURES		1 / 3
SIDS		RUNWAYS
<input checked="" type="checkbox"/>	CUIT2	01L
<input type="checkbox"/>	DUMB6	01R
<input type="checkbox"/>	EUGEN5	10L
<input type="checkbox"/>	GAPP3	10R
<input type="checkbox"/>	LUVVE2	19L
<input type="checkbox"/>	<INDEX	ROUTE>

The selected SID is then identified and, when available, a list of transitions associated with the selected SID are displayed. The list of runways now will have only those runways allowable for the selected SID and transition.

KSFO DEPARTURES		1 / 2
SIDS		RUNWAYS
<input checked="" type="checkbox"/>	CUIT2<SEL>	01L
TRANS		
<input checked="" type="checkbox"/>	CIC	01R
<input type="checkbox"/>	ENI	28L
<input type="checkbox"/>	LIN	28R
<input type="checkbox"/>	RBL	
<input type="checkbox"/>	<INDEX	ROUTE>

Any of the other SIDs originally listed and runways not associated with the selected SID are removed from the list.



If the SID has transitions listed in the navigation databases, they will be listed for selection next.



Select the desired transition.



Next select the desired runway.





This now defines the departure in the flight plan route.

```

KSFO DEPARTURES 1 / 1
SIDS             RUNWAYS
CUIT2<SEL>      <SEL>01L
TRANS
LIN<SEL>
-----
<ERASE          ROUTE>

```

Once the route is activated and executed, the <SEL> indicators will change to an active “<ACT>” indicator. When the departures page is visited again, all of the airport SID and runways are again listed with the active selections from the flight plan indicated.

```

KSFO DEPARTURES 1 / 3
SIDS             RUNWAYS
CUIT2<ACT>      <ACT>01L
DUMB6           01R
EUGEN5          10L
GAPP3           10R
LUVVE2          19L
-----
<INDEX         ROUTE>

```

If a different SID or runway is required, simply return to this page, make the new selection, and execute the MOD change. Until the changes are executed, the INDEX prompt (LSK 6L) changes to an ERASE prompt to allow removing the selections made prior to executing.

The DEPARTURES page may also be used to view the same information on another airport located within one of the navigation databases. Enter the desired airport identifier into the scratch pad and select it to the OTHER line (LSK 6L). The SIDs, transitions, and runways for that airport are listed just as above, however, nothing is selectable.



When a missed approach is planned in the active flight plan, the Departures page is updated with the departure information, and the departure is updated to the arrival airport.



ENGINE OUT SIDS OPTION:

If the Engine Out SIDs (EO SID) option is available, any EO SID available in the navigation databases will also be listed and selectable.

	KSFO DEPARTURES	1 / 1
<input type="checkbox"/>	SIDS	RUNWAYS
<input type="checkbox"/>	CUIT2<SEL>	01L
<input type="checkbox"/>	TRANS	
<input type="checkbox"/>	LIN<SEL>	01R
<input type="checkbox"/>	EO SID	
<input type="checkbox"/>	-NONE-	28L
<input type="checkbox"/>		28R
<input type="checkbox"/>	-----	
<input type="checkbox"/>	<INDEX	ROUTE>



ARRIVALS

The Arrivals page provides an alphabetic listing of the STARs, transitions, approaches, and runways available for the selected airport (identified as part of the title line). It is not necessary to enter the arrival procedures into the flight plan route at this time, but doing so may save time later on when preparation for descent is being performed.

PAGE ACCESS

- DEP/ARR INDEX page ARR prompt (LSK 2R or LSK 6R)

```

KMEM ARRIVALS      1 / 6
STARS              APPROACHES
GQE3              ILS 09

HLI1              GPS 09

UJM3              NDB 09

WLDER4           ILS 18C
                  GPS 18C
-----
< INDEX          ROUTE >

```

```

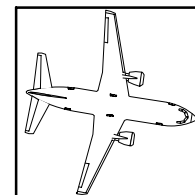
KMEM ARRIVALS      1 / 1
STARS              RUNWAYS
GQE3 <SEL>        <SEL> 36R
TRANS
RZC<SEL>

RWY EXT
-- . -NM
      FPA
      - . --
-----
< INDEX          ROUTE >

```

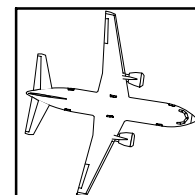


- Select from the listed STARS and transitions from the left side choices, select approaches and runways from the right side choices.
- Selected items are identified as selected with “<SEL>”.
- After activation and execution of the route, the “<SEL>” identification changes to the active “<ACT>” indicator.
- If a runway extension is desired, enter it into the scratchpad and select it to RWY EXT (LSK 3R).
- If an FPA is desired, enter it into the scratchpad and select it to FPA (LSK 4R).
- Manually entered RWY EXT and FPA may be DELETED.



NOTE

When the dash prompt is displayed at LSK 4R, the FMC will use the default value of 3.00 degrees for computations.



NOTE

Entering a runway extension and/or an FPA creates a MOD ARRIVALS page. If another page is selected, the EXEC annunciator turns off but the entries are not erased. Returning to the ARRIVALS page re-lights the EXEC annunciator, and the entered values are still displayed.



DETAILED OPERATION

Upon entering the ARRIVALS page, the display is basically divided into two columns, with the available STARS and transitions for the selected airport (included in the title line) listed on the left, and the approaches and runways for the selected airport listed on the right. The list is in alphabetical order and may continue on for several pages depending on the size of the airport.

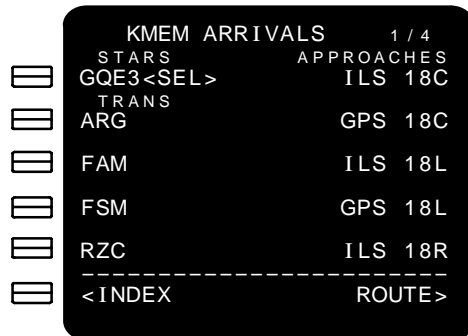
Select the desired STAR by pressing the LSK next to that line.



The selected STAR is then identified (<SEL>).

The right side lists the approaches and runways allowable for the selected STAR and any associated transitions listed.

After selecting the desired STAR, a list of associated transitions located in the navigation databases is displayed for selection. Select the desired transition. The transition is then also identified (<SEL>).





The list of compatible approaches and runways are only those suitable for the selected STAR/TRANS combination.

<p>KMEM ARRIVALS 1 / 4 STARS APPROACHES GQE3<SEL> ILS 18C TRANS RZC<SEL> GPS 18C ILS 18L GPS 18L ILS 18R ----- <INDEX ROUTE></p>	<p>KMEM ARRIVALS 4 / 4 TRANS RUNWAYS 18R 36C 36L 36R ----- <INDEX ROUTE></p>
---	---

Next select the desired approach or runway.

<p>KMEM ARRIVALS 4 / 4 TRANS RUNWAYS 18R 36C 36L 36R ----- <INDEX ROUTE></p>	<p><input type="checkbox"/></p> <p><input type="checkbox"/></p> <p><input type="checkbox"/></p> <p><input checked="" type="checkbox"/></p> <p><input type="checkbox"/></p> <p><input type="checkbox"/></p>
---	--

After a runway is selected, the RWY EXT and FPA fields are displayed. If a runway extension fix and/or FPA are desired, enter the extension into RWY EXT (LSK 3R) and the FPA into FPA (LSK 4R) prior to activating and executing the flight plan.

<p>KMEM ARRIVALS 1 / 1 STARS RUNWAYS GQE3<SEL> <SEL>36R TRANS RZC<SEL></p>	<p>RWY EXT 8.5NM FPA 3.10 ----- <INDEX ROUTE></p>
--	--



After pressing the EXEC key, these fields and headers are blank if an entry is not made. If entered, the runway extension is displayed on the route as an additional waypoint at the entered distance from the runway threshold. A runway extension fix appears on the RTE LEGS page as RX- followed by the runway number (i.e., RX-36C).

This now defines the arrival in the flight plan route.

Once the route is activated and executed, the <SEL> indicators will change to an active <ACT> indicator. When the arrivals page is visited again, all of the airport STARS, transitions, approaches, and runways are again listed with the active selections from the flight plan indicated (<ACT>).

```

KMEM ARRIVALS      1 / 1
STARS              RUNWAYS
GQE3<ACT>          <ACT>36R
TRANS
RZC<ACT>
-----
<INDEX            ROUTE>

```

RWY EXT/FPA NOT ENTERED

```

KMEM ARRIVALS      1 / 1
STARS              RUNWAYS
GQE3<ACT>          <ACT>36R
TRANS
RZC<ACT>
RWY EXT
8.5NM
FPA
3.10
-----
<INDEX            ROUTE>

```

RWY EXT/FPA ENTERED

If a different STAR, approach, or runway is required, simply return to this page, make the new selection, enter a runway extension and FPA if desired, and execute the MOD change.

```

KMEM ARRIVALS      1 / 4
STARS              APPROACHES
GQE3<ACT>          ILS 18C
TRANS
ARG                GPS 18C
FAM                ILS 18L
FSM                GPS 18L
RZC<ACT>          ILS 18R
-----
<INDEX            ROUTE>

```

```

KMEM ARRIVALS      4 / 4
TRANS              RUNWAYS
                  18R
                  36C
                  36L
                  <ACT>36R
-----
<INDEX            ROUTE>

```



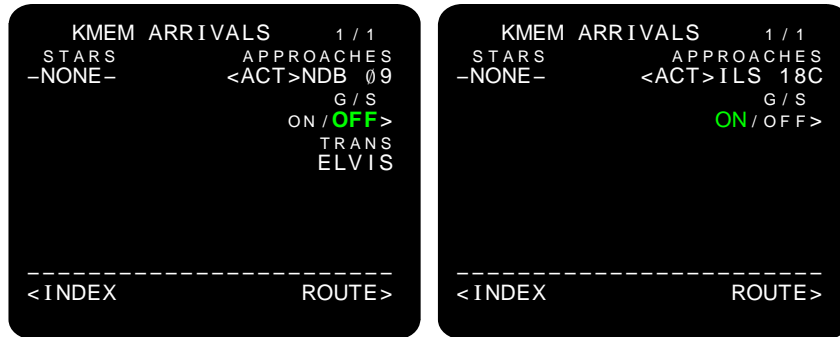
- RWY EXT (LSK 3R) – a runway extension fix may be entered into this field. The fix is generated along the selected runway centerline at the distance entered into this field.
 - Field is displayed after a runway is selected.
 - Allowable entries may be between 1.0 and 25.0 nm.
 - The entry may be overwritten or deleted (returns to a dash prompt).
 - Creates a waypoint in front of the runway centerline with a DISCO inserted before and after the fix waypoint.
 - Waypoint label is identified as RX–NNA where NNA is the runway.
 - Header and data field is blanked when the MOD page is EXECuted and an offset was not entered.
- FPA (LSK 4R) – a flight path angle may be entered into this field.
 - Field is displayed after a runway is selected.
 - Allowable entries may be between 2.00 and 5.50 degrees.
 - The entry may be overwritten or deleted (returns to a dash prompt).
 - If an entry is not made, the FMC uses the default angle of 3.00 degrees for computations.
 - Header and data field is blanked when the MOD page is EXECuted and an FPA was not entered.

Leaving the ARRIVALS page when a MOD selection is displayed will not erase the MOD selections as happens on other pages. Returning to the ARRIVALS page with the EXEC pending displays the MOD page and the selections and entries made earlier.

The ARRIVALS page may also be used to view the same information on another airport located within one of the navigation databases. Enter the desired airport identifier into the scratchpad and select it to the OTHER line (LSK 6R). The STARS, transitions, approaches, and runways for that airport are listed just as above, however, nothing is selectable.

INTEGRATED APPROACH NAVIGATION OPTION:

When the Integrated Approach Navigation (IAN) option is available, precision and non-precision approaches may be selected from the navigation databases.



Glideslope is displayed as follows:

- For the following localizer-based approaches, the glide slope toggle defaults to ON.

- ILS
- BCS
- IGS
- LDA
- LOC
- SDF

- For the following non-localizer based approaches, the glide slope toggle defaults to OFF.

- GPS
- RNAV
- NDB
- VOR

A transition selection is displayed if available from the navigation database.

When an IAN approach is selected, the FPA is not available for manual entry.



RTE LEGS

The Route Legs page provides a complete list of all legs in the flight plan, and detailed information for each. After all the basic reference points are entered into the RTE pages, the RTE LEGS page expands the list to include all waypoints along the planned route and lists them from the first point in the departure procedure to the arrival runway. Any restrictions at any of the waypoints along the path are also included.

After the route is activated and executed, the FMC computes the speed and altitude for each leg not containing constraints and restrictions.

PAGE ACCESS

- Press LEGS key.
- Selecting a waypoint from the SELECT DESIRED WPT page.
- RTE DATA page LEGS prompt (LSK 6R).

```

RTE LEGS 1 / 6
1 2 ° HDG 0 . 6 NM
( 4 2 0 ) <CTR> ---- / 4 2 0 A
1 3 ° 3 . 5 NM
SFO-04 ---- / -----
3 2 0 ° HDG 5 . 5 NM
( INTC ) ---- / -----
3 4 4 ° 1 1 NM
REBAS ---- / 6 0 0 0 A
6 6 ° 6 6 NM
LIN ---- / -----
RNP / ACTUAL ----- MAP CTR
1 . 0 0 / 0 . 0 9 NM STEP>

```

(DCP SET TO PLAN MODE)

For each leg, the leg direction, distance to go or computed leg length, the waypoint identifier, the computed speed, and altitude are displayed.

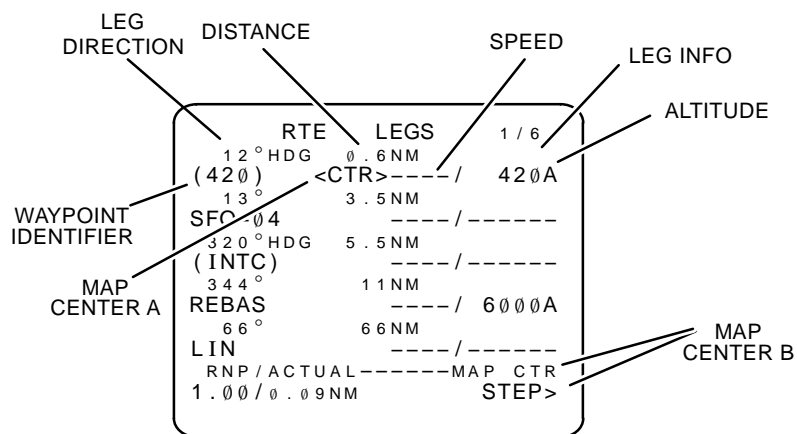
The first waypoint listed is the go-to waypoint indicating the distance remaining to that waypoint. The distance shown for the remaining waypoints in the list is the computed leg length.



DETAILED OPERATION

The Route Legs page provides a detailed view of each leg in the route. Manual entries are allowed, and specific legs may be added or deleted at any time. Floating waypoints and discontinuities are not selectable.

The first two lines on the first page are reserved for the go-to waypoint. As the go-to waypoint in the route is transitioned, the next waypoint in the list replaces the old go-to waypoint.



LEG DIRECTION – may be displayed in several different forms depending on the route. In general, the display will show:

- A computed course to a waypoint.
- A specific procedural course stored in the navigation data base.
- A specific procedural heading to a conditional waypoint stored in the navigation data base.
- A specific procedural instruction such as:
 - BYPASS
 - HOLD AT
 - PROC TURN
 - XX.X ARC Y (DME arc turn or fixed radius turn with specified radius length in nm, and turn direction, left or right)



- OFFSET
- GP X.X° (leg has vertical angle from navigation data base with angle specified)
- THEN (displayed prior to a route disconnect BOX prompt)

Coarse and heading are relative to true north when the MAG TRUE switch is in the TRUE position or outside the region of a valid magnetic variation. When relative to true north, the displayed coarse or heading is suffixed with "T".

DISTANCE – The line 1 displays the DTG from PPOS to the go-to waypoint. This distance is dynamically updated as the flight progresses. Leg distances of less than 10nm include tenths of a nautical mile.

The distance displayed for all other waypoints in the list is the computed distance of the leg. Distance is not displayed for special procedures such as holds, procedural turns, arc turns, etc.

Leg Info – displays additional information concerning the leg. Multiple descriptors are prioritized as follows:

- OFFSET
- BYPASS
- G/P angle

WAYPOINT IDENTIFIER – displays the waypoint name that the information in the preceding line pertains to. Valid waypoints include any of the following:

- Any published waypoint from the navigation databases.
- A Navaid Identifier.
- Any waypoint already defined which includes a radial and distance.
- A coarse intersection.
- Latitude/Longitude points.
- An offset point (waypoint/offset distance).
- Runway waypoints already loaded into the flight plan.
- Airport Identifiers.
- Any fixed waypoints from the flight plans stored within the FMC.



- Floating waypoints from the navigation databases or generated by the FMC.
 - (VECTOR)
 - (specified heading)
 - (specified altitude)
 - (INTC)
 - (INBD)

SPEED/ALTITUDE – prior to activating and executing the route, speeds and altitudes are displayed as a dash prompt unless a restriction or a constraint at a waypoint is in the navigation database or has been manually entered.

After the route is activated and executed, the FMC computed speed and altitude predictions are displayed in small font. Manually entered restrictions or restrictions entered from the navigation database are displayed in large font.

The typical speed range is 100 to 340 kts.

RNP/ACTUAL – The RNP value shown defaults to the current environment unless a different RNP value is defined in the navigation database for the leg.

NDB RNP or current environment default RNP values cannot be deleted.

Manual RNP entries:

- Displayed in large font.
- May be deleted, but will revert to default value.
- Must be smaller than the default values.
- Automatically transferred to the POS SHIFT page.

MAP CENTER (A & B) – when the DCP is in PLAN mode, the <CTR> indicator and STEP prompt (LSK 6R) are displayed. The <CTR> indicator points to the waypoint that is currently displayed as the ND center point. Each press of the STEP prompt will advance the <CTR> indicator on the RTE LEGS page one waypoint, and that waypoint is shifted to the center point of the ND. When the control panel is switched to MAP mode, the indicator and prompt are no longer displayed.



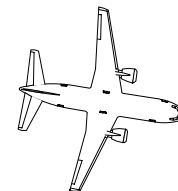
EDITING THE ROUTE:

Any discontinuities (DISCOs) must be closed up. If not closed when the airplane transitions off the last leg before the DISCO, the FMC will fly the airplane on a straight course using the last valid heading before the DISCO.

The DISCO is identified by a BOX prompt in the waypoint field with -- ROUTE DISCONTINUITY -- following it.

To close the DISCO;

- Enter an appropriate waypoint into the scratch pad and select it to the BOX prompt.
- Select a waypoint from farther down the list and select it to the BOX prompt. When this is performed, any waypoints between the selected waypoint and the DISCO are deleted.



NOTE

Several waypoints may be required to link the two waypoints on either side of the DISCO. When this occurs, the DISCO continues to push down the list until all waypoints link.

SPEED/ALTITUDE entries;

- In the climb legs, the manual speed or altitude entries are treated as restrictions/constraints for that leg only.
- In the cruise legs, manual speed entries are continued on to the top-of-descent from the leg the entry is made and can only be entered while in the cruise phase.
- In the descent legs, manual speed entries are continued on down path until a leg with a lower speed is encountered.
- When a hold exists in the cruise portion of the route, the speed changes entered do not affect the holding speed.
- The displayed runway altitude is the threshold elevation and is considered an AT restriction.
- The displayed runway speed is blank unless VREF is selected on the APPROACH REF page. When VREF is selected, the



speed displayed is the VNAV target speed (displayed in large font).

- Manual entries are automatically entered in the climb, cruise, or descent pages as applicable except for a missed approach.
- Speed restrictions or altitude constraints for a missed approach are automatically entered into applicable climb, cruise and descent pages after the missed approach becomes active.

When the entry and exit waypoints of an airway are entered on the RTE pages, all of the waypoints along the airway are compiled and included in the RTE LEGS pages. If desired, some of the waypoints may be removed.

Floating waypoints are generated by the FMC or are retrieved from the navigation data bases and are enclosed in parentheses.

RTE	LEGS	1 / 6
1 2 ° HDG	0 . 6 NM	
(4 2 0)	<CTR>---- /	4 2 0 A
1 3 °	3 . 5 NM	
SFO-04	----- / -----	
3 2 0 ° HDG	5 . 5 NM	
(INTC)	----- / -----	
3 4 4 °	1 1 NM	
REBAS	---- /	6 0 0 0 A
6 6 °	6 6 NM	
LIN	----- / -----	
RNP / ACTUAL	-----	MAP CTR
1 . 0 0 / 0 . 0 9 NM		STEP>

Using the RTE LEGS page shown above as an example;

- Fixed waypoints (LIN, REBAS or any fixed waypoint farther down the list) may be selected to floating waypoints ((INTC)).
- Floating waypoint (INTC) can not be selected or deleted.
- A fixed waypoint (REBAS) following a floating waypoint ((INTC)) can not be deleted or overwritten.

For Holding Patterns or Procedural Turns;

Unless the entry waypoint is the go-to waypoint.

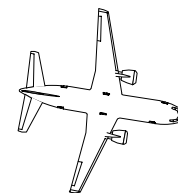
- Entering or selecting a waypoint from down the list to an exit waypoint of a hold or procedural turn will delete the holding pattern or procedural turn.



RTE	LEGS	1 / 6
12° HDG	0.6 NM	
(420)	<CTR>----	420A
13°	3.5 NM	
SFO-04	----	
320° HDG	5.5 NM	
(INTC)	----	
344°	1.1 NM	
REBAS	----	6000A
66°	6.6 NM	
LIN	----	
RNP / ACTUAL	-----	MAP CTR
1.00 / 0.09 NM		STEP>

RTE	LEGS	2 / 6
HOLD AT		
LIN	----	
60°	2.5 NM	
MELTS	----	
63°	4.8 NM	
SONNY	----	
63°	5.3 NM	
BABIT	----	6000A
64°	1.7 NM	
MVA	----	
RNP / ACTUAL	-----	MAP CTR
1.00 / 0.09 NM		STEP>

- Deleting an entry or exit waypoint of a hold or procedural turn will delete the holding pattern or procedural turn.
- Selecting the HOLD AT waypoint (LIN on page 2 above) to the hold entry waypoint (LIN on page 1) will delete the hold.
- Deleting the (INTC) or (INBD) waypoint of a procedural turn or hold will delete the procedural turn or hold.

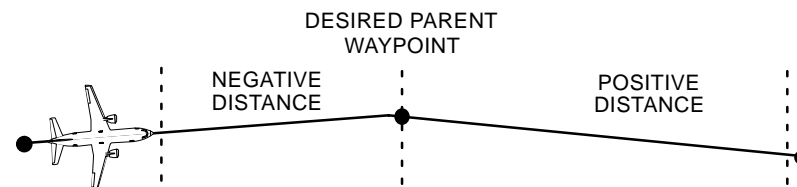


NOTE

If the procedural turn or hold contained a glideslope intercept point, the glideslope intercept point is retained in the route and a DISCO is inserted after it.

For Along-Track Offset (ATO) waypoints

ATO waypoints may be generated for valid waypoints already in the flight plan. The offset is entered as a positive or negative distance in nautical miles from the desired parent waypoint and is automatically named by the FMC.





- The offset distance must be less than the leg length, from the parent waypoint to PPOS or to the waypoint following the parent waypoint.
- The following waypoint types cannot be offset into (i.e., cannot specify a positive distance from an entry waypoint or a negative distance from an exit waypoint):
 - Holding patterns
 - Procedure turns
 - DME arc legs
 - Fixed radius turns



CREATING AN ATO

```

RTE LEGS 2 / 6
HOLD AT
LIN ----- / -----
60° 25 NM
MELTS ----- / -----
63° 48 NM
SONNY ----- / -----
63° 53 NM
BABIT ----- / 6000A
64° 17 NM
MVA ----- / -----
RNP / ACTUAL ----- MAP CTR
1.00 / 0.09 NM STEP>
    
```

Select or enter the desired parent waypoint

Add a slash and a positive or negative distance

```

RTE LEGS 2 / 6
HOLD AT
LIN ----- / -----
60° 25 NM
MELTS ----- / -----
63° 48 NM
SONNY ----- / -----
63° 53 NM
BABIT ----- / 6000A
64° 17 NM
MVA ----- / -----
RNP / ACTUAL ----- MAP CTR
1.00 / 0.09 NM SONNY / -25 STEP>
    
```

Select the desired parent waypoint again

```

RTE LEGS 2 / 6
HOLD AT
LIN ----- / -----
60° 25 NM
MELTS ----- / -----
63° 48 NM
SONNY ----- / -----
63° 53 NM
BABIT ----- / 6000A
64° 17 NM
MVA ----- / -----
RNP / ACTUAL ----- MAP CTR
1.00 / 0.09 NM STEP>
    
```

```

RTE LEGS 2 / 6
HOLD AT
LIN ----- / -----
60° 25 NM
MELTS ----- / -----
63° 25 NM
SON01 ----- / -----
63° 23 NM
SONNY ----- / -----
63° 53 NM
BABIT ----- / 6000A
RNP / ACTUAL ----- MAP CTR
1.00 / 0.09 NM STEP>
    
```

NOTE: A POSITIVE DISTANCE WOULD PLACE SON01 AFTER THE PARTENT WAYPOINT.



- PPOS hold entry or exit waypoints cannot be used.
- Cannot specify a negative distance on the Go-To waypoint of a Direct-To modification.

For missed approaches;

- Entering a waypoint into the route that is also contained in the missed approach is inserted with a DISCO following it.
- Entering a waypoint into the route that is contained farther down the list and in the missed approach will cause the waypoints in the list between the two instance to be deleted and the missed approach will have a DISCO inserted after that waypoint.

After the route is activated and executed the FMC computes the required speeds and altitudes at each waypoint listed in the flight plan.

```
ACT RTE      LEGS      1 / 6
 12 ° HDG    0.6 NM
(420)        153 / 420 A
 13 °      3.5 NM
SFO-04      238 / 2299
 320 ° HDG  5.5 NM
(INTC)      250 / 8781
 344 °      11 NM
REBAS       322 / 6000 A
 66 °       66 NM
LIN         .805 / FL220
RNP / ACTUAL -----
1.00 / 0.09 NM      RTE DATA>
```

All changes made to the flight plan from this point on are considered flight plan modifications.



SELECT OR ENTER
A WAYPOINT

ACT RTE	LEGS	1 / 6
1 2 ° HDG	0 . 6 NM	
(4 2 0)	1 5 3 /	4 2 0 A
1 3 °	3 . 5 NM	
SFO-04	2 3 8 /	2 2 9 9
3 2 0 ° HDG	5 . 5 NM	
(INTC)	2 5 0 /	8 7 8 1
3 4 4 °	1 1 NM	
REBAS	3 2 2 /	6 0 0 0 A
6 6 °	6 6 NM	
LIN	. 8 0 5 /	FL 2 2 0

RNP / ACTUAL		
1 . 0 0 / 0 . 0 9 NM		RTE DATA>

SELECT THE POSITION
TO INSERT IT

ACT RTE	LEGS	1 / 6
1 2 ° HDG	0 . 6 NM	
(4 2 0)	1 5 3 /	4 2 0 A
1 3 °	3 . 5 NM	
SFO-04	2 3 8 /	2 2 9 9
3 2 0 ° HDG	5 . 5 NM	
(INTC)	2 5 0 /	8 7 8 1
3 4 4 °	1 1 NM	
REBAS	3 2 2 /	6 0 0 0 A
6 6 °	6 6 NM	
LIN	. 8 0 5 /	FL 2 2 0

RNP / ACTUAL		
1 . 0 0 / 0 . 0 9 NM		RTE DATA>
REBAS		

SELECT ERASE PROMPT
TO UNDO CHANGE

OR
PRESS **EXEC**

MOD RTE	LEGS	1 / 6
1 2 ° HDG	0 . 6 NM	
(4 2 0)	1 5 3 /	4 2 0 A
1 3 °	3 . 5 NM	
SFO-04	2 3 8 /	2 2 9 9
3 4 4 °	1 1 NM	
REBAS	3 2 2 /	6 0 0 0 A
6 6 °	6 6 NM	
LIN	. 8 0 5 /	FL 2 2 0
6 0 °	2 5 NM	
MELTS	. 7 9 9 /	FL 2 6 3

<ERASE		RTE DATA>

When the change is made, the status in the title line changes to MOD (modification) and the changes are highlighted. Selecting the ERASE prompt (LSK 6L) will undo the change. Pressing the EXEC key incorporates the change into the active flight plan and changes the status back to ACT.



RTE DATA

The Route Data page provide a route sequential listing of the waypoints in the flight plan. The number of pages available are determined by the number of waypoints in the route. History waypoints are not retained.

Each waypoint listed includes the predicted ETA and any assigned wind data for the waypoint.

When the flight plan is activated, the go-to waypoint is displayed in line 1 of the first page (highlighted) and successive waypoints are cycled up to line 1 as they are transitioned.

PAGE ACCESS

- RTE LEGS page RTE DATA prompt (LSK 6R)

ACT	RTE	DATA	1 / 5
		ETA	WIND
MELTS		1 0 4 5 Z	
SONNY		1 4 5 2 Z	1 2 3 ° / 2 2
BABIT		1 4 5 9 Z	1 2 3 ° / 2 2
MVA		1 1 4 1 Z	1 2 3 ° / 2 2
KROST		1 1 1 3 Z	1 2 3 ° / 2 2

LEGS>			

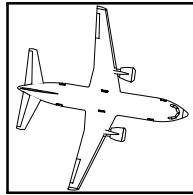
Forecast wind entries can be made for cruise waypoints only, and can help optimize performance calculations, however, they are not required.



DETAILED OPERATION

Wind data is entered into the scratchpad and selected to a line using the line select key on the right side of the display. Any wind data entered manually is displayed in large font and propagated through the list of waypoints that follow until another manual entry or T/D is encountered. Propagated wind is displayed in small font.

If cruise wind data has not been entered, the cruise waypoints contain DASH prompts for wind direction and speed.



NOTE

CRZ wind entries made on the PERF INIT page propagate to all cruise waypoints.

Wind data cannot be entered for CLB and DES waypoints. In the example below, T/C is after MELTS and a DASH prompt is not available.

ACT	RTE	DATA	1 / 5
		ETA	WIND
MELTS		1045Z	
SONNY	1452Z	123° /	22
BABIT	1459Z	123° /	22
MVA	1141Z	123° /	22
KROST	1113Z	123° /	22

LEGS>			



ENTER WIND DIRECTION AND SPEED

① ① ① / ① ⑧

ACT RTE	DATA	ETA	WIND
ILC	1125Z	123° /	22
MLF	1134Z	123° /	22
HVE	1149Z	123° /	22
HBU	1213Z	123° /	22
ELWAY	1217Z	123° /	22

111 / 18 LEGS>



SELECT THE DESIRED WAYPOINT

MOD RTE	DATA	ETA	WIND
ILC	1125Z	123° /	22
MLF	1134Z	123° /	22
HVE	1149Z	111° /	18
HBU	1213Z	123° /	22
ELWAY	1217Z	123° /	22

LEGS>

EXEC

EXECUTE

ACT RTE	DATA	ETA	WIND
ILC	1125Z	123° /	22
MLF	1134Z	123° /	22
HVE	1149Z	111° /	18
HBU	1213Z	111° /	18
ELWAY	1217Z	111° /	18

LEGS>






PERF INIT

The Performance Initialization page provides the pilot with the means to enter aircraft and atmospheric parameters required to compute performance target values. The more accurate the information supplied, the more accurate the FMC predictions will be. When all required entries are made, the EXEC annunciator will light. Press the EXEC key to activate the PERF INIT entries.

If the airplane configuration is set for US pounds, all weights are entered in thousands of pounds. When set up for kilograms, the weights are entered in thousands of kilograms.

PAGE ACCESS

- Press  key (on the ground and IRS initialized)
- INIT REF INDEX page PERF prompt (LSK 3L)
- ACT RTE page PERF INIT prompt (LSK 6R) (on the ground)
- TAKEOFF REF page PERF INIT prompt (LSK 5L) (prior to pre-flight complete)
- PERF LIMITS page  or 

```

PERF INIT          1 / 2
GW / CRZ CG      CRZ ALT
□□ . □ / 10 . 0%  □□□□□
FUEL             CRZ WIND
31 . 3          --- ° / ---
ZFW
□□□ . □
RESERVES
□□ . □
COST INDEX
□□□
-----
< INDEX          N1 LIMIT >

```

All BOX prompts must have entries made. If zero-fuel weight (ZFW) is entered first, gross weight GW will be calculated. If GW is entered first, the ZFW is calculated.

CRZ WIND will increase the accuracy of the FMC predictions but is not required.



DETAILED OPERATION

PERF INIT		1 / 2
GW/CRZ CG	CRZ ALT	
□□□ .□ / 10 . 0	□□□□□	
FUEL	CRZ WIND	
31 . 0	--- ° / ---	
ZFW		
□□□ . □		
RESERVES		
□□ . □		
COST INDEX	TRANS ALT	
□□□	18000	

<INDEX	N1 LIMIT>	

PERF INIT		1 / 2
GW/CRZ CG	TRIP/CRZ ALT	
111 . 0 / 10 . 0	FL321 / FL320	
FUEL	CRZ WIND	
31 . 0	--- ° / ---	
ZFW	ISA DEV	
80 . 0	---- ° F ---- ° C	
RESERVES	T / C OAT	
4 . 0	---- ° F ---- ° C	
COST INDEX	TRANS ALT	
27	18000	

<INDEX	N1 LIMIT>	

GW and ZFW – the gross weight (GW) is calculated by the FMC based on the entered zero–fuel weight (ZFW) and the fuel quantity.

Either GW or ZFW may be manually entered, and results in the other value being calculated and displayed.

CRZ CG – This is aircraft/CAA/FAA/JAA flight rules dependent and if the entry is deleted, the default value is displayed.

FUEL – displays the total fuel quantity from the FQIS. If the fuel unit fails, or fails to send a valid quantity for 30 minutes, a dash prompt is displayed and manual entry is allowed. Manual entries are followed by “MAN” in small font and must be periodically updated.

RESERVES – enter the amount of reserve fuel required for the destination. Entry in this field is in thousands of lbs.

COST INDEX – the cost index is a numerical indicator that tells the FMC how to control the flight, from most economical to most critical RTA. A value of 0 to 500 for the cost index must be entered.

CRZ ALT – Once an origin, destination, GW, RESERVES, and COST INDEX are known, the TRIP altitude is computed and displayed next to the CRZ ALT BOX prompt. The TRIP altitude is the optimum economy altitude for the flight based on the entries made.

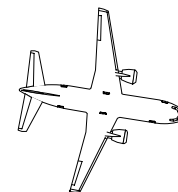
- Cruise altitude may be entered in any of the formats described in Part 1.
- CRZ ALT cannot exceed the displayed TRIP altitude (entries higher than TRIP altitude result in an INVALID ENTRY message being displayed).



- Once the cruise altitude is entered;
 - Automatically included on the CLB, CRZ, and RTE LEGS pages.
 - The ISA DEV and T/C OAT fields are displayed for entry.

ISA DEV and T/C OAT – ISA DEV (forecast enroute ISA deviation) and T/C OAT (top of climb outside air temperature) may be entered to improve the FMC predictions.

- Entering one temperature (in F or C) in line 4R results in all other values calculated and displayed.



NOTE

The aircraft temperature measurement base (°C or °F) is program pin controlled. To enter a value in the opposite measurement base, suffix the entry with the appropriate letter C or F.

Negative values must be preceded by the minus sign.

- The information is automatically included in the climb and cruise segments of the flight.
- When transitioning onto a missed approach, the ISA DEV is changed to the value entered into the DES FORECASTS page.

CRZ WIND – If wind data for the cruise altitude is known, it may be entered, but is not required. It is used to tweak the FMC predictions to the destination.

TRANS ALT – the transition altitude displayed is the FMC default value. It is always displayed in feet regardless of the entry method, and can be modified in one of the following ways;

- May be manually over written.
- May be a different default value if a customized performance defaults database is loaded into the FMC.
- May be changed automatically when a departure procedure is selected and the navigation database contains a stored transition altitude.



```
PERF INIT 1 / 2
GW / CRZ CG TRIP / CRZ ALT
111.0 / 10.0 FL321 / FL320
FUEL CRZ WIND
31.0 ---- ° / ----
ZFW ISA DEV
80.0 ---- ° F ---- ° C
RESERVES T / C OAT
4.0 ---- ° F ---- ° C
COST INDEX TRANS ALT
□□□ <27 18000
-----
<INDEX N1 LIMIT>
```

When the FMCS experiences an unexpected fault, the recovery process starts by clearing the COST INDEX to a BOX prompt. This will cause VNAV to become invalid.

Displayed next to the BOX prompt is the original Cost Index before the fault. Selecting LSK 5L with the scratchpad empty sets the Cost Index back to the original value.

The crew can also manually enter a new Cost Index and select it to 5L.

Once the Cost Index is re-entered and the FMC finishes predictions, the crew can reselect VNAV on the MCP.

PLAN FUEL OPTION:

When the planned fuel option is available, PLAN (line 2L) is displayed to allow entry of the anticipated fuel quantity prior to knowing the actual fuel. The planned fuel load may be manually entered into the PLAN field to provide early predictions.

```
PERF INIT 1 / 2
GW/CRZ CG CRZ ALT
□□□ .□ / 10 . 0 □□□□
PLAN/FUEL CRZ WIND
--- . - / 31 . 0 --- ° / ---
ZFW
□□□ . □
RESERVES
□□ . □
COST INDEX TRANS ALT
□□□ 18000
-----
<INDEX N1 LIMIT>
```

- The actual fuel quantity will be used after engine start-up.
 - Engine start up is flaps set to other than zero degrees position, or the A/T indicates to the FMC that engines are running.
- If data from the FQIS is not available, only FUEL is displayed.
- Acceptable planned fuel quantities are 0.1 to 60.0 klbs.

GROSS WEIGHT INHIBIT OPTION:

When the gross weight inhibit option is available, a BOX prompt is not available in GW (1L), and entering a gross weight results in an INVALID ENTRY message displayed in the scratchpad. The FMC calculated gross weight is displayed when ZFW (LSK 3L) is entered.

```
PERF INIT          1 / 2
GW / CRZ CG       CRZ ALT
/ 10.0           □□□□
PLAN / FUEL       CRZ WIND
---. - / 31.0    --- ° / ---
ZFW
□□□. □
RESERVES
□□. □
COST INDEX       TRANS ALT
□□□             18000
-----
<INDEX          N1 LIMIT>
```

The gross weight will be calculated and displayed after zero fuel weight (ZFW) is entered.

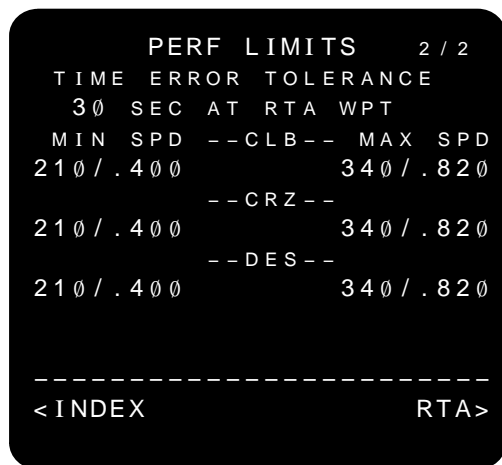


PERF LIMITS

The Performance Limits page allows the pilot to enter speed restrictions in the FMC flight plan to optimize the predictions in ECON and RTA modes. Speeds may be restricted on the low and/or high sides of the climb, cruise, and descent phases to meet special operational situations.

PAGE ACCESS

- PERF INIT page  or 
- RTA PROGRESS page LIMITS prompt (LSK 6L)



TIME ERROR TOLERANCE – specifies the allowable time tolerance for an RTA target. The enterable range is 5 to 30 seconds with a default time of 30 seconds.

MIN SPD/MAX SPD – displays the minimum and maximum speeds that will be used for each phase of the flight plan predictions.

- Manual entries in each phase must fall between the minimum and maximum values listed in that phase.
- Manual entries are displayed in large font.

RTA prompt (LSK 6R) – displays the RTA PROGRESS page to designate an RTA waypoint for RTA mode.



DETAILED OPERATION

Default settings essentially do not provide restrictions on the cost-index driven flight profile optimizations (which are constrained by speed performance limitations associated with buffet margin restrictions).

PERF LIMITS				2 / 2
TIME ERROR TOLERANCE				
30	SEC	AT	RTA	WPT
MIN SPD	--CLB--		MAX SPD	
210 / .400			340 / .820	
MIN SPD	--CRZ--		MAX SPD	
210 / .700			340 / .820	
MIN SPD	--DES--		MAX SPD	
210 / .400			340 / .820	

<INDEX		RTA>		

Any manual entries on this page are displayed in large font and create a MOD to the flight plan that must be executed to be incorporated. Deleting an entry displays the default value.

TIME ERROR TOLERANCE – generates an RTA deviation allowance from 5 to 30 seconds at any RTA specified waypoint. The default time frame is 30 seconds unless a customized performance data base containing a different value is loaded. When the TIME ERROR TOLERANCE entry is exceeded, the RTA speeds schedules are re-estimated.

MIN SPD/MAX SPEED – allow placing speed restrictions at the upper and lower end of the speed range. The FMC uses these values to compute flight plan restrictions for the RTA and ECON modes.

Manual entries must fall between the minimum and maximum speeds displayed for that phase of the flight plan.

Examples of invalid entries for the sample page shown above are:

- Trying to change the MAX SPD above 340 kts or .825 Mach.
- Trying to change the MIN SPD below 210 kts or .400 Mach.



TAKEOFF REF

The Takeoff Reference page is used to enter required takeoff data and review the FMC takeoff thrust data. Page 1 also provides the status of the initialization process with prompts to incomplete pages.

This is the last page of the initialization processes prior to takeoff.

PAGE ACCESS

- N1 LIMIT page TAKEOFF prompt (LSK 6R)
- ACT RTE page TAKEOFF prompt (LSK 6R)
(on ground and PERF INIT completed)
- INIT/REF INDEX page TAKEOFF prompt (LSK 4L)

When all required parameters and data are entered, page 1 indicates PRE-FLT COMPLETE and the prompts for the other initialization pages do not appear.

FLAPS must be entered if a BOX prompt is displayed.



```

TAKEOFF REF      1 / 2
FLAPS            V1
  □□ °          ---KT
  20K N1        VR
  88.9 / 88.9   ---KT
  CG            V2
  -- .-%        ---KT
-----PRE-FLT STATUS-----
<POS INIT      ROUTE>

<PERF INIT     DEPARTURE>
-----
<INDEX

```

```

TAKEOFF REF      2 / 2

SEL / OAT
--- ° / +15 °C

ACCEL HT      EO ACCEL HT
1000AGL      1000AGL

-----
<INDEX

```




DETAILED OPERATION

Page 1

```

TAKEOFF REF      1 / 2
FLAPS            V1
15 °            ---KT
 20K N1         VR
88.9 / 88.9     ---KT
CG   TRIM      V2
22.1% 5.04     ---KT
-----PRE-FLT STATUS-----
<POS INIT      ROUTE>

<PERF INIT     DEPARTURE>
-----
<INDEX

```

PRE-FLIGHT
IN PROGRESS

```

TAKEOFF REF      1 / 2
FLAPS            V1
15 °            ---KT
 20K N1         VR
88.9 / 88.9     ---KT
CG   TRIM      V2
22.1% 5.04     ---KT
-----PRE-FLT COMPLETE-----

-----
<INDEX

```

PRE-FLIGHT
COMPLETE

FLAPS – takeoff flaps position is determined by the airplane model/ engine configuration and the loaded performance database.

If the FMC determines that the loaded values are invalid or a performance database is not loaded, a BOX prompt is displayed and flaps must be manually entered. The manually entered value cannot be deleted when the BOX prompt was displayed, however a new valid setting may be written over the last entry.

FLAPS will be blank when V1, VR, and V2 are blank.

Takeoff N1 (line 2L) – This line and header are not static. The header changes to reflect the model/engine configuration, selected takeoff thrust rating, and selected temperate. The actual rating displayed is the FMC computed N1 thrust.

Typical header examples include:

- 20K N1 – full thrust rating.



- 20K BUMP N1 – slightly higher thrust limits when available.
- RED 20K N1 – reduced thrust using selected (SEL) temperature.
- 18.5K N1 – takeoff thrust showing derate level.

CG – the center of gravity may be entered but is not required. Values range from 5 to 32 percent MAC. Entering CG allows the FMCS to calculate the take off stabilizer trim setting when the gross weight entry is valid.

TRIM – once CG is entered and GW is calculated, the FMC computes and displays the trim position.

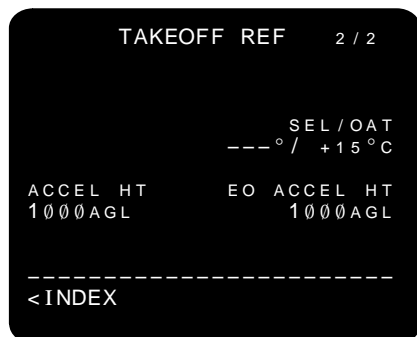
V1, VR, V2 – may be entered while on the ground. Manual entries return to a dash prompt if a performance parameter is changed or when the airplane is in the air. Typical values range from 90 to 220 knots.

- V1 is the critical engine failure velocity
- V2 is the takeoff climb velocity
- VR is the takeoff rotation velocity

If V1, VR, and V2 fields are blank, FLAPS will also be blank.

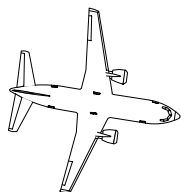
PRE-FLT STATUS – four prompts are used to guide the initialization processes. As each required initialization page is completed, the prompt is blank, offering a quick view of the entry status.

- POS INIT prompt – no longer displayed when a valid IRS position has been entered on the POS INIT page and that value agrees with all IRSs that are in ALIGN mode.
- PERF INIT prompt – blanked when valid fuel reserves, cost index, gross weight, and cruise altitude data has been entered on the PERF INIT page and EXECuted.
- DEPARTURES prompt – blanked when the RUNWAY and VIA fields on the RTE page are completed.
- ROUTE prompt – blanked when a route is activated on the RTE page.



SEL/OAT – Displays the temperature that the takeoff N1 computations are based on.

- The SEL (selected) temperature allows manual entry of an assumed temperature for the purposes of reduced takeoff thrust. SEL temperature inputs are limited to the range set in the airplanes performance database. Deleting the entered SEL temperature causes the display to return to the dash prompt. Enter the assumed temperature as ttt (ttt = temperature), followed by the optional suffix C or F if desired. If this reduces the takeoff N1 thrust, N1 changes, with the label RED nnK N1 (nn is the applicable engine thrust rating).
- The OAT is automatically entered from aspirated TAT probe data supplied to the FMC and is displayed in small font. Manual entries may be made which will override the OAT temperature. Deleting the manually entered OAT causes the OAT value to revert to the TAT input. Enter an OAT as /ttt (ttt = temperature), followed by the optional suffix C or F if desired.



NOTE

When the manually entered temperature changes, N1 is recomputed and is also changed on the N1 LIMITS page. Any changes on the N1 LIMITS page will also be reflected here. These entries only affect the takeoff thrust ratings.



ACCEL HT – displays the default acceleration height from the FMC defaults or stored in the Loadable Defaults Database. The crew can over write this height while setting up for each takeoff.

EO ACCEL HT – displays the default engine out acceleration height from the FMC defaults or stored in the Loadable Defaults Database. The crew can over write this height while setting up for each takeoff.

THRUST BUMP:

When a bump N1 thrust level is available for the airplane/engine configuration and selected, the display provides the additional N₁ limit parameters from the MEDB. The thrust reduction height is always indicated in feet AGL for the ORIGIN airport entered into the flight plan.

PAGE 1:

This page operates like the standard TAKEOFF REF page 1. When a bump N1 thrust is selected, it is displayed in the header (2L).

PAGE 2:

- THR REDUCTION (5R) – displays the height (feet AGL for the origin airport) at which the takeoff thrust to climb thrust limit transition occurs.
 - The header and field is blanked until TAT is available or OAT is entered.
 - Displays the dash prompt until ORIGIN airport is entered, and clears to a dash prompt at end of flight.
 - The default thrust reduction altitude is 1500 feet AGL. Manual entries are allowed and are displayed in large font.
- Climb Rating (5 center) – displays the selected climb rating to be used at the thrust reduction height transition.
 - Displays the CLB, CLB-1, or CLB-2 that is selected on the N1 LIMITS page.



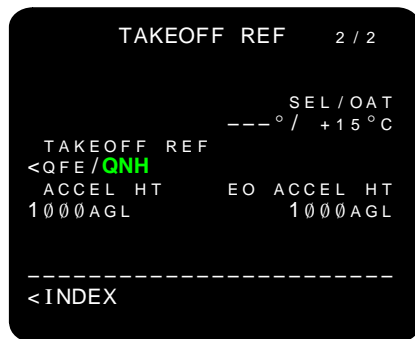
- Defaults to CLB if a derate is not selected on the N1 LIMITS page.
- Field is blanked until an ORIGIN airport is entered on the RTE page.
- When the performance option is enabled, the FMC will automatically select the highest climb rating that will satisfy the throttle reduction requirement at the thrust reduction high transition. The selected rating is set here and on the N1 LIMITS page.

QFE REFERENCE OPTION:

When the QFE option is available, the TAKEOFF REF prompt is displayed on TAKEOFF REF page 2.

TAKEOFF REF – displays the active selection for the Quick Reference Handbook type.

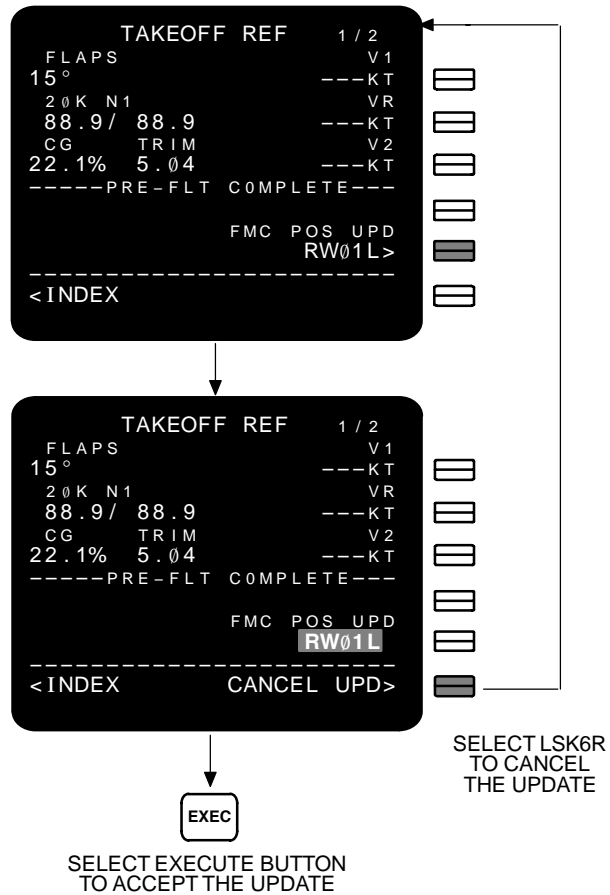
The selection works as a toggle with each press of LSK 3L, alternately switching between the QFE and QNH look-up tables. The default selection is the sea level altimeter setting table (QNH). The active selection is highlighted.



RUNWAY POSITION UPDATE OPTION:

When the runway position update option is available, the TAKEOFF REF page will display the FMC POS UPD prompt (LSK 5R) after the following conditions are met:

- A runway was entered into the RUNWAY (LSK 2L) on the RTE page.
- The airplane is on the ground, and the route is active.



The runway entered on the RTE page 1 is automatically entered here.

Selecting the runway update will update the FMC position to the runway threshold.

This prompt is cleared at takeoff.



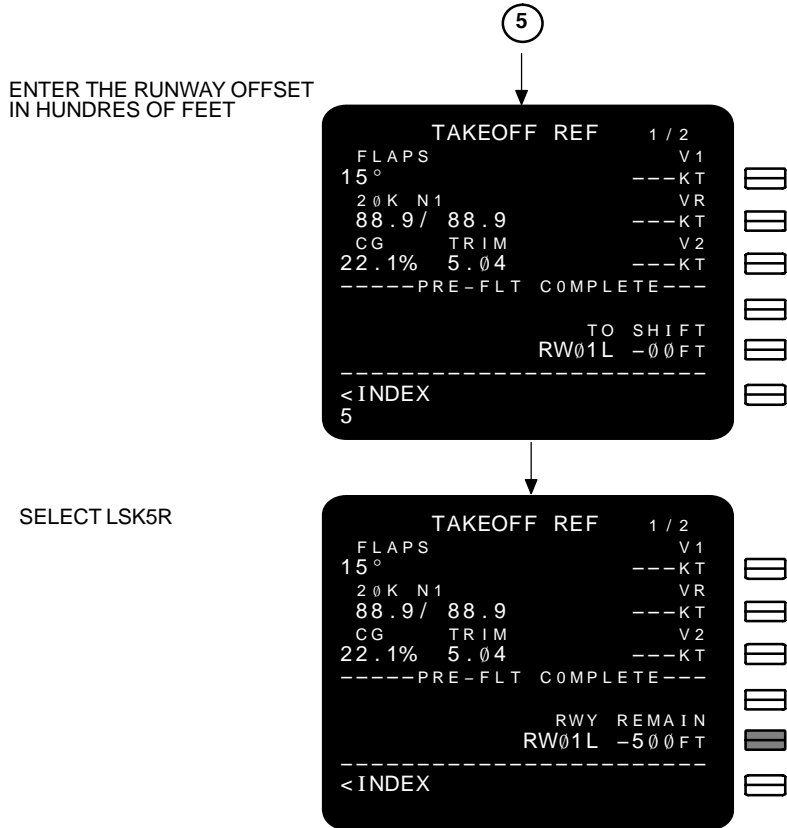
RUNWAY OFFSET OPTION:

When the runway offset option is available, an offset from the navigation database stored runway threshold along the centerline may be entered. Distance is displayed in feet or in meters depending on the default setting feet/meters.

Valid entries are 100 to 900 meters or 100 to 3300 feet.

The TAKEOFF REF page will display the TO SHIFT prompt (LSK 5R) after the following conditions are met:

- A runway was entered into the RUNWAY (LSK 2L) on the RTE page.
- The airplane ground speed is less than 60 kts and the route is active.





During takeoff, the FMC position is updated each time the TOGA switch is pushed (for ground speed less than 60 kts) and the runway and offset on the TAKEOFF page is highlighted.

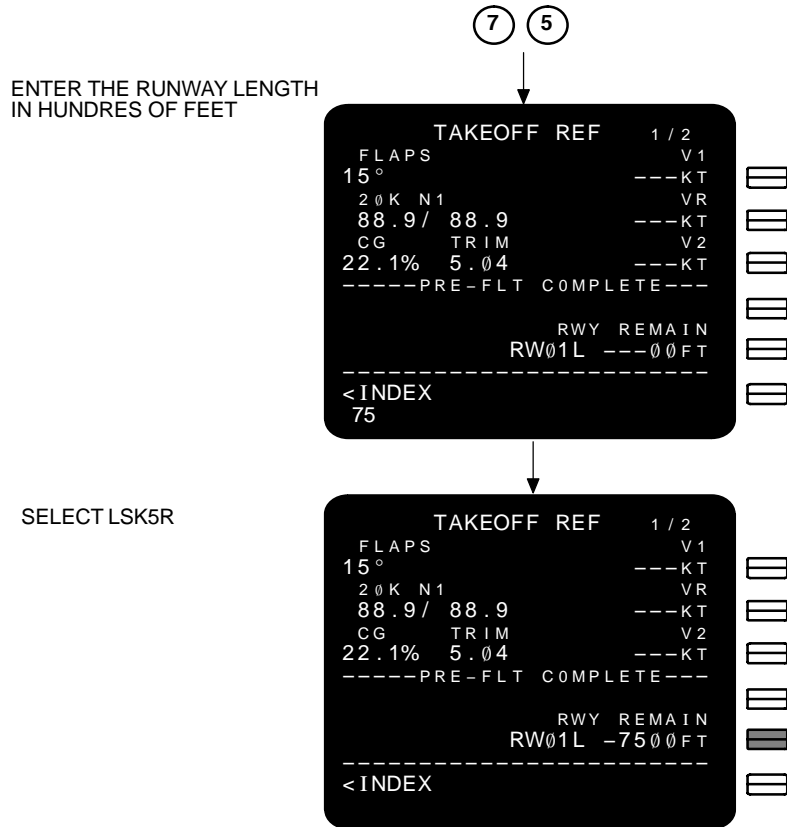
This prompt is cleared at takeoff.



RUNWAY REMAINING OPTION:

When the runway remaining option is available, the length of the runway may be entered. Distance is displayed in feet or in meters depending on the default setting feet/meters.

Valid entries are 1000 to 9900 meters or 3300 to 33000 feet.

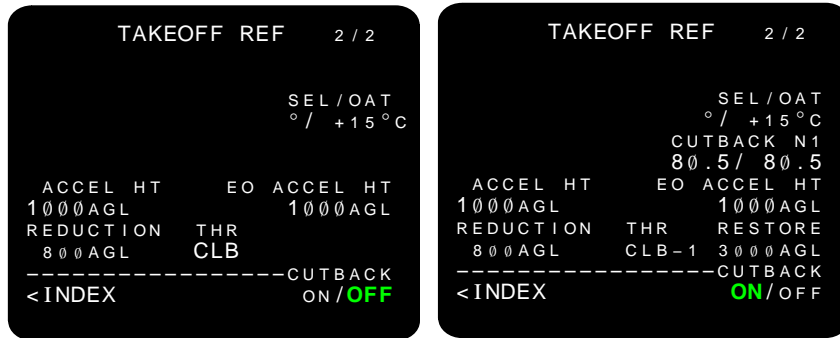


The runway length may be entered from a runway marker or from the navigation data base if the runway data is included. During takeoff, the runway length is updated each time the TOGA switch is pushed (for ground speed less than 60 kts).

This prompt is cleared at takeoff.

QUIET CLIMB SYSTEM (QCS) OPTION:

When the QCS option is available, the FMC computes a cutback takeoff N_1 thrust limit as well as reduction and restoration heights for controlling the selected takeoff and climb N_1 thrusts at each. Thrust reduction and resoration height is always displayed in feet AGL for the ORIGIN airport entered into the RTE page.

PAGE 1:

This page operates like the standard TAKEOFF REF page 1.

PAGE 2:

- THR REDUCTION (5L) – displays the height (feet AGL for the ORIGIN airport) at which the takeoff thrust to climb thrust limit transition occurs.
 - The header and field is blanked until TAT is available or OAT is entered.
 - Displays the dash prompt until ORIGIN airport is entered into the RTE page, and clears to a dash prompt at end of flight.
 - The default thrust reduction height is obtained from the MEDB and depends upon the state of CUTBACK (6R).
 - CUTBACK selected OFF – defaults to the thrust reduction height that fits the takeoff profile.
 - CUTBACK selected ON – defaults to the computed CUTBACK N_1 thrust reduction height.



- Manual entries are allowed and are displayed in large font.
- Climb Rating (5C) – displays the selected climb rating to be used at the thrust reduction height transition.
 - Field is blanked until an ORIGIN airport is entered on the RTE page.
 - Displays the CLB, CLB-1, or CLB-2 that is selected on the N1 LIMITS page. Defaults to CLB if a derate is not selected on the N1 LIMITS page.
 - When performance option ONE is enabled, the FMC will automatically select the highest climb rating that will satisfy the throttle reduction requirement at the thrust reduction height transition. The selected rating is set here and on the N1 LIMITS page.
- CUTBACK N1 (3R) – displays the computed cutback N₁ limits providing all required inputs are completed.
 - Header and field are blanked until cutback is selected ON.
- RESTORE Transition height (5R) – displays the height (feet AGL at the ORIGIN airport) that the cutback N₁ will transition to the normal climb N₁.
 - The default setting is determined by the MEDB or Loadable performance database.
 - May be manually entered. Manual entries are displayed in large font. Deleted entries result in the default value being used.
 - The height is always displayed in feet.
 - Displayed when CUTBACK is selected ON.
- CUTBACK (6R) – provides a toggle to turn the cutback function on and off. The ON/OFF toggle is displayed after all required entries are completed. The header is always displayed.
 - The ON/OFF toggle will not be displayed under the following conditions:
 - The airplane is on the ground and not in TAKEOFF mode.
 - Not all of the required entries are completed.
 - The airplane is above the RESTORE height.
 - The airplane is above the REDUCTION height and CUTBACK is toggled OFF by the FMC or by the flight crew.

TAKEOFF SPEEDS OPTION:

When one of the takeoff speeds options is available, the FMC computes the takeoff speeds, and displays them in small font next to the V1, VR, and V2 fields for selection. Page 2 includes addition runway parameters to include in the computations.

TAKEOFF REF			1 / 2
FLAPS	VSPDS	V1	
15°			---
20K N1		VR	
88.9 / 88.9			---
CG	TRIM	V2	
22.1%	5.04		---
-----PRE-FLT COMPLETE-----			
-----SELECT			
<INDEX	VSPDS ON>		

COMPUTED
TAKEOFF SPEEDS OFF

TAKEOFF REF			1 / 2
FLAPS	QRH	V1	
15°			---
20K N1		VR	
88.9 / 88.9			---
CG	TRIM	V2	
22.1%	5.04		---
-----PRE-FLT COMPLETE-----			
-----SELECT			
<INDEX	QRH ON>		

CERTIFIED
TAKEOFF SPEEDS OFF

TAKEOFF REF			1 / 2
FLAPS	VSPDS	V1	
15°	133>		---
20K N1		VR	
88.9 / 88.9	136>		---
CG	TRIM	V2	
22.1%	5.04	141>	---
-----PRE-FLT COMPLETE-----			
-----SELECT			
<INDEX	VSPDS OFF>		

COMPUTED
TAKEOFF SPEEDS ON

TAKEOFF REF			1 / 2
FLAPS	QRH	V1	
15°	133>		---
20K N1		VR	
88.9 / 88.9	136>		---
CG	TRIM	V2	
22.1%	5.04	141>	---
-----PRE-FLT COMPLETE-----			
-----SELECT			
<INDEX	QRH OFF>		

CERTIFIED
TAKEOFF SPEEDS ON

In both cases, the FMC computes the takeoff speeds using the parameters currently displayed and incorporates any runway data available on page 2. Selecting a computed speed (LSK 1R, 2R, or 3R) places the computed speed into the active speed column under V1, Vr, or V2 and will be used as the takeoff target speed.

When ever the FMC recomputes the speeds due to selections and changes to parameters, the current computed speeds are momentarily blanked.



SELECT VSPDS/QRH ON/OFF – provides a toggle to turn speeds on or off. The displayed selection is the opposite of the current page status (i.e., When VSPDS is turned on, 6R displays VSPDS OFF).

```

                TAKEOFF REF      2 / 2
RW WIND      18° / 7      RW COND
                DRY / WET / SK-R>
RW SLOPE / HDG  3.0% / 18°  SEL / OAT
                ---° / +15°C

ACCEL HT      EO ACCEL HT
1000AGL      1000AGL

-----
<INDEX
  
```

The runway condition may be entered to improve the takeoff speed computations displayed on page 1.

- Enter Runway wind direction and speed.
- Enter the runway slope and heading.
- Select the runway condition.

TAKEOFF DERATE INHIBIT OPTION:

If the takeoff derate inhibit option is active, the takeoff derate selections are blanked

MANUAL TAKEOFF SPEEDS OPTION:

When the manual takeoff speeds option is active, all takeoff speed changes must be made manually.

TO THRUST AUTO-SELECT OPTION:

When the Takeoff thrust auto-select option is active, the FMCS will automatically select a takeoff thrust rating for the origin airport or origin airport/runway combination entered into the RTE page.

Selection is made when the flight crew EXECutes the flight plan. The FMCS locates the origin airport or airport/runway combination in the LDDDB Airport/Runway Data List and enters the associated takeoff thrust into the takeoff parameters.

The FMC will determine the default setting as follows:

- If the origin airport or airport/runway combination is not in the LDDDB Airport/Runway Data List, and a default data record is available, the FMCS will default to the takeoff thrust rating specified in the default data record, and display the VERIFY TAKEOFF THRUST message in the FMCS display scratchpad.
- If the origin airport or airport/runway combination is not in the LDDDB Airport/Runway Data List, and a default data record is not available, the FMCS will default to the full takeoff thrust rating and display the VERIFY TAKEOFF THRUST message in the FMCS display scratchpad.







CLB

The Climb page provides status to the top-of-climb point in the flight plan and allows selection of different modes to modify the climb. The climb phase may also be used to monitor the estimated time to the next waypoint in the climb phase, and check the time window when an RTA waypoint is designated. Waypoint related constraints displayed here are entered on the RTE LEGS page.

During a missed approach, the climb page is reset for the new speed and altitude requirements. If the missed approach CRZ ALT is above the current altitude and the DES page is displayed, the climb phase is set active and the CLB page is displayed.

PAGE ACCESS

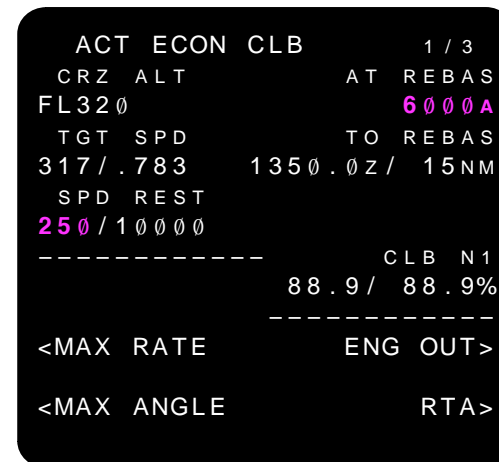
- Press  key (CDU or MCDU)
- Press  key when climb is the active performance mode (FANS MCDU)
- Press  key from DES page (FANS MCDU)
- Press  key from CRZ page (FANS MCDU)
- Automatically displayed from TAKEOFF REF page when transitioning to the climb phase

```

ACT ECON CLB          1 / 1
CRZ ALT              AT REBAS
FL320                6000A
TGT SPD              TO REBAS
317 / .783          1350.0Z / 15NM
SPD REST
250 / 10000
-----
                                CLB N1
                                88.9 / 88.9%
-----
<MAX RATE           ENG OUT>
<MAX ANGLE          RTA>

```

CDU or MCDU



FANS MCDU

The default mode is economy (ECON) with a 250 knot speed restriction below 10,000 feet and can be modified by:

- The origin airport entry on the RTE page, when a speed restriction and transition altitude are included in the navigation database.
- Can be manually changed.

The active speed selection between target speed or speed restriction is highlighted.

Six climb modes are available:

- ECON – economy mode (default mode)
- ENG OUT – engine out mode (advisory only)
- Manual Speed – manual target speed mode
- MAX ANGLE – maximum angle mode
- MAX RATE – maximum rate mode
- RTA – required time of arrival mode

On MOD pages, the RTA prompt (LSK 6R) is temporarily replaced with an ERASE prompt. Selecting ERASE backs out any changes made (providing the EXEC button has not been pressed) and returns the page to the active status.



The selected climb mode is displayed in the title line.





- Initially the page will display the $V_2 + 20$ (MCP + 20) kts target speed to the acceleration height.
- After the aircraft crosses the acceleration height, the title line displays the lower of the limited target speed:
 - Flaps placard speed minus 5 kts (limited to 230 kts).
- or
- $V_{REF} + 70$ kts
- After flaps/slats are retracted the title line displays the selected climb thrust mode (i.e., ECON, RTA, etc).

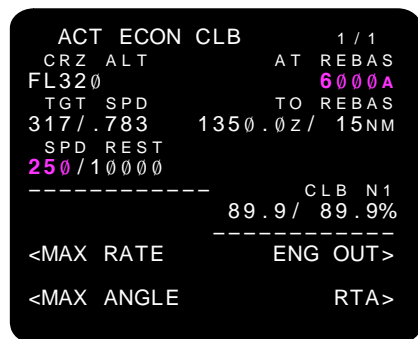


DETAILED OPERATION

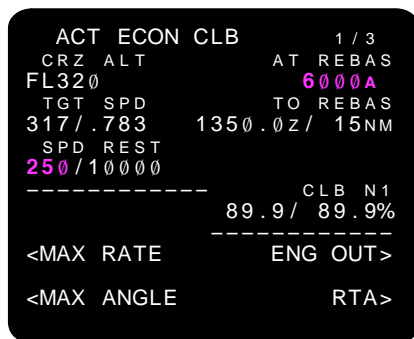
The only difference between the two pages shown below is the page number, due to the key differences on the FMCS display keyboard.

PAGE ACCESS

- Automatically when the TAKEOFF REF page is displayed and the airplane transitions to climb.
- Automatically when the DES page is displayed while transitioning onto the missed approach and the new CRZ altitude is above the current altitude.
- Press  key (CDU and MCDU).
- Press  key (FANS MCDU) then use
 - DES page  key.
 - CRZ page  key.



CDU AND MCDU



FANS MCDU

If the economy climb mode is desired, nothing need be done (the default mode is economy), however, if a different mode is desired it must be set prior to takeoff, and only one mode can be pre-programmed.

Prior to takeoff with the flight plan active, press the CLB or VNAV button on the FMCS display. Use the ECON mode as is or select the desired mode from the available prompts (LSK 5L, 6L, 5R, or



6R) or manually enter the desired target speed (manual mode). When the EXEC annunciator lights, press EXEC. This mode will now be used for climb functions for the flight unless the mode is manually changed during flight.

CRZ ALT (1L) – is displayed when entered on the PERF INIT page or may be manually entered here. When entered here, cruise altitude is inserted on all pages displaying CRZ ALT.

TGT SPD (2L) – displays the FMC computed target speeds.

- Valid range is between 100 and 340 kts CAS and 0.40 to 0.82 MACH.
- Manual speed entries are performance limited.

SPD REST (3L) – displays the airport environment speed restriction:

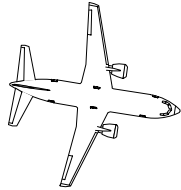
- May be the default setting (250 kts below 10,000 feet).
- May be the default from a custom performance data base if loaded.
- Speed and altitude may be changed independently, valid speed range is 100 to 340 kts.
- Delete removes speed and altitude for non-waypoint associated restrictions, and only speed for waypoint associated restrictions.
- Changes are reflected in the RTE LEGS page.
- HOLD speeds cannot be changed or modified.
- Displays a dash prompt when a restriction is not applied.
- Speed is highlighted when it is more restrictive than TGT SPD.
- The altitude changes to FLAPS when the speed restriction is less than the minimum speed for the current flaps setting.
- The altitude changes to HOLD when decelerating to hold speed prior to entering the hold.
- On a missed approach, when an airport climb speed restriction is in the navigation database, it is inserted. When a restriction does not exist the default restriction is used.

AT (1R) – displays the next waypoint in the flight plan to be sequenced in the header and provides the altitude constraint for that waypoint if one exists. The constraint may be deleted on this page or the RTE LEGS page.



Any changes to the altitude constraint are considered flight plan modifications and require the EXEC button to be pressed to incorporate the change into the active flight plan.

TO (2R) – displays the next waypoint in the flight plan to be sequenced in the header and provides the predicted ETA and distance to that waypoint.



NOTE

If the top-of-climb is the next point in the flight plan, the cruise flight level is displayed.

ERR (3R) (not shown) – when the FMC predictions indicate an undershoot, the waypoint affected is displayed as part of the header, and the undershoot is displayed below it.

N1 (4R) – displays the computed N1 value. This field is blank when a reduced climb is not specified or when the reduced N1 equals the full N1.

The following prompts are blanked when the mode is active:

- ECON
- MAX RATE
- MAX ANGLE

With VNAV armed before takeoff, the climb page will display the current target speed in the header ($V_2 + 20$ kts) while the airplane is below the acceleration height.



```

ACT 145 CLB 1 / 1
CRZ ALT AT REBAS
FL320 6000A
TGT SPD TO REBAS
317 / .783 1350 .0Z / 15NM
SPD REST
250 / 10000
----- CLB N1
89.9 / 89.9%
-----
<MAX RATE ENG OUT>
<MAX ANGLE RTA>
    
```

CDU AND MCDU

```

ACT 145 CLB 1 / 3
CRZ ALT AT REBAS
FL320 6000A
TGT SPD TO REBAS
317 / .783 1350 .0Z / 15NM
SPD REST
250 / 10000
----- CLB N1
89.9 / 89.9%
-----
<MAX RATE ENG OUT>
<MAX ANGLE RTA>
    
```

FANS MCDU

Once the airplane crosses the acceleration height, the next speed target is obtained. If the speed target is limited, the limited speed is displayed in the climb page title, and highlighted.

```

ACT 180 LIM CLB 1 / 1
CRZ ALT AT REBAS
FL320 6000A
TGT SPD TO REBAS
317 / .783 1350 .0Z / 15NM
SPD REST
250 / 10000
----- CLB N1
89.9 / 89.9%
-----
<MAX RATE ENG OUT>
<MAX ANGLE RTA>
    
```

CDU AND MCDU

```

ACT 180 LIM CLB 1 / 3
CRZ ALT AT REBAS
FL320 6000A
TGT SPD TO REBAS
317 / .783 1350 .0Z / 15NM
SPD REST
250 / 10000
----- CLB N1
89.9 / 89.9%
-----
<MAX RATE ENG OUT>
<MAX ANGLE RTA>
    
```

FANS MCDU

A limit speed in this case is the lower of the following:

- Trailing edge flaps placard speed – 5 kts.
- Leading edge flaps limit speed.
- Maximum 230 kts.

Once all flaps and slats are fully retracted, the normal full climb will continue.





ENGINE OUT CLB

The engine out climb mode is an advisory climb display providing recommended cruise altitude and speed. When the ENG OUT prompt is selected, a MOD page is not displayed and the EXEC annunciator does not light. The computed maximum altitude, speed, and continuous N1 may be manually entered into the active climb page to facilitate the engine out condition.

Access the engine out climb page via the ENG OUT prompt (LSK 5R) on the active climb page. Select the left engine (LSK 3L) or right engine (LSK 3R) to view the appropriate parameters.

To return to the active climb page;

- Press  key (CDU or MCDU).
- Press  key (FANS MCDU).



```

ACT ECON CLB 1 / 1
CRZ ALT AT REBAS
FL320 6000A
TGT SPD TO REBAS
317 / .783 1350.0Z / 15NM
SPD REST
250 / 10000
----- CLB N1
89.9 / 89.9%
-----
<MAX RATE ENG OUT>
<MAX ANGLE RTA>

```

```

ENG OUT CLB 1 / 1
CRZ ALT MAX ALT
FL320 10707
ENG OUT SPD CON N1
259KT 92.1%
-----
<LT ENG OUT RT ENG OUT>

```

```

ENG OUT CLB 1 / 1
CRZ ALT MAX ALT
FL320 10707
ENG OUT SPD CON N1
259KT 92.1%
-----
<LT ENG OUT RT ENG OUT>

```



MANUAL SPEED CLB

The manual speed climb mode is displayed when the flight crew enters a desired speed target. The title line reflects the manually entered speed that was entered into the TGT SPD.

All manual speed entries are performance limited which may result in a slower speed than actually entered.

```
ACT 335KT CLB      1 / 1
CRZ ALT
FL320
TGT SPD           TO FL365
335 / .780      1350.0Z / 98NM
SPD REST
--- / ---
-----
                        CLB N1
                        89.6 / 89.6%
-----
<MAX RATE          ENG OUT>
<MAX ANGLE         RTA>
```

The data fields are the same as for the economy climb mode.



MAXIMUM ANGLE CLB

The maximum angle climb mode provides target speeds that allow the maximum climb angle to the next waypoint along the climb path.

```
ACT MAX ANGLE CLB 1 / 1
CRZ ALT          AT REBAS
FL320           6000A
TGT SPD         TO REBAS
212 / .780     1350.0Z / 15NM
SPD REST
250 / 10000
-----
<ECON          CLB N1
                88.6 / 88.6%
-----
<MAX RATE     ENG OUT>
                RTA>
```

The data fields are the same as for the economy climb mode.



MAXIMUM RATE CLB

The maximum rate of climb mode provides target speeds that produce the greatest rate of climb to the cruise altitude.

```
ACT MAX RATE CLB 1 / 1
CRZ ALT
FL320
TGT SPD      TO FL320
246 / .780   1350.0Z / 15NM
SPD REST
250 / 10000
-----
<ECON          CLB N1
                87.2 / 87.2%
-----
                ENG OUT>
<MAX ANGLE          RTA>
```

The data fields are the same as for the economy climb mode.



RTA CLB

The RTA Climb may be used to create a required time of arrival at a specified waypoint along the climb segment of the flight plan.

The RTA Climb is initiated by placing an RTA requirement on any waypoint in the path. The RTA prompt (LSK 6R) provides a direct link to the RTA PROGRESS page to save key strokes.

- Select the RTA prompt (LSK 6R)

```

ACT ECON CLB      1 / 1
CRZ ALT          AT REBAS
FL320           6000A
TGT SPD         TO REBAS
317/.783      1350.0Z/ 15NM
SPD REST
250/10000
-----
                        CLB N1
                        89.9/ 89.9%
-----
<MAX RATE      ENG OUT>
<MAX ANGLE      RTA>

```

- Enter the desired waypoint into the RTA WPT (LSK 1L) on the RTA PROGRESS page

```

MOD RTA PROGRESS  3 / 4
RTA WPT          RTA
LIN             1403:42Z
RTA SPD         TIME ERROR
317/.783      ON TIME
SPD REST       GMT
250/10000     1350:43Z
DIST--TO LIN   --ALT/ETA
77NM         FL251/1403:42Z
FIRST--RTA WINDOW--LAST
1403:42Z     1405:31Z
-----
<ERASE

```



- Execute the modification

```

MOD RTA PROGRESS 3 / 4
RTA WPT RTA
LIN 1403:42Z
RTA SPD TIME ERROR
317/.783 ON TIME
SPD REST GMT
250/10000 1350:43Z
DIST--TO LIN --ALT/ETA
77NM FL251/1403:42Z
FIRST--RTA WINDOW---LAST
1403:42Z 1405:31Z
-----
<LIMITS
    
```

- Re-select the climb page (CLB or VNAV button) to monitor the RTA status.

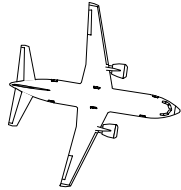
```

ACT RTA CLB 1 / 1
CRZ ALT AT REBAS
FL320 6000A
TGT SPD TIME ERROR
317/.783 ON TIME
SPD REST
250/10000
----- CLB N1
<ECON 87.3/ 87.3%
-----
<MAX RATE ENG OUT>
<MAX ANGLE RTA>
    
```

The TO (2R) field is replaced by a TIME ERROR field providing the RTA status to the designated waypoint and the title line includes the RTA mode.

ALTITUDE/SPEED INTERVENTION OPTION:

When the altitude/speed intervention option is active the cruise altitude may be changed using the altitude intervention button. For each press of the altitude intervention button, the lowest altitude constraint between the airplanes current altitude and the FMC cruise altitude is deleted from the flight plan.

**NOTE**

When this is done, the altitude constraint is deleted without a route modification.

When the flight plan does not contain an altitude constraint between the current altitude and the entered CRZ ALT with the MCP altitude above the CRZ ALT, the MCP altitude will be the new cruise altitude providing it is not above the airplanes maximum altitude capability.

The FMC TGT SPD is set to the MCP speed and cannot be changed or deleted on the CLB page.

```

ACT ECON CLB      1 / 1
CRZ ALT          AT REBAS
FL320            6000A
TGT SPD          TO REBAS
335/MCP         1350.0Z / 15NM
SPD REST
250 / 10000
-----
                        CLB N1
                        89.9 / 89.9%
-----
<MAX RATE       ENG OUT>
<MAX ANGLE      RTA>

```

An altitude constraint in the AT target (1R) may be removed by altitude intervention.

QUIET CLIMB SYSTEM (QCS) OPTION:

When the QCS option is active, and cutback is selected on, the cutback N1 limits and restore height are used to calculate the SPD REST speed and altitude. The inserted altitude is the runway elevation plus the RESTORE altitude.

A cutback speed restriction cannot be deleted or modified.

```
ACT ECON CLB      1 / 1
CRZ ALT          AT REBAS
FL320           6000A
TGT SPD         TO REBAS
241 / .805     1350.0Z / 15NM
SPD REST
220 / 00807
----- CUTBACK N1
                81.3 / 81.3%
-----
<MAX RATE      ENG OUT>
<MAX ANGLE     RTA>
```

CUTBACK N1 is displayed in 4R.







CRZ

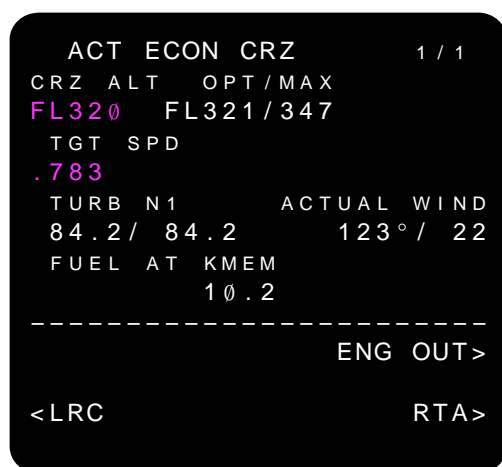
The Cruise page provides status and predictions during the active cruise phase of the flight plan and allows access to other cruise modes or changes in the cruise schedule.

The economy mode is the default unless a different mode is pre-planned. The FMC computes the best speed target to provide a level cruise phase at the target altitude with the information provided.

PAGE ACCESS

- Press  key (CDU or MCDU)
- Press  key when climb is the active performance mode (FANS MCDU)
- Press  key from CLB page (FANS MCDU)
- Press  key from DES page (FANS MCDU)
- Automatically displayed from CLB page when transitioning to the cruise phase

Prior to CRZ transition





After CRZ transition

CDU or MCDU

```

ACT ECON CRZ      1 / 1
CRZ ALT  OPT/MAX  STEP
FL320  FL321/347  -----
TGT SPD          TO T/D
.783          1526.1z / 33NM
TURB N1        ACTUAL WIND
84.2 / 84.2    123° / 22
FUEL AT KMEM
              10.2
-----
                                ENG OUT>
<LRC                                RTA>
    
```

FANS MCDU

```

ACT ECON CRZ      2 / 3
CRZ ALT  OPT/MAX  STEP
FL320  FL321/347  -----
TGT SPD          TO T/D
.783          1526.1z / 33NM
TURB N1        ACTUAL WIND
84.2 / 84.2    123° / 22
FUEL AT KMEM
              10.2
-----
                                ENG OUT>
<LRC                                RTA>
    
```

The cruise page accommodates four modes:

- ECON – economy mode (default mode)
- ENG OUT – engine out mode (advisory only)
- Manual – manual target speed mode
- LRC – long range cruise
- RTA – required time of arrival mode



A step climb or descent may be initiated to change the planned cruise altitude.

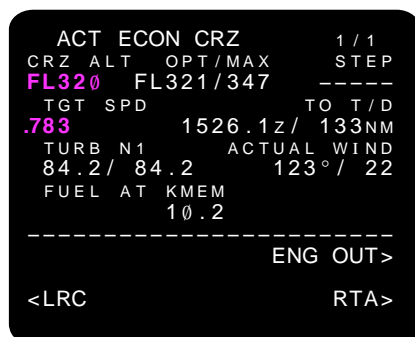
In the FANS MCDU, this page is VNAV page 2/3.

Transitioning onto a missed approach when the descent page is displayed causes the default mode cruise page to be re-displayed. The page will be updated with the missed approach information included.



DETAILED OPERATION

The Cruise page is not active until the the climb phase transitions to the top-of-climb (T/C). Once active, the FMC computes the time and distance to the top-of-descent (T/D) and displays it. Fuel predictions to the destination are also updated at this time. When cruise wind data is entered, the prediction computations take it into account.



CRZ ALT – displays the cruise altitude entered on the PERF INIT page and may be overwritten within the constraints of the airplane.

When the the cruise phase is active (ACT displayed in title line), and cruise altitude is changed, the display automatically changes to the CRZ CLB page to perform a step climb or CRZ DES for a step descent.

OPT/MAX – displays the FMC computed optimum and maximum cruise altitude based on weight, wind, fuel, flight distance, and performance data.

TGT SPD – displays the current FMC computed target speed. Manual entries may be made in ether CAS or MACH value. When the CRZ page is active, the target speed is highlighted and this is the FMC speed used. Valid ranges are 100 to 400 CAS or 0.40 to 0.82 MACH. Target speed displays (speed)/HOLD when decelerating to a holding speed prior to entering the hold.

TURB N1 – displays the computed turbulence penetration N1 for current entries. This is for reference only.

FUEL AT – displays the estimated remaining fuel weight at the destination.

- Blank if a destination was not entered on the RTE page.



- Changes to the flight plan or wind data will cause the FMC to recompute this value.
- Recomputed for a step climb. Prior to the step point, the displayed fuel weight estimate is preceded by W/STEP.

TO T/D – displays the computed distance to the top-of-descent point and the estimated time of arrival.

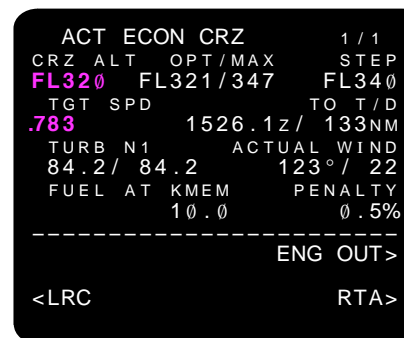
Step Climb and Step Descent.

While the cruise segment of the flight plan is active, the step function is enabled to allow altitude changes while in climb.

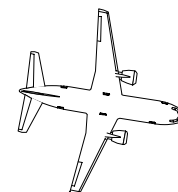
Entering a new altitude, above or below the current cruise altitude, displays the step point, the fuel advisory prediction, and fuel remaining at destination prediction.

The RTA prompt (LSK 6R) changes to an ERASE prompt when a new CRZ ALT is entered.

STEP – allows a change in altitude to be planned while the CRZ page is active. Entering a new attitude in STEP causes the FMC to recompute fuel estimates, and indicates a penalty or savings at line 4R.



- Only displayed on ACT cruise page. Header and dash prompt are blank prior to the cruise phase.



NOTE

The prompt is again blanked when the airplane is closer than 100 nm from the top-of-descent (T/D) point.



- Entering an altitude above the airplanes maximum altitude displays the error message INVALID ENTRY.
- Entering an altitude above the MCP altitude but below the MAX altitude displays the message RESET MCP ALT.
- Entering an altitude below the airplanes maximum altitude and above the MAX altitude on the CRZ page displays the message MAX ALT (altitude).

STEP POINT – displays the point at which the predictions for fuel advisory and fuel remaining at destination predictions were computed from.

- Step climb:
 - When PPOS is greater than 100 nm from the T/D, the ETA and distance to the step point are displayed.
 - When PPOS is greater than 100 nm from the T/D, and after the step point, NOW is displayed.
 - If the step point is closer than 100 nm from the T/D, UNABLE is displayed.
- Step descent:
 - Displays NOW and assumes an immediate descent to the new cruise altitude and uses PPOS for the fuel advisory and fuel remaining at destination predictions.

ACTUAL WIND (3R) – displays the current wind information used in the fuel predictions. If desired, other wind data may be entered. The header changes to EST WIND for manual entries and reverts back when deleted or a new altitude is entered and executed.

Fuel advisory (4R) – after a new altitude is entered into STEP (LSK 1R, the FMC predicts fuel usage from the step point (PPOS if NOW is displayed) to the destination, flying the same route with the new cruise altitude.

- SAVINGS – displayed when a fuel savings is predicted.
- PENALTY – displayed if the altitude change is predicted to use more fuel than is currently predicted for the active flight plan.

FUEL AT – displays the predicted fuel quantity remaining when the airplane has landed on the runway. Prior to executing a step change, the indication includes W/STEP to show the prediction includes the proposed change.

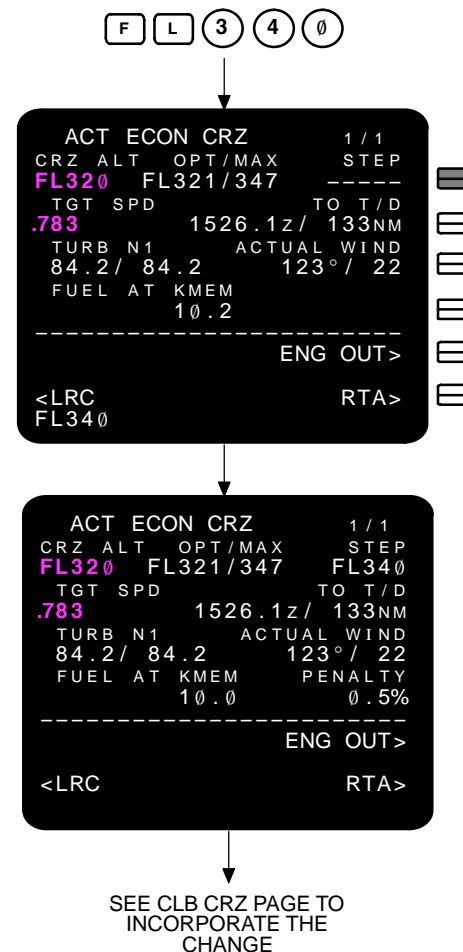
ERASE (6R) – the RTA prompt normally displayed is changed to an ERASE prompt whenever a new altitude is entered into the STEP.



Selecting the ERASE prompt will back out the changes and restore the page to the ACT CRZ page prior to pressing the EXEC button.

RTA (6R) – displayed on the active cruise page to select an RTA point.

To view the results of a desired change in the cruise altitude, enter the new altitude and select it to the STEP DASH prompt (LSK 1R). The results will be displayed in a few seconds.



To incorporate the change indicated by the step refer to:

- CRZ CLB for altitudes above the current cruise altitude.
- CRZ DES for altitudes below the current cruise altitude.



ENGINE OUT CRZ

The Engine Out Cruise mode is an advisory cruise display providing recommended cruise altitude and speed. When the ENG OUT prompt is selected (LSK 5R), a MOD flight plan is not generated and the EXEC annunciator does not light. The computed maximum altitude, speed, and continuous N1 may be manually entered into the active cruise page to facilitate the engine out condition.

Access the engine out cruise page via the ENG OUT prompt (LSK 5R) on the active cruise page. Select the left engine (LSK 4L) or right engine (LSK 4R) to view the appropriate parameters.

To return to the active cruise page;

- Press CRZ key (CDU or MCDU).
- Press VNAV key (FANS MCDU).



```

ACT ECON CRZ      1 / 1
CRZ ALT  OPT/MAX  STEP
FL320  FL321/347  -----
TGT SPD          TO T/D
.783      1526.1z / 133NM
TURB N1        ACTUAL WIND
84.2 / 84.2    123° / 22
FUEL AT KMEM
              10.2
-----
                                ENG OUT>
<LRC                      RTA>
    
```

```

ACT ECON CRZ      1 / 1
CRZ ALT  OPT/MAX  STEP
FL320  FL321/347  -----
TGT SPD          TO T/D
.783      1526.1z / 133NM
TURB N1        ACTUAL WIND
84.2 / 84.2    123° / 22
FUEL AT KMEM
              10.2
-----
<LT ENG OUT  RT ENG OUT>
    
```

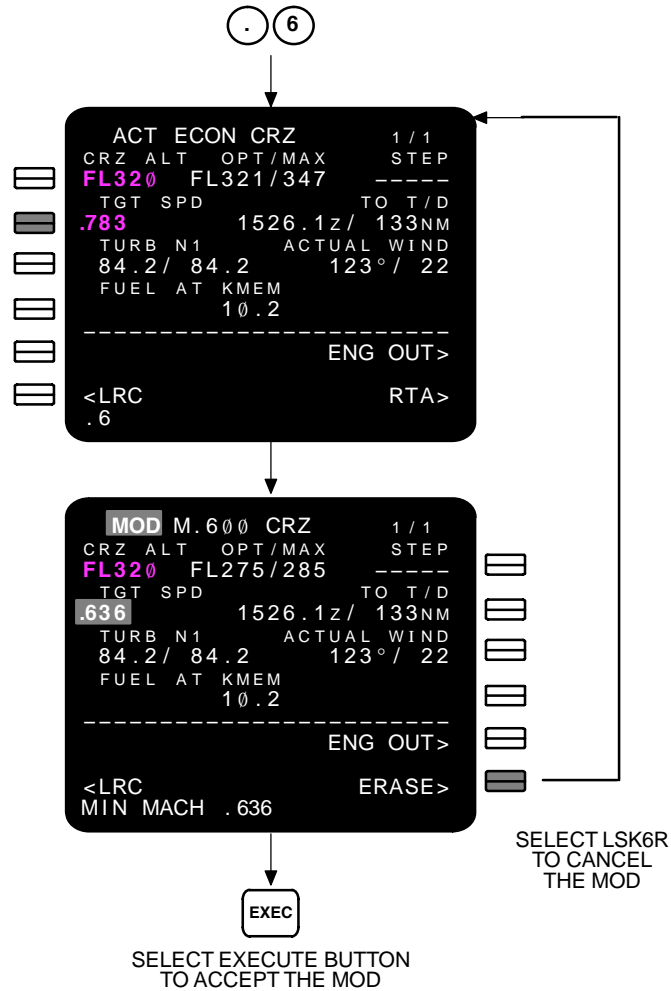
```

ENG OUT CRZ      1 / 1
CRZ ALT          MAX ALT
FL320          10706
ENG OUT SPD
263KT
CON N1
98.5%
-----
<LT ENG OUT  RT ENG OUT
    
```



MANUAL SPEED CRZ

The Manual Speed Cruise mode is entered when a speed target is entered when a speed target is entered into TGT SPD (2L). Speed entries are performance limited which may result in a different speed displayed than was entered. The title line will display the entered speed even though the FMC inserted a performance limited speed at 2L, and will follow the format (CAS/MACH) as entered.



When the entered speed is below the minimum required cruise speed, the message MIN MACH or MIN CAS message is displayed



in the scratchpad. If the entered speed is above the maximum speed, the message MIN MACH or MIN CAS message is displayed in the scratchpad. In both cases, the message will include the performance limited value inserted into TGT SPD.



LRC CRZ

The Long Range Cruise page computes and uses the best economy predicted target speed from PPOS to T/D.

```
ACT LRC CRZ      1 / 1
CRZ ALT  OPT/MAX  STEP
FL320  FL321/347  -----
TGT SPD      TO T/D
.773      1726.1Z/1133NM
TURB N1      ACTUAL WIND
84.2 / 84.2      123° / 22
FUEL AT KMEM
      10.2
-----
<ECON      ENG OUT>
      RTA>
```

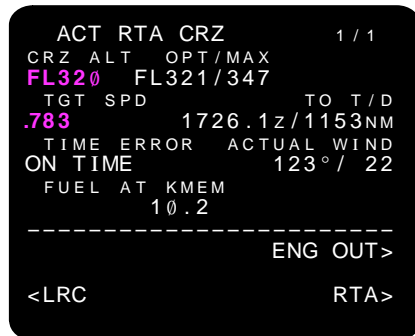
The data fields are the same as for ECON CRZ.



RTA CRZ

The RTA cruise page allows an RTA to be entered along the flight path. The turbulence N1 is replaced with the RTA time error indicator to allow monitoring the progress without changing pages.

Anytime an RTA is placed on a waypoint along the path, the CRZ page is set to an RTA CRZ page.



The RTA prompt (LSK 6R) provides a direct link to the RTA PROGRESS page to help save keyboard strokes.

ALTITUDE/SPEED INTERVENTION OPTION:

When the speed/altitude intervention option is available and a manual speed change is made on the MCP, the /MCP indicator follows the new target speed.

- The change cannot be modified or deleted on the LCD, it must be changed again at the MCP.
- The change does not result in a MOD cruise page and does not require executing.

```
ACT ECON CRZ      1 / 1
CRZ ALT  OPT/MAX  STEP
FL320  FL321/347  ----
TGT SPD          TO T/D
.799/MCP  1526.1Z/ 33NM
TURB N1        ACTUAL WIND
84.2 / 84.2    123° / 22
FUEL AT KMEM
              10.2
-----
                        ENG OUT>
<LRC                      RTA>
```


CRUISE SPEED FORWARD PROPAGATION OPTION:

When the Cruise Speed Forward Propagation option is available, a manually entered CAS or MACH TGT SPD (LSK 2L) entered on a CRZ page is propagated onto the DES page TGT SPD to prevent sudden speed changes at top-of-descent, and also allows ATC assign speeds to be rapidly entered while still in CRZ.

```
ACT ECON CRZ      1 / 1
CRZ ALT  OPT/MAX  STEP
FL320  FL321/347  ----
TGT SPD          TO T/D
.799          1526.1z/ 33NM
TURB N1        ACTUAL WIND
84.2 / 84.2    123° / 22
FUEL AT KMEM
              10.2
-----
                        ENG OUT>
<LRC                      RTA>
```


When the CRZ mode is changed on any CRZ page, the descent mode is also changed on the DES page.



PROGRESS

The Progress pages provide current status as well as predicted RTA status from the history waypoint to the end of the flight.

PAGE ACCESS

- Press  key anytime.
- Select the RTA prompt (LSK 6R) on any climb, cruise, or descent pages

The history waypoint (line 1) provides the altitude, the actual time of arrival, and the available fuel quantity at that time.

The active waypoint, next waypoint, and destination are displayed in lines 2 through 4, with the active waypoint highlighted (line 2). These provide the distance-to-go from PPOS, the estimated time of arrival and the estimated fuel remaining.

PROGRESS				1 / 4
FROM	ALT	ATA	FUEL	
HBU	FL320	1530Z	15.4	
82°	DTG	ETA	FUEL	
ELWAY	25	1538Z	15.2	
84°				
FSHER	104	1549Z	14.7	
KMEM	868	1730Z	10.2	
TO T/D		FUEL QTY		
1709Z /	755NM		15.3	
WIND				
091° /	2KT	NAV STATUS>		

Line 5 displays status for key events.

- Step-to points
- Top-of-climb
- Top-of-descent
- End-of-descent



Page 2 displays wind and position status.

```

                PROGRESS                2 / 4
HEADWIND                CROSSWIND
 9KT                    L 7KT
WIND                    SAT / ISA DEV
091° / 2                -48°C / +00°C
XTK ERROR
R 0.01NM

                                TAS
                                456KT
    
```

Page 3 is used to enter a waypoint and generate an RTA reference.

```

                RTA PROGRESS                3 / 4
RTA WPT
-----

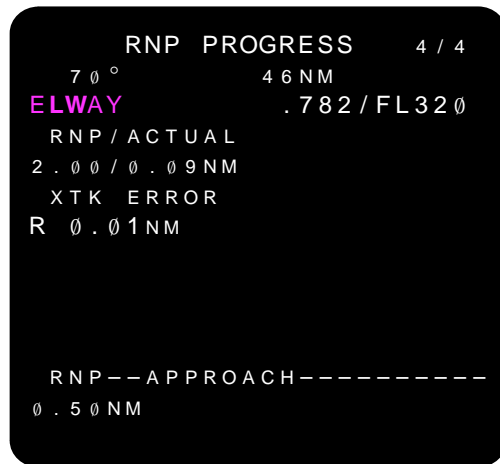
-----
<LIMITS
    
```




Page 4 displays RNAV status and allows manual entry of RNP at LSK 2L.

RNP values entered on this page are propagated to other pages displaying RNP/ANP values.

During descent line 3R displays the vertical deviation (not shown)



Only the RNP at line 2 may be altered.

FMC RNP values are displayed in small font, while manual entries are displayed in large font.



DETAILED OPERATION

The Progress pages display navigation and time requirements for key event points of the flight. This is a status page so few entries are permitted, however, changes made on other pages are immediately updated on these pages.

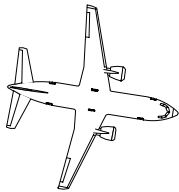
As each waypoint in the route is sequenced, the queue on page 1 moves up a position.

Page 1 – Flight plan progress status.

PROGRESS				1 / 4
FROM	ALT	ATA	FUEL	
HBU	FL320	1530Z	15.4	
82°	DTG	ETA	FUEL	
ELWAY	25	1538Z	15.2	
84°				
FSHER	104	1549Z	14.7	
KMEM	868	1730Z	10.2	
TO T/D		FUEL QTY		
1709Z /	755NM		15.3	
WIND				
091° /	2KT	NAV STATUS>		

Line 1:

- Reserved for the last history waypoint sequenced.
- ALT – displays the altitude at the time the waypoint was sequenced.
- ATA – displays the actual time-of-arrival at the waypoint.
- FUEL – displays the fuel quantity remaining when the waypoint was sequenced.



NOTE

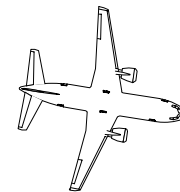
This is the only page that maintains the history waypoint.

LINE 2 through 4:

- Line 2 is reserved for the current go-to waypoint in the route and is highlighted.
- line 3 is reserved for the next waypoint in the route to be sequenced.
- Line 4 is reserved for the destination airport in the route.

Lines 2 through 4 provide the following information for each waypoint:

- DTG – the distance-to-go is listed in nautical miles.
- ETA – displays the FMC computed estimated time-of-arrival to the indicated waypoint.
- FUEL – displays the predicted fuel quantity remaining at the indicated waypoint.

**NOTE**

When a heading is associated with a waypoint, it will be shown immediately below that waypoint.

LINE 5:

Line 5 shows the computed ETA and distance to the event specified in the line header. Events listed in this line are:

- Top-of-climb
- Top-of-descent
- End-of-descent
- Step points

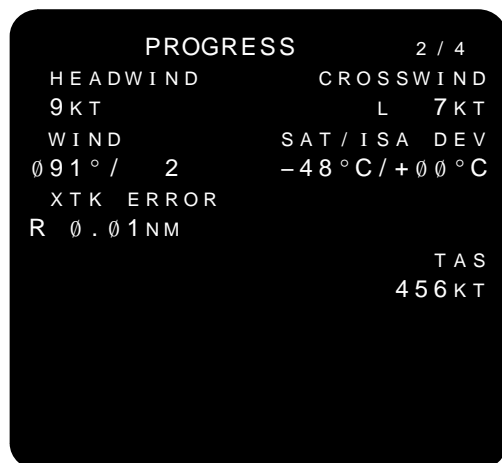
FUEL QTY – displays the current fuel quantity obtained from the FQIS.

LINE 6:

Line 6 will display the current wind direction and speed.

Page 2

Displays current wind and tracking information.



Line 1:

- Left side – displays HEADWIND or TAILWIND speed affect in kts.
- Right side – displays the crosswind in knots and specifies the direction (L or R).

Line 2:

- Left side – displays the current wind direction and speed.
- Right side – displays SAT and equivalent ISA deviation.
 - If SAT is not entered, OAT is displayed.
 - Field is blank when on the ground or the airplane is not equipped with an aspirated TAT probe.

Line 3:

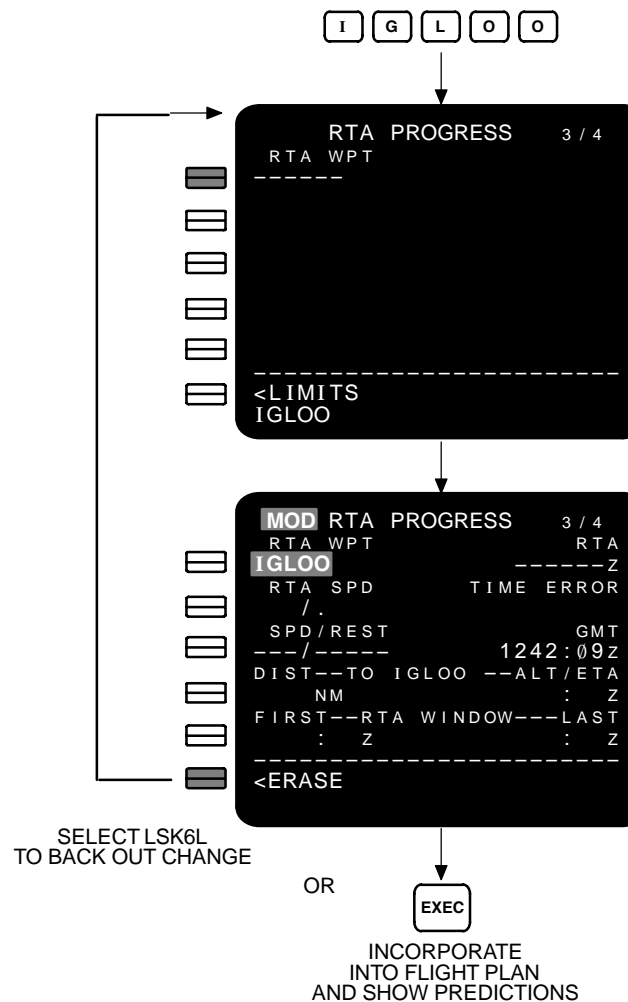
- Left side – displays the current crosstrack error from the desired track shown on the ND. When the distance is zero, a direction (L or R) is not displayed.

Line 4, right side – displays the current TAS.



Page 3

The RTA PROGRESS page is where the RTA function is enabled. When the RTA prompt on any page is selected, the RTA PROGRESS page is displayed. Select a waypoint from another page (i.e., RTE LEGS page) or manually enter the waypoint into the scratch pad. Select the waypoint to the RTA WPT line (LSK 1L).



Select the ERASE prompt (LSK 6L) to remove the change or execute the change to incorporate it into the active flight plan. Once executed, all flight mode pages reflect the active RTA function in



the title line for the page and the RTA PROGRESS page shows ACT in the title line.

```
ACT RTA PROGRESS 3 / 4
RTA WPT RTA
IGLOO 1707:41Z
RTA SPD TIME ERROR
.781 ON TIME
GMT
1531:29Z
DIST--TO IGLOO --ALT/ETA
706NM FL320/1707:41Z
FIRST--RTA WINDOW---LAST
170501Z 1722:41Z
-----
<LIMITS
```

After execution all parameters and status are completed. Other flight plan pages are now updated to supply the RTA status on them and page titles are updated to include the active RTA schedule.

To remove an active RTA schedule, press the **DEL** key and select the RTA WPT (LSK 1L). The RTA PROGRESS page again shows the modification status, the ERASE prompt replaces the LIMITS prompt and the EXEC annunciator on the keyboard lights. Executing the deletion removes the RTA schedule from all pages (does not remove the waypoint from the flight plan).

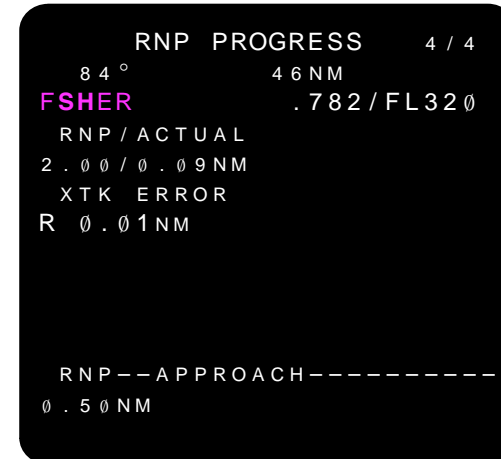


Page 4

Displays RNP information related to the flight. Only the RNP/ACTUAL line may be altered on this page. All other changeable information must be made on other pages.

The first line displays the go-to waypoint from the active flight plan (RTE LEGS page line 1). When a heading is associated with that waypoint, it is displayed above it along with the FMC computed distance to go. The current FMC speed and altitude is also provided.

Leg info (i.e., OFFSET, BYPASS, GP angle) is also displayed above the flight level when applicable.



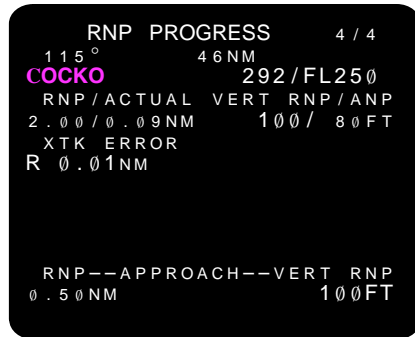
RNP/ACTUAL – displays the current FMC RNP/ANP values. The RNP may be overwritten (manual entries are displayed in large font) and affects the approach RNP value. The RNP value displayed is selected from the performance defaults database (environment default) if not specified in the navigation database.

XTK ERROR – displays the current crosstrack error from the desired track shown on the ND display. When the value is zero, a direction (L or R) is not displayed.

Approach RNP – displays the current lowest applicable navigation database or default RNP for the approach.



Vertical RNP – when the CDS LNAV/VNAV scales are enabled line 2R displays the vertical RNP/ANP in feet for the descent and for the approach.



During descent after the path is captured, the vertical deviation is displayed in line 3R.

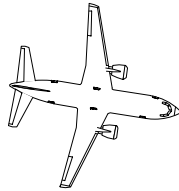


MANUAL RNP OPTION:

When the manual RNP option is available the RNP entries can be altered by the flight crew.

RNP/ACTUAL – The RNP may be overwritten (manual entries are displayed in large font) and affects the approach RNP value in line 6L. The RNP value displayed is determined as follows:

- Manual Entries
- Navigation data base assigned
- Performance defaults database (environment default)



NOTE

Manual entries of RNP that are greater than NDB or PERF DB values are accepted and display the message VERIFY RNP VALUE.

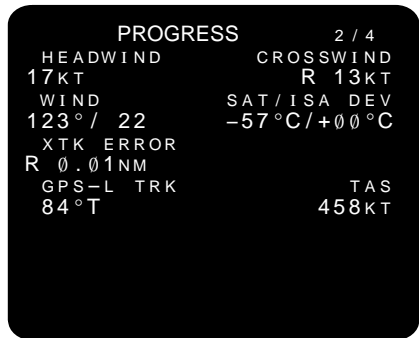
This message will also be displayed when the NDB or environment default changes to a smaller value than an existing manual entry.

Approach RNP – displays the current lowest applicable navigation database or default RNP for the approach when manual entries were not made in line 2. If an entry is made in line 2, this field reflects that entry.

Vertical RNP – when the CDS LNAV/VNAV scales are enabled line 2R displays the vertical RNP/ANP in feet for the descent and for the approach and may be manually changed. The vertical RNP range is from 10 to 999 feet.

GPS OPTION:

When the GPS WITH INTEGRITY option is used, page 2 also displays the GPS track for comparison with other tracking data.



If the DIRECT GPS INPUT option is enabled, the FMCS will receive GPS data directly from the MMR.

FLIGHT NUMBER OPTION:

When the flight number option is available the flight number entered in the RTE page 3 is displayed as part of the PROGRESS page title line. When a flight number has not been entered, the flight number portion of the title line displays dashes.

CHILLUSA PROGRESS 1 / 4			
FROM	ALT	ATA	FUEL
HBU	FL320	1530Z	15.4
82°	DTG	ETA	FUEL
ELWAY	25	1538Z	15.2
84°			
FSHER	104	1549Z	14.7
KMEM	868	1730Z	10.2
TO T/D		FUEL QTY	
1709Z /	755NM		15.3
WIND			
091° /	2KT	NAV STATUS>	

The flight number may be up to eight characters in length.

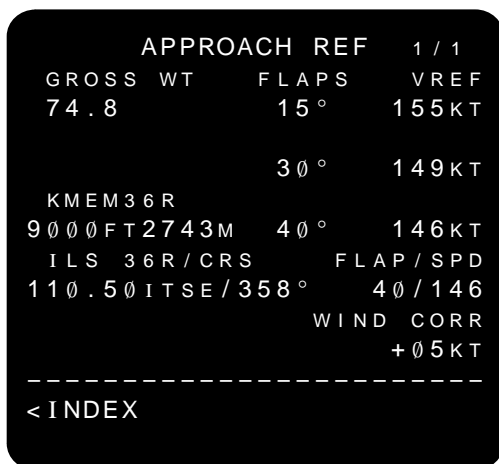


APPROACH REF

The Approach Reference page allows the approach to be pre-planned during cruise.

PAGE ACCESS

- Press  key.
- INIT/REF INDEX page APPROACH prompt (LSK 5L)



Destination airport approach reference information is displayed.

Displayed information includes:

- Gross weight – Box prompts are displayed if computed gross weight is invalid.
- Landing Reference
- Runway length (when a runway is entered into the flight plan and the length is contained in the navigation database).
- ILS approach procedure navaid data.
- VREF increment for the landing flaps target speed.
- ILS front course.



DETAILED OPERATION

The Approach Reference page displays the FMC computed landing reference speed, the runway length from the navigation data base, and the selected approach identifier.

This page should be used while in cruise to select the intended FLAP/SPD for landing.

APPROACH REF		1 / 1
GROSS WT	FLAPS	VREF
74.8	15°	155KT
	30°	149KT
KMEM36R		
9000FT	2743M	40° 146KT
ILS 36R/CRS		FLAP/SPD
110.50ITSE/358°		--/---
	WIND CORR	+05KT

< INDEX		

GROSS WT – displays the current FMC computed gross weight. To estimate landing speeds, a gross weight may be entered and the resulting landing speed can be checked. The gross weight and landing speed calculations revert to FMC computed values when exiting this page. The box prompt is displayed if the computed value is not valid.

FLAPS and VREF – displays flaps detent (maximum of three) used to compute the corresponding values of VREF speeds. The approach speed for each flaps position is computed based on the current gross weight.

RUNWAY LENGTH (line 3) – displays the runway length whenever the runway is specified in the active flight plan and the length is contained in the navigation database. The header displays the airport and runway identifier.

APPROACH (line 4) – when a localizer-based or GLS-based approach is selected in the active flight plan, the header line displays the approach type to the selected runway, and the data line displays the frequency or channel, the approach identifier, and the



course. This header and data field are blank until an ILS/GLS based approach is entered into the flight plan.

CRS displays the ILS/GLS based approach front course. When the course is referenced to true north, the suffix "T" is added.

FLAP/SPD – allows entry of the desired landing flaps and speed for landing while in the air.

To select a default flaps setting and use the FMC computed speed, use the current gross weight minus the projected fuel remaining weight at the destination from the PROGRESS page to obtain an estimated gross weight. Enter this into GROSS WT (LSK 1L). VREF will be re-computed. This may be treated as advisory only or can be used as a manual entry. To enter the FLAP/SPD selection, double-click the desired FLAPS and VREF (LSK 1R, 2R, or 3R). The manually entered GROSS WT is reset to the FMC current computed weight when leaving the page.

To manually enter a flap/speed setting other than the displayed default FLAPS and VREF, enter the desired settings into the scratchpad and select it to FLAP/SPD.

- Valid flaps settings are 0, 1, 2, 5, 10, 15, 25, 30, and 40.
- Valid speed settings are to be in the displayed VREF range.
- Deleting the entry returns the display to a dash prompt.
- When FLAPS/SPD is a dash prompt, both must be entered. Entering just FLAPS or just SPD results in the message INVALID ENTRY being displayed in the scratchpad.

WIND CORR – the wind correction defaults to +5 knots which is added to the VREF speeds displayed in 1R, 2R, and 3R to obtain the block speeds for each flaps setting. The valid range for entry is 0 to 20 knots (always positive).

QFE ALTITUDE REFERENCE OPTION:

The QFE altitude reference option provides a toggle to allow selection of the reference table used for the approach. The reference table selection is highlighted.

APPROACH REF		1 / 1
GROSS WT	FLAPS	VREF
74.8	15°	155KT
LANDING REF		
<QFE / QNH	30°	149KT
KMEM36R		
9000FT2743M	40°	146KT
ILS 36R / CRS	FLAP / SPD	
110.50ITSE / 358°	-- / ---	
	WIND CORR	
	+05KT	

< INDEX		

Selection is made using LSK 2L as a toggle to switch back and forth. The reference selected on the TAKEOFF REF page is propagated to this page.

INTEGRATED APPROACH NAVIGATION OPTION:

When the IAN option is available, the crew can select a precision or a non-precision approach into the flight plan and set up the approach during cruise.

```

      APPROACH REF  1 / 1
GROSS WT   FLAPS   VREF
 74.8      15°     155KT
LANDING REF
<QFE / QNH   30°     149KT
KMEM36R
9000FT2743M  40°     146KT
ILS 36R / CRS   FLAP / SPD
110.50ITSE / 358°  -- / ---
                                WIND CORR
                                +05KT
-----
<INDEX

```

IAN OPTION ENABLED AND A PRECISION APPROACH SELECTED

```

      APPROACH REF  1 / 1
GROSS WT   FLAPS   VREF
 74.8      15°     155KT
LANDING REF
<QFE / QNH   30°     149KT
KMEM09
8923FT2719M  40°     146KT
                                FLAP / SPD
                                -- / ---
G / S      WIND CORR
<ON / OFF   +05KT
-----
<INDEX

```

IAN OPTION ENABLED AND A NON-PRECISION APPROACH SELECTED

QFE/QNH (LSK 2L) – when the QFE Altitude Reference option is available, the crew must remember to select the QNH LANDING REF. If QFE is selected when a non-precision approach is entered into the flight plan, the message FMC APP MODE UNAVAIL-QFE is displayed in the scratchpad.



G/S (LSK 5L) – the glide slope selection toggle is displayed when a non-localizer approach type is in the flight plan. The default is OFF. Selecting G/S ON will result in tuning error messages being displayed in the scratchpad.

ALTERNATE DESTINATIONS OPTION:

When the alternate destinations option is available, a prompt is displayed in 6R. Selecting LSK 6R displays the ALTERNATE DESTS page.

```
      APPROACH REF  1 / 1
GROSS WT  FLAPS  VREF
74.8      15°    155KT

              30°    149KT
KMEM36R
9000FT2743M  40°    146KT
ILS 36R/CRS  FLAP/SPD
110.50ITSE/358°  --/---
              WIND CORR
                  +05KT
-----
<INDEX      ALTN DEST>
```

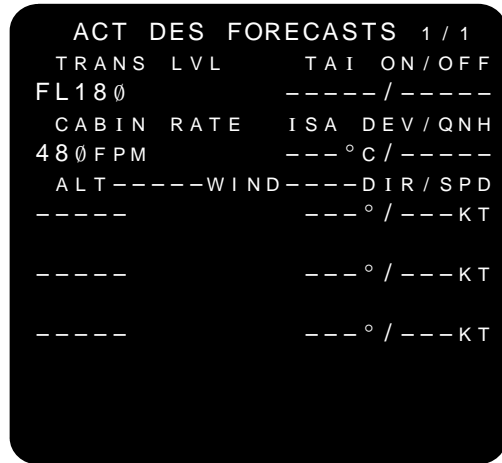



DES FORECASTS

The Descent Forecasts page enables the pilot to enter descent wind data to more accurately define the descent path and allow for varying conditions. The DES FORECASTS page becomes active when the vertical flight plan is active.

PAGE ACCESS

- Any DES or CRZ DES page FORECASTS prompt (LSK 6L).



Entries may be made in any field displaying the DASH prompt. Cabin rate is the computed rate. Entry or deletion is not allowed.



DETAILED OPERATION

Enter the desired altitude into the scratchpad.

5 0 0 0

Then press LSK 3L to transfer the scratchpad to ALT.

```

ACT DES FORECASTS 1/1
TRANS LVL      TAI ON/OFF
FL180          -----/-----
CABIN RATE    ISA DEV/QNH
480FPM         10°C/ 1024
ALT-----WIND-----DIR/SPD
-----        ---°/---KT
-----        ---°/---KT
-----        ---°/---KT
5000

```

Enter known wind data into the scratchpad.

1 3 0 / 2 9

Then press LSK 3R to transfer the scratchpad to DIR/SPD.

```

MOD DES FORECASTS 1/1
TRANS LVL      TAI ON/OFF
FL180          -----/-----
CABIN RATE    ISA DEV/QNH
480FPM         10°C/ 1024
ALT-----WIND-----DIR/SPD
5000          -----/-----
-----        ---°/---KT
-----        ---°/---KT
-----        ---°/---KT
130/29
ERASE>

```

```

MOD DES FORECASTS 1/1
TRANS LVL      TAI ON/OFF
FL180          -----/-----
CABIN RATE    ISA DEV/QNH
480FPM         10°C/ 1024
ALT-----WIND-----DIR/SPD
5000          130°/ 29KT
-----        ---°/---KT
-----        ---°/---KT
-----        ---°/---KT
ERASE>

```

Press LSK 6R to back out changes.

or

Press EXECute to activate the changes.



TRANS LVL – displays the transition level for decent planning level.

CABIN RATE – displays the computed rate of descent.

TAI ON/OFF – displays the start/stop altitude levels that anti-ice is expected to be used. This helps the FMCS account for additional high idle thrust required over the normal decent idle throttle setting.

ISA DEV – displays the manually entered value to be used for descent path construction.

QNH – displays value of QNH entered above the transition level to provide compensation for the differences between pressure and local area baro altitude. QNH may be entered in inches of mercury or in millibars.

LINES 3 through 5 – Allows entries of altitude, wind direction, and wind speed. Valid entries are sequenced from highest (line 3) to lowest (line 5) altitude and must be more than 100 feet apart. Incomplete entries are automatically deleted after leaving the page. Manually deleting an altitude will delete the corresponding wind data.







DES

DESCENT

The Descent page displays the current planned descent parameters and allows selection of different modes. The information is automatically updated as the flight progresses and changes are made to the route. This page also provides access to the descent forecasts wind data when it is available for the descent legs in the flight plan.

An early descent may be initiated by using the DES NOW prompt.

PAGE ACCESS

- Press  Key
- Press  key when descent is the active performance mode (FANS MCDU ONLY)
- Press  key from CRZ page (FANS MCDU)
- Press  key from CLB page (FANS MCDU)
- Automatically displayed at top of descent when the following conditions are present:
 - An active CRZ page is displayed
 - Path descent mode is available
 - MCP altitude is set below cruise altitude
- CRZ DES page PLANNED DES prompt (LSK 5R)



```

ECON PATH DES 1 / 1
E / D ALT AT RW36R
391 152 / 391
TGT SPD TO T / D
.783 / 270 1403.1Z / 917NM
SPD REST WPT / ALT
240 / 10000 RW36R / 391
FPA V / B V / S
0.0 0.3 347
-----
SPEED>
<FORECAST DES NOW>
    
```

(PRIOR TO DESCENT)



DETAILED OPERATION

Flight plan modifications entered and executed during the active descent result in the FMC flying the old flight plan until it completes path predictions for the new plan. The FMC will fly the old flight plan for no more than 60 seconds while waiting for the new path predictions. If after 60 seconds, predictions for the new plan have not been completed, VNAV disengages. This operation protects against possible violations of new plan constraints. Failure to complete path predictions within allotted time can be a result of multiple bypasses in descent or insufficient time between crew-entered modifications.

There are two types of descent; path descent (PATH DES) and airspeed descent (SPD DES). In a path descent, the FMC controls pitch to fly the airplane along an altitude profile (path) based upon flight plan and altitude restrictions. Using the speed brake or the throttle, the pilot controls speed to the FMC-generated target airspeed displayed on the airspeed indicator. The path predictions are based on either an FMC-generated economy speed (ECON) or a manually entered speed, either of which can be preplanned.

The descent page is displayed automatically when the current display is a CRZ page and T/D is transitioned. Five miles prior to T/D, a RESET MCP ALTITUDE message is displayed in scratchpad if the MCP altitude is not dialed down.

Path descent data such as vertical deviation (VERT DEV), vertical bearing (V/B), and vertical speed (V/S) are not available unless there is a waypoint in the descent path prior to any discontinuities with an associated AT altitude constraint.

```

      ECON PATH DES 1 / 1
E / D ALT          AT RW36R
 391              152 / 391
TGT SPD           TO T / D
.783 / 270      1403.1Z / 917NM
SPD REST         WPT / ALT
240 / 10000      RW36R / 391
                  FPA V / B  V / S
                  0.0 0.3 347
-----
                        SPEED>
<FORECAST        DES NOW>

```



Planned descent during cruise

E/D ALT – the end of decent altitude is the altitude constraint or the predicted altitude of the last waypoint in the descent path. When a discontinuity exist in the flight plan between the airplane and the end of descent waypoint, VNAV remains engaged, and the FMC flies a great circle path across the discontinuity. E/D ALT is blank when a descent path is not entered into the active flight plan.

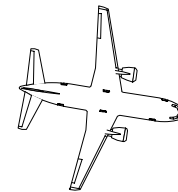
TGT SPD – displays the computed descent MACH/CAS schedule. While descent is active (ACT), the governing speed (MACH or CAS) is highlighted.

The speeds displayed for the ECON PATH DES are computed by the FMC according to the entered cost index (CI) on the PERF INIT page. Valid range is:

- CAS – 100 to 340 knots
- MACH – 0.40 to 0.82

SPD REST – displays speed restrictions in the descent path according to the following rules:

- When speed restrictions are not in the active flight plan, the destination airport speed restriction minus 10 knots will be displayed.
- When speed restrictions are in the active flight plan, the most restrictive is selected according to the following guidelines:
 - Destination airport restriction minus 10 knots
 - Any waypoint restriction that is greater than 210 knots
 - Minimum flaps up operating speed
- When the flaps are extended, the appropriate flaps speed is displayed and identified by “/FLAPS” following the speed.
- When decelerating to a hold speed prior to the hold entry point, the hold speed is displayed and identified by “/HOLD”.



NOTE

Hold and flaps speed restrictions can not be deleted.



The speed restriction is highlighted when it is the governing speed.

VERT DEV – the vertical deviation is displayed during the descent when a path descent is in the active flight plan. The indication is the airplane vertical position in feet above or below the intended path. This field is blank when the descent is not active or when other than a path descent is planned (or not loaded into the active flight plan).

AT (1R) – displays the next waypoint in the descent path that contains altitude/speed restrictions and/or constraints. The header contains the waypoint identifier and the data line displays the restriction/constraint. When a PATH descent is selected and a path is not in the flight plan, this header and data field are blanked.

TO (2R) – displays different information depending on the where the airplane is at in the flight plan.

- Prior to the descent being activated, the display is TO T/D and provides the ETA and DTG.
- When an early descent is initiated (selecting the DES NOW prompt (LSK 6R)) the display is TO T/D and provides the ETA and DTG for the original top-of-descent point. After passing the original top-of-descent, one of the following, which ever occurs first in the flight plan, is displayed:
 - TO XXXXX – displays the ETA and DTG to the first waypoint along the path that contains an altitude constraint.
 - TO T/D-XXXXX – an intermediate top-of-descent point.

WPT/ALT – displays a waypoint and altitude as follows:

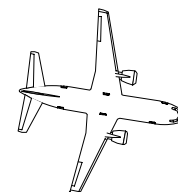
- Default is the waypoint and restriction displayed at LSK 1R.
- If the constraint is a window, The highest is displayed until reached, then the lowest is displayed.
- The crew can manually enter a runway from the active flight plan destination airport. The altitude is automatically displayed from the LEGS page unless manually entered.
- Displays the dash prompt when an AT waypoint is not displayed (LSK 1R) and a manual altitude entry has not been made.

FPA – displays the continuous instantaneous flight path angle during CRZ and DES. The FPA is computed based on current ground speeds and vertical speeds. During CLB the header remains displayed but the data field is blank.



V/B – the vertical bearing is the FMC computed V/B referenced to the ground, and is based on PPOS and the waypoint/altitude displayed in WPT/ALT (3R). The range is 0.0 to 9.9, and 10 to 90 degrees. When LSK 3R is a dash prompt, this data line is blanked.

V/S – vertical speed is the FMC computed V/S recommendation in FPM to maintain the airplane V/B displayed. The range is 0 to 9999 fpm. When LSK 3R is a dash prompt, this data line is blanked.



NOTE

V/S will not display greater than 9999 fpm even if the required rate is 10,000 or greater.

SPEED/PATH prompt (5R) – this prompt toggles between the two descent modes. PATH DES pages display the SPEED prompt, SPD DES pages display the PATH prompt.

The SPEED prompt is not displayed when the active leg is a STAR or when the approach transition leg has a vertical angle.

```

ECON PATH DES 1 / 1
E / D ALT      AT RW36R
391           152 / 391
TGT SPD      TO T / D
.783 / 269   1403.1z 917NM
SPD REST      WPT / ALT
240 / 10000   RW36R / 391
              FPA V / B V / S
              0.0 0.4 350
-----
SPEED>
<FORECAST      DES NOW>
    
```

```

ECON SPD DES 1 / 1
E / D ALT      AT RW36R
391           152 / 391
TGT SPD      TO T / D
.783 / 269   1403.1z 917NM
SPD REST      WPT / ALT
240 / 10000   RW36R / 391
              FPA V / B V / S
              0.0 0.4 355
-----
PATH>
<FORECAST      DES NOW>
    
```

Initiating an early descent can be performed by selecting the DES NOW prompt (LSK 6R) and pressing the EXEC button to activate the MOD.

MANUAL PATH/SPEED DESCENT

The Manual Path or Speed Descents are initiated by entering a target MACH, speed, or MACH/speed schedule and executing the resulting MOD page. The title line will include the entered speed (in MACH or CAS format reflecting the entry). Manual entries are performance limited. The title line will display the speed that was entered, however, if the upper or lower limits are exceeded, the minimum or maximum speed is entered by the FMC.

M.800	PATH DES	1 / 1
E/D ALT	AT RW36R	
391	151 / 391	
TGT SPD	TO T/D	
.800/269	1413.1z 724NM	
SPD REST	WPT/ALT	
240/10000	RW36R / 391	
	FPA V/B V/S	
	0.0 0.5 367	

<ECON	SPEED>	
<FORECAST	DES NOW>	

M.800	SPD DES	1 / 1
E/D ALT	AT RW36R	
391	151 / 391	
TGT SPD	TO T/D	
.800/269	1413.1z 724NM	
SPD REST	WPT/ALT	
240/10000	RW36R / 391	
	FPA V/B V/S	
	0.0 0.6 473	

<ECON	PATH>	
<FORECAST	DES NOW>	

RTA DESCENT

When an RTA is set on a waypoint within the descent path, the descent page provides RTA status. In this example, the RTA is set at the runway.

```
RTA PATH DES 1 / 1
E / D ALT AT RW36R
391 151 / 391
TGT SPD TIME ERROR
.781 / 269 ON TIME
SPD REST WPT / ALT
240 / 10000 RW36R / 391
FPA V / B V / S
0.0 0.5 377
-----
<ECON SPEED>
<FORECAST DES NOW>
```




ALTITUDE/SPEED INTERVENTION OPTION:

When the altitude/speed intervention option is available, the AT altitude restriction may be deleted by dialing the MCP altitude down to the clearance altitude and pressing the altitude intervention button.

COMMON VNAV OPTION

When the Common VNAV option is available, the descent page provides commonality with other Boeing FMS equipped aircraft types. VNAV SPD is then used as the speed on elevator mode for over-speed reversion, and VNAV will remain engaged under these conditions.

```

ACT 269KT DES      1 / 1
E / D ALT         AT RW36R
 391             152 / 391
TGT SPD          TO T/D
.783 / 269      1403.1Z 917NM
SPD REST        WPT / ALT
240 / 10000     RW36R / 391
                FPA V/B V/S
                3.0 0.4 350
-----
<ECON
<FORECAST      RTA>

```

```

ECON DES          1 / 1
E / D ALT         AT RW36R
 391             152 / 391
TGT SPD          TO T/D
.783 / 269      1403.1Z 917NM
SPD REST        WPT / ALT
240 / 10000     RW36R / 391
                FPA V/B V/S
                0.0 0.4 355
-----
                SPEED>
<FORECAST      DES NOW>

```

```

RTA DES          1 / 1
E / D ALT         AT RW36R
 391             151 / 391
TGT SPD          TIME ERROR
.781 / 269      ON TIME
SPD REST        WPT / ALT
240 / 10000     RW36R / 391
                FPA V/B V/S
                0.0 0.5 377
-----
<ECON          SPEED>
<FORECAST      DES NOW>

```




CRUISE SPEED FORWARD PROPAGATION OPTION:

When the Cruise Speed Forward Propagation option is available, a manually entered CAS or MACH TGT SPD (LSK 2L) entered on a CRZ page is propagated onto the DES page TGT SPD to prevent sudden speed changes at top-of-descent, and also allows ATC assign speeds to be rapidly entered while still in CRZ.

When the CRZ mode is changed on any CRZ page, the descent mode is also changed on the DES page.

Note that a manually entered TGT SPD entered on a DES page does not propagate back to the CRZ page.



ALTERNATE DESTS

ALTERNATE DESTINATIONS (OPTION):

When the alternate destinations option is available, the Alternate Destinations page may be used to enter alternate airport, navaid, or waypoint identifiers, or a list of alternates may be loaded from the navigation data base. Displayed alternates may be selected and inserted into the flight plan.

Page 1 provides a summary list of the alternates entered or loaded, while pages 2 through 6 provide detailed information about each alternate.

PAGE ACCESS

- APPROACH REF page ALTN DEST prompt (LSK 6R)
- INIT/REF INDEX page ALTN DEST prompt (LSK 3R)
- RTE page ALTN DEST prompt (LSK 6L)
- ALTERNATE DESTS pages 2 thru 6 INDEX prompt (LSK 6L)

ALTERNATE DESTS		1 / 6
ALTN		
-----	>	
-----	>	
-----	>	
-----	>	
-----	>	
NEAREST ARPTS>		

NEAREST AIRPORTS					1 / 6
ALTN	VIA	DTG	ETA	FUEL	
K79	D	16	1437z	47.2>	
KDDC	D	29	1437z	47.2>	
KLOR	D	36	1437z	47.2>	
KOCK	D	45	1437z	47.2>	
ØH1	D	46	1437z	47.2>	
					PREVIOUS>

The FMC determines the approach method (direct or missed approach) and computes the distance, estimated time of arrival, and the fuel quantity remaining to the alternate.

Selecting an LSK on the right will display the detailed information for that identifier.

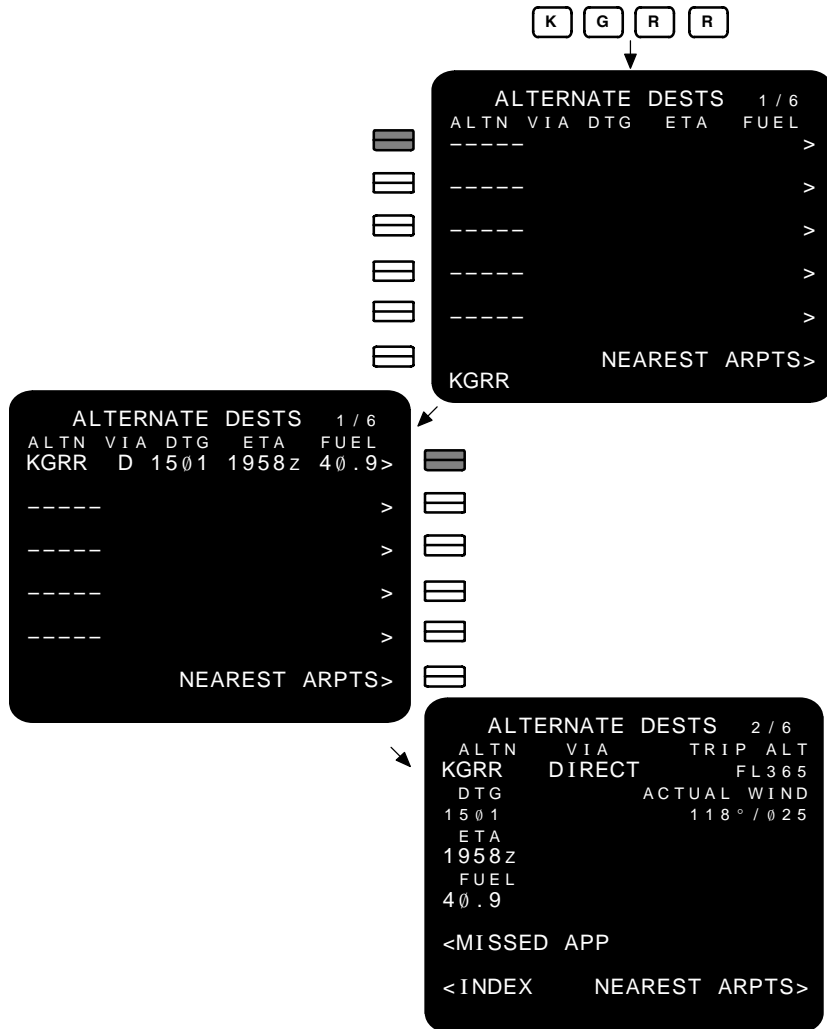


DETAILED OPERATION

There are two methods to obtain planning information for an airport, navaid, or waypoint that is not entered into the flight plan.

Manual entry:

On display page 1, enter an identifier into the scratchpad and select it to one of the DASH prompts (LSK 1L through 5L). The FMC will display the approach method (VIA) and compute the DTG, ETA, and FUEL to the alternate. To view the detailed page, select the line using LSK 1R through 5R adjacent to the identifier data line.





The direct to approach is assumed to be from PPOS.

The MISSED APP prompt (LSK 5L) may be selected to display the planning information from the current destination in the flight plan to the displayed alternate.

```

ALTERNATE DESTS 2 / 6
ALTN VIA TRIP ALT
KGRR MISAPP FL397
DTG EST WIND
1908 000° / 000
ETA KMEM-KGRR
2102Z 519
FUEL
35.8

<DIRECT-TO
<INDEX NEAREST ARPTS>

```

A new alternate identifier may be entered into the ALTN field (page 1, LSK 1L thru 5L or pages 2 through 6, LSK 1L), causing the information to be recomputed with respect to the new identifier and displayed. The aircrew may also edit DTG, TRIP ALT, and ACTU-AL or EST WIND on pages 2 through 6.

Any changes made on pages 2 through 6 are reflected on page 1.

To insert the alternate into the flight plan, select the identifier, return to the RTE or RTE LEGS page and select the scratchpad to the appropriate position in the route.

The INDEX prompt (LSK 6L) on all pages 2 through 6 will return the display to page 1.



The second method of obtaining information is through the use of the NEAREST AIRPTS prompt (LSK 6R). This prompt initiates a search of the navigation databases, and provides a list of the five closest airports to PPOS. Identifiers are list by distance, closest to farthest from the airplane.

NEAREST AIRPORTS 1 / 6				
ALTN	VIA	DTG	ETA	FUEL
KFSM	D	26	1935Z	42.4>
H35	D	24	1935Z	42.4>
KFYV	D	31	1935Z	42.4>
O11	D	39	1935Z	42.4>
32A	D	36	1936Z	42.4>
PREVIOUS>				

NEAREST AIRPORTS 2 / 6			
ALTN	VIA	TRIP	ALT
KFSM	DIRECT		FL365
DTG		ACTUAL WIND	
32		118° / 025	
ETA			
1936Z			
FUEL			
42.4			
<MISSED APP			
<INDEX		PREVIOUS>	

The NEAREST AIRPORTS page ALTN identifiers can only be selected.

Selecting the INDEX prompt (LSK 6L) on pages 2 through 6 returns the display to the NEAREST AIRPORTS page 1.

Selecting the PREVIOUS prompt (LSK 6R) returns the display to ALTERNATE DESTS page 1.



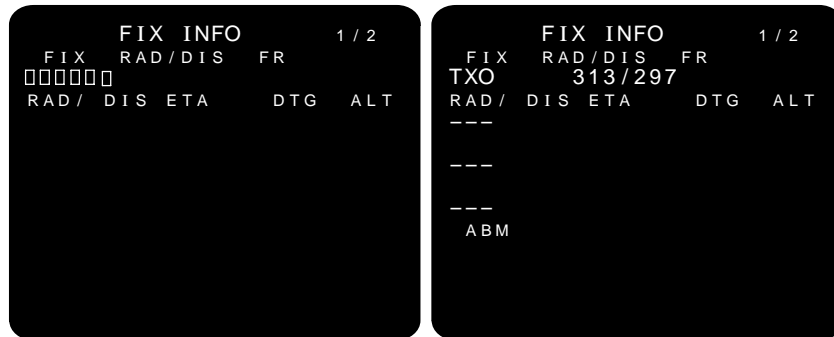
FIX INFO

The Fix Information page allows the crew to create waypoint fixes and waypoints from the intersection points between the flight plan and selected radials or distances from known waypoints.

When a lateral offset exists in the flight plan, the title of this page changes to OFFSET FIX INFO, and the fix information provided is advisory only.

PAGE ACCESS

- Press FIX key (in flight with active flight plan only).



Entering a fix displays fix information on the ND while in map mode.

- The FMC computes the radial and distance from PPOS to the entered waypoint (RAD/DIS FR).
- Up to three radial/distance entries may be made into the DASH prompts.
- ABM (ABEAM) – may be selected to compute a radial and distance from the fix waypoint to the flight path.

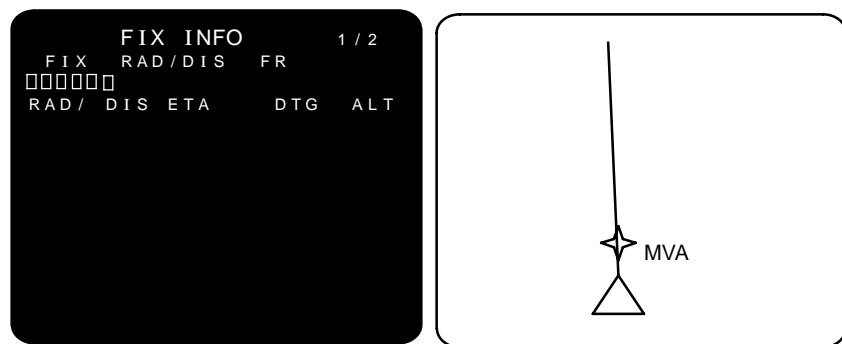


DETAILED OPERATION

This page is operational when an active flight plan is available, and as long as an identifier is entered, the FMC computed information is dynamically updated.

Each of the two Fix Information pages provide bearing, distance, ETA, DTG, and predicted ALT from PPOS to the intersection of the radial and the active flight path, and provides a graphical representation on the navigation display.

Computed azimuth is relative to magnetic north except when at the polar regions or when the MAG/TRUE switch is set to TRUE.



FIX (LSK 1L) – after entering an identifier, the FMC computes the radial and distance from PPOS to the entered identifier (RAD/DIS FR). The following rules apply to FIX entries:

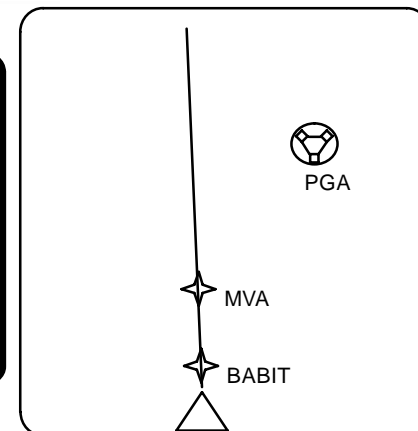
- Identifiers must be in one of the navigation databases.
- Valid entries are a maximum of 6 alphanumeric characters including hyphens.
- Entries may be overwritten or DELETED.
- Airport identifiers.
- Navaid identifiers.
- Waypoint identifiers
- Runways located at the active flight plan destination airport.

The airport, navaid, or waypoint is displayed on the ND with a circle when the the identifier is entered into FIX, and the FMC computes the radial and distance to the identifier (RAD/DIS FR).



FIX INFO					1 / 2
FIX	RAD/DIS	FR	ETA	DTG	ALT
PGA	283/364				

ABM					

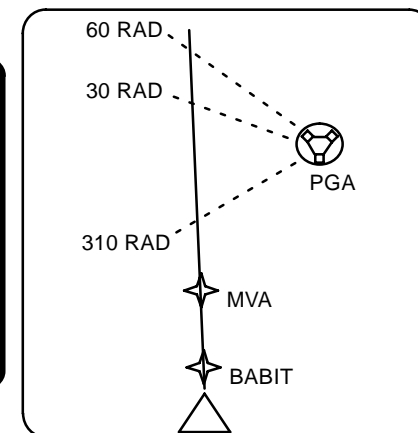


RAD/ DIS (LSK 2L through LSK 4L) – entries can be a radial or a distance. The following rules apply to RAD/DIS entries:

- Valid RAD entries are 0 to 359 degrees (360 degrees is treated and displayed as 0 degrees).
- Valid DIS entries are 10 nm to 511 nm, and 0.1 nm to 9.9 nm.
- Slash entry rule applies when entering a distance.
- Entries may be overwritten or DELETED.

As each radial or distance is entered, the computed intersection with the active path is drawn on the ND. The ETA and DTG is computed from PPOS and displayed along with the expected altitude (ALT) of the intersection point.

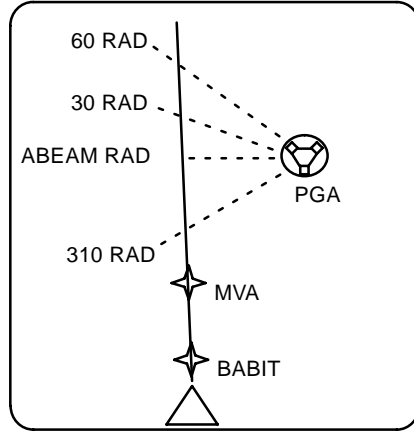
FIX INFO					1 / 2
FIX	RAD/DIS	FR	ETA	DTG	ALT
PGA	283/364				
035/153	1453.7	434	FL320		
060/297	1515.9	603	FL320		
310/151	1426.9	225	FL320		
ABM					





ABM (ABEAM) (LSK 5L) – may also be selected to compute a radial and distance from the fix waypoint to the active path.

FIX INFO							1 / 2
FIX	RAD/DIS FR						
PGA	283/364						
RAD/ DIS	ETA	DTG	ALT				
035/153	1453.7	434	FL320				
060/297	1515.9	603	FL320				
310/151	1426.9	225	FL320				
ABEAM							
352/112	1440.1	352	FL320				



Any of the fix intersections may now be entered into the flight plan. Select a RAD/DIS (LSK 2L through LSK 4L) or the ABEAM (LSK 5L) to the scratchpad, then select the RTE or RTE LEGS page.

FIX INFO							1 / 2
FIX	RAD/DIS FR						
PGA	283/364						
RAD/ DIS	ETA	DTG	ALT				
035/153	1453.7	434	FL320				
060/297	1515.9	603	FL320				
310/151	1426.9	225	FL320				
ABEAM							
352/112	1440.1	352	FL320				
PGA060.3/297.7							

FIX INFO							1 / 2
FIX	RAD/DIS FR						
PGA	283/364						
RAD/ DIS	ETA	DTG	ALT				
035/153	1453.7	434	FL320				
060/297	1515.9	603	FL320				
310/151	1426.9	225	FL320				
ABEAM							
352/112	1440.1	352	FL320				
PGA352.1/112.5							



Select the scratchpad to the desired waypoint in the route to insert the fix point. The intersection point is inserted into the flight plan as a PBD waypoint.

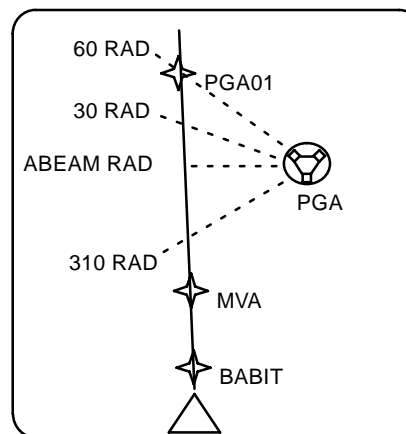
SELECT THE FIX
TO A POSITION.

ACT	RTE	LEGS	1 / 6
64°		17NM	
BABIT		302 / 6000.4	
63°		182NM	
		.800 / FL290	
86°		593NM	
		.800 / FL290	
98°		119NM	
		.800 / FL290	
113°		38NM	
		.800 / FL290	
RNP / ACTUAL -----			
1.00 / 0.09NM		RTE DATA>	
PGA060.0 / 296.6			

PRESS **EXEC**

MOD	RTE	LEGS	1 / 6
64°		17NM	
BABIT		302 / 6000.4	
63°		182NM	
		.800 / FL290	
76°		552NM	
PGA01		.800 / FL290	
86°		41NM	
		.800 / FL290	
98°		119NM	
		.800 / FL290	

<ERASE		RTE DATA>	



ACT	RTE	LEGS	1 / 6
64°		17NM	
BABIT		302 / 6000.4	
63°		182NM	
		.800 / FL290	
76°		552NM	
PGA01		.800 / FL290	
86°		41NM	
		.800 / FL290	
98°		119NM	
		.800 / FL290	
RNP / ACTUAL -----			
1.00 / 0.09NM		RTE DATA>	

To remove the fix point and/or any radials from the navigation display, return to the FIX INFO page and DELEte the undesired radial(s), or DELEte FIX (LSK 1L) to remove them all.



ADDITIONAL FIX PAGES OPTION:

When the Additional Fix Pages option is available, the crew can generate fix information on six fix points. The pages operate the same.






INIT/REF INDEX

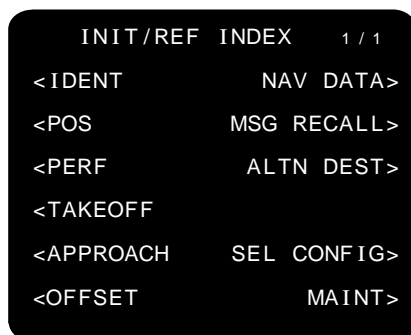
The Initialization/Reference Index page provides direct access to the most often used FMCS pages.

PAGE ACCESS

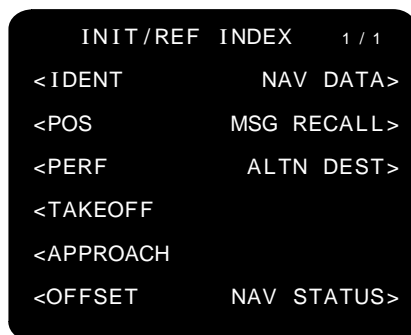
– All pages with an INDEX prompt (LSK 6L)

– Press  key

On the ground.



In the air.



INIT/REF index page provides access to the following pages:

- IDENT
- POS INIT
- PERF INIT
- TAKEOFF REF
- APPROACH REF







- LATERAL OFFSET
- NAV DATA
 - REF NAV DATA
 - SUPP NAV DATA
(When on the ground)
NOTE: Enter SUPP in scratchpad prior to selection of NAV DATA.
- MESSAGE RECALL
(airline selectable option)
- ALTN DEST
(airline selectable option)
- ACARS
(airline selectable option)
- NAV STATUS
(When in the air)
- SEL CONFIG
(When on the ground for maintenance personnel)
- MAINT
(When on the ground for maintenance personnel)

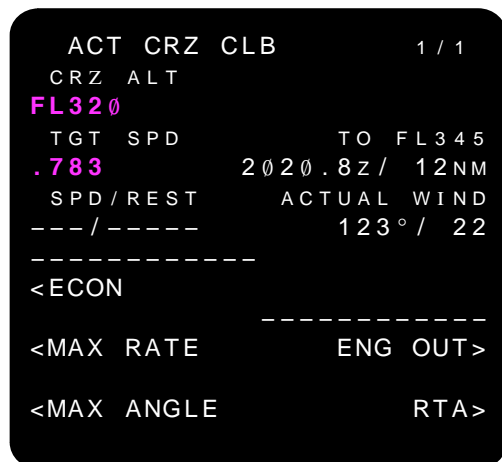


CRZ CLB

The Cruise Climb page allows the flight crew to initiate a climb from the Cruise page while in cruise. With LNAV and VNAV coupled, the transition is performed under FMC control. This page provides ETA and distance to the new cruise altitude target.

PAGE ACCESS

- Press  key when cruise is the active performance mode (CDU or MCDU)
- Press  key when cruise climb is the active performance mode (FANS MCDU)
- Press  key from DES page (FANS MCDU)
- Press  key from CRZ page (FANS MCDU)
- Enter a higher CRZ ALT on the active cruise page



The information and prompts on this page are the same as the CLB page except the N1 values are not displayed.

A speed restriction may also be entered.



When an RTA exists in the flight plan, the time error to the RTA waypoint as well as the ETA and distance to the new cruise altitude target are provided.

```

ACT RTA CRZ CLB 1 / 1
CRZ ALT TIME ERROR
FL320 ON TIME
TGT SPD TO FL345
.783 2020.8Z / 12NM
SPD/REST ACTUAL WIND
---/----- 123° / 22
-----
<ECON
<MAX RATE -----
ENG OUT>
<MAX ANGLE RTA>

```

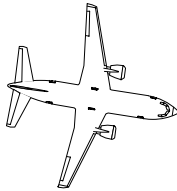



DETAILED OPERATION

There are several methods available for setting the cruise climb mode. Regardless of the method used, the MCP altitude must be dialed at or above the desired altitude and the desired altitude should not exceed the FMC MAX ALT (displayed on the CRZ page) for normal ECON mode cruise.

- The easiest method is shown on the next page. While on the CRZ page, enter the new altitude into the scratchpad and select it to CRZ ALT (LSK 1L).
- If the CLB button (CDU and MCDU) is pressed while cruise is active, an inactive climb page is displayed with a BOX prompt for the CRZ ALT. Enter the new cruise altitude into the BOX prompt (LSK 1L).

Either method results in a MOD CLB page being displayed. Press the EXEC button to incorporate the change. The CRZ page then changes to the ACT CRZ CLB page with ETA and distance to the new cruise altitude (T/C) shown. Once the new cruise altitude is reached, the display changes back to the active CRZ page.



NOTE

The performance mode will default to the planned performance mode. If ECON was the current mode, the FMC transitions to the active ECON CRZ mode after the new T/C is reached.



F L 3 4 5

```

ACT ECON CRZ 1 / 1
CRZ ALT OPT / MAX STEP
FL320 FL365 / 375 -----
TGT SPD TO T / D
.799 1522.4z / 33NM
TURB N1 ACTUAL WIND
84.2 / 84.2% 123° / 22
FUAL AT KMEM
10.2
-----
<LRC RTA>
FL345
  
```

```

MOD ECON CLB 1 / 1
CRZ ALT
FL345
TGT SPD TO FL345
335 / .793 . Z / NM
SPD REST
--- / -----
----- CLB N1
98.5 / 98.5%
-----
<MAX RATE ENG OUT>
<MAX ANGLE ERASE>
  
```

EXEC

```

ACT CRZ CLB 1 / 1
CRZ ALT
FL345
TGT SPD TO FL345
.793 1526.3z / 12NM
SPD REST ACTUAL WIND
--- / ----- 123° / 22
-----
<ECON
-----
<MAX RATE ENG OUT>
<MAX ANGLE RTA>
  
```

CRUISE SPEED FORWARD PROPAGATION OPTION:

When the Cruise Speed Forward Propagation option is available, a manually entered CAS or MACH TGT SPD (LSK 2L) entered on the CRZ CLB page is propagated onto the DES page TGT SPD to prevent sudden speed changes at top-of-descent, and also allows ATC assign speeds to be rapidly entered while still in CRZ.


```
ACT CRZ CLB      1 / 1
CRZ ALT
FL345
TGT SPD          TO FL345
.793            1526.3Z / 12NM
SPD REST        ACTUAL WIND
---/-----    123° / 22
-----
<ECON
-----
<MAX RATE      ENG OUT>
<MAX ANGLE     RTA>
```




CRZ DES





The Cruise Descent page allows the aircrew to initiate a descent to a lower cruise altitude under FMC control when VNAV and LNAV are coupled.

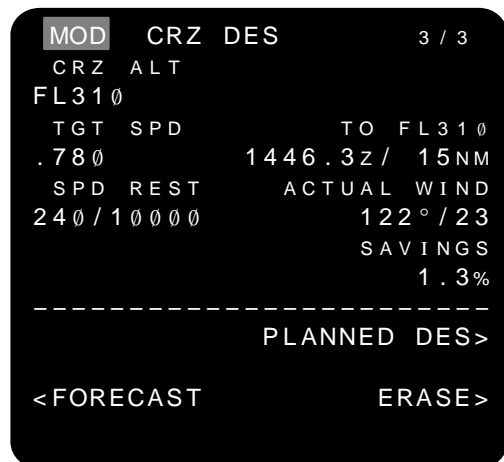
This page is automatically displayed during a missed approach if the DES page was displayed and the airplane is above the missed approach cruise altitude. This allows the aircrew to rapidly enter the new cruise altitude and descend to it under FMC control.

The descent is initiated by pressing  .

For a CDU or MCDU this page is displayed as page 1 of 1. The FANS MCDU is shown below.

PAGE ACCESS

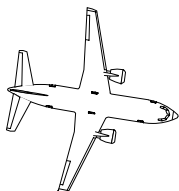
- Entering a lower CRZ ALT on the CRZ page while in cruise.
- Press  key when CRZ DES is active (CDU, MCDU).
- Press  key when CRZ DES is active (FANS MCDU).
- CRZ page  key (FANS MCDU).
- CLB page  key (FANS MCDU).





DETAILED OPERATION

- CRZ ALT – displays the new altitude entered on the CRZ page.
 - New altitude must be lower than current CRZ ALT.
 - May be changed on this page.
 - After EXECuting, the new altitude is propagate to all pages displaying CRZ ALT.
- TGT SPD – target speed initially displays the current FMC target speed. A new speed may be manually entered and will be used as the new target speed. When manually changed, the cruise mode changes to manual speed mode.
- SPD REST – displays the speed restriction for the destination airport.
 - Default restriction is 240 knots below 10,000 feet unless the NDB or custom performance DB contains a different value.
 - Speed, altitude, or both may be changed.
 - DEleting displays DASH prompts.



NOTE

When decelerating to a hold speed prior to entering the hold, the target speed is suffixed with /HOLD.

When the target speed is restricted by a flaps position, the target speed is suffixed with /FLAPS.

These can not be changed or deleted.

- TO (2R) – displays the ETA and distance to the new cruise altitude transition point. If the new cruise altitude transition point is after the new Top-of-Descent, the header will display TO T/D.
- ACTUAL WIND – displays cruise wind direction and speed. When manual entry of wind data is made, the header changes to estimated wind (EST WIND).
- SAVINGS/PENALTY (4R) – displayed while page is in the MOD state. Provides an indication of the fuel usage for the



new altitude compared to the predicted usage of the original flight plan.

- PLANNED DES – displays the planned descent profile.
- ERASE/RTA (6R) – displays the ERASE prompt while in the MOD state. Selecting the ERASE prompt removes the the changes and returns the display to the CRZ page. When MOD is not displayed in the title line, the RTA prompt is displayed. Selecting the RTA prompt displays the RTA PROGRESS page.

ALTITUDE/SPEED INTERVENTION OPTION:

When the Altitude/Speed Intervention option is available and the speed intervention is active, the target speed is controlled by the MCP speed and cannot be changed on this page.

```
CRZ DES          3 / 3
CRZ ALT
FL310
TGT SPD          TO FL310
.780 / MCP      1446.3z / 15NM
SPD REST        ACTUAL WIND
240 / 10000     122° / 23
                 SAVINGS
                 1.3%
-----
                 PLANNED DES>
<FORECAST      RTA>
```




DIR TO/INTC LEG

(CDU Display Operation)

The Direct To a waypoint and Intercept Leg at functions allow the aircrew to rapidly alter the flight path.

The DIRECT TO function allows changing the course from PPOS to a specified waypoint.

The INTERCEPT LEG function allows the aircrew to specify a course change to intercept a leg.

PAGE ACCESS

- Press  key with route active.

ACT RTE	LEGS	1 / 6
67°	46 NM	
LIN	.805 / FL220	
60°	25 NM	
MELTS	.805 / FL263	
63°	48 NM	
SONNY	.779 / FL320	
63°	53 NM	
BABIT	.779 / FL320	
64°	17 NM	
MVA	.779 / FL320	
DIRECT TO-----INTC LEG		
□□□□□	TO □□□□□	

DISPLAY FOR CDU ONLY

Enter or select a waypoint to the DIRECT TO BOX prompt (LSK 6L).

- If the designated DIRECT TO waypoint is selected from the active flight plan, the waypoint is inserted as the go to waypoint (line 1) and all legs between the old go to waypoint and the DIRECT TO waypoint are deleted from the flight plan.
- If the designated DIRECT TO waypoint is not in the flight plan, the waypoint is inserted as the new go to waypoint with a disconnect prompt inserted following. The aircrew may then select an appropriate waypoint from the flight plan and move it to the disconnect.

Enter or select a waypoint to the INTC LEG BOX prompt (LSK 6R).

- If the designated waypoint is in the flight plan, the waypoint is inserted as the go to waypoint (line 1) and a course is computed to intercept the leg prior to the waypoint.





- If the designated waypoint is not in the flight plan, the waypoint is inserted as the go to waypoint, a course is computed to intercept the leg prior to the waypoint, and a disconnect is inserted following. Close the disconnect as needed.





DETAILED OPERATION
(CDU Display Operation)



To initiate a DIRECT TO function:

- Press  key.
- Select a waypoint from the route or enter any waypoint from the NDB into the scratchpad, then select it to the DIRECT TO BOX prompt (LSK 6L).
- Press  to activate the route modification.

Alternate method to initiate a DIRECT TO function:

- Press  key.
- Select a waypoint from the route or enter any waypoint from the NDB into the scratchpad, then select it to the go to waypoint (LSK 1L).
- Press  to activate the route modification.

To initiate an INTERCEPT LEG function:

- Press  key with route active.
- Select the waypoint from the route or enter the waypoint from the NDB into the scratchpad, then select it to the INTG LEG BOX prompt (LSK 6R).
- Press  to activate the route modification.

Valid entries include:

- Waypoint identifier
- Navaid identifier
- Any defined waypoint plus a radial and distance
- Course intersection
- Latitude/longitude
- Runway waypoint in the flight plan

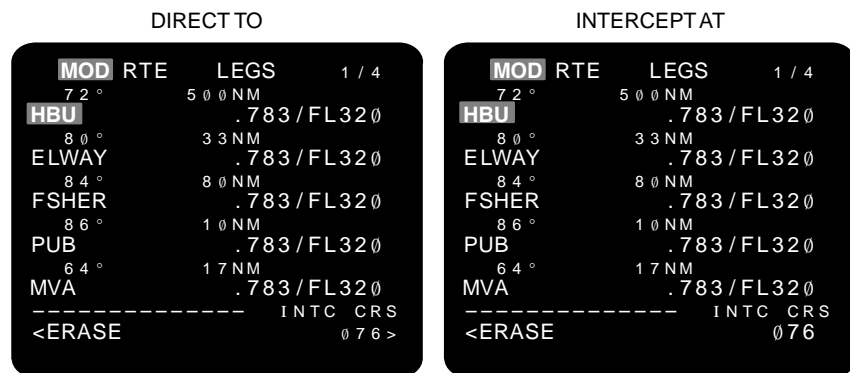


- Airport identifier
- Procedure turn exit point (while in the procedure turn only)
- DME arc or fixed radius turn leg exit point



DIR TO and INTC LEG
(MCDU Display Operation)

In the MCDU and FANS MCDU, the DIRECT TO and INTERCEPT LEG function perform the same operation, however, they are initiated differently.



DISPLAY FOR MCDU


To initiate a DIRECT TO:

- Press **LEGS** key.
- Enter a valid waypoint into the scratchpad or select a waypoint from the route.
- Select the go to waypoint (LSK 1L).
- Press **EXEC** to activate the route modification.

To initiate an INTERCEPT LEG:

- Press **LEGS** key.
- Enter a valid waypoint into the scratchpad or select a waypoint from the route.
- Select the go to waypoint (LSK 1L).
- Select the FMC computed INTC CRS (LSK 6R) or enter a course into the scratchpad and select it to INTC CRS.
- Press **EXEC** to activate the route modification.



ERASE prompt (6L) – may be selected to remove the change prior to pressing the  key.

When the waypoint selected to go-to waypoint (1L) is not in the route, INTC CRS displays a DASH prompt.



ABEAM POINTS OPTION:

When the abeam points option is available the path can be straightened while maintaining waypoints and cruise wind data. The ABEAM PTS prompt (LSK 5R) is not displayed when the total number of parent waypoints in the route plus the abeam waypoints exceeds 150.

```

MOD RTE LEGS 1 / 3
83° 108NM
IGLOO .783 / FL320
89° 41NM
ICT .783 / FL320
115° 38NM
BURDN .783 / FL320
118° 81NM
COODY .783 / FL320
RZC -----
ABEAM PTS>
-----INTC CRS
<ERASE 102>

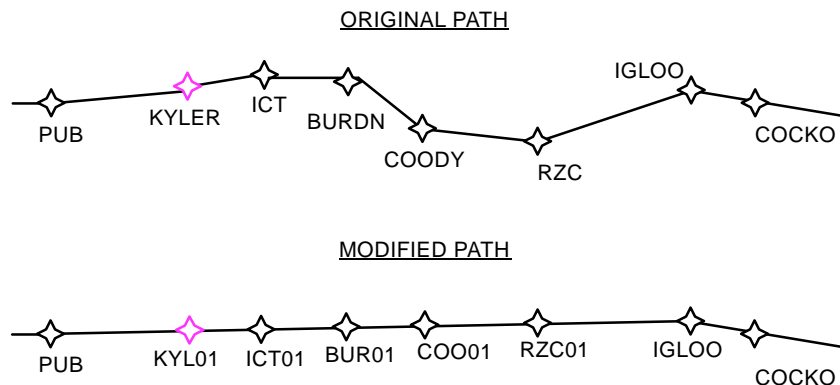
```

Waypoints from the flight plan are automatically transferred to the altered route as place/bearing/distance type waypoints and re-named. Cruise wind data associated with any waypoint that is 100 nm or less from the new path is assigned to the new waypoints.

Waypoints are not transferred if they fall within the following guidelines:

- Within 10 nm of PPOS
- Within 10 nm of the new go to waypoint (direct to).
- More than 700 nm abeam of the new path.

The path change is shown below.





ACT	RTE	LEGS	2 / 3
98°		119 NM	
IGLOO		.783 / FL320	
113°		38 NM	
COCKO		292 / FL250	
114°		20 NM	
WILSU		292 / FL191	
115°		10 NM	
GQE		292 / 16029	
125°		9.4 NM	
BEERT		292 / 13218	
RNP / ACTUAL		-----	
2.00 / 0.09 NM		RTE DATA>	
IGLOO			

ENTER OR SELECT THE DESIRED WAYPOINT

PREV PAGE

SELECT THE SCRATCHPAD TO THE GO TO WAYPOINT

ACT	RTE	LEGS	1 / 3
83°		108 NM	
KYLER		.783 / FL320	
89°		41 NM	
ICT		.783 / FL320	
115°		38 NM	
BURDN		.783 / FL320	
118°		81 NM	
COODY		.783 / FL320	
106°		71 NM	
RZC		.783 / FL320	
RNP / ACTUAL		-----	
2.00 / 0.09 NM		RTE DATA>	
IGLOO			

MOD	RTE	LEGS	1 / 3
83°		108 NM	
IGLOO		.783 / FL320	
89°		41 NM	
ICT		.783 / FL320	
115°		38 NM	
BURDN		.783 / FL320	
118°		81 NM	
COODY		.783 / FL320	
106°		-----	
RZC		ABEAM PTS>	
-----		INTC CRS	
<ERASE		102>	

SELECT THE ABEAM PTS PROMPT

THE FMC WILL NAME THE ABEAM POINTS USING PBD FORMAT

MOD	RTE	LEGS	1 / 3
106°		37 NM	
KYL01		.783 / FL320	
103°		48 NM	
ICT01		.783 / FL320	
104°		37 NM	
BUR01		.783 / FL320	
105°		79 NM	
COO01		.783 / FL320	
107°		-----	
RZC01		ABEAM PTS	

<ERASE		RTE DATA>	


EXEC

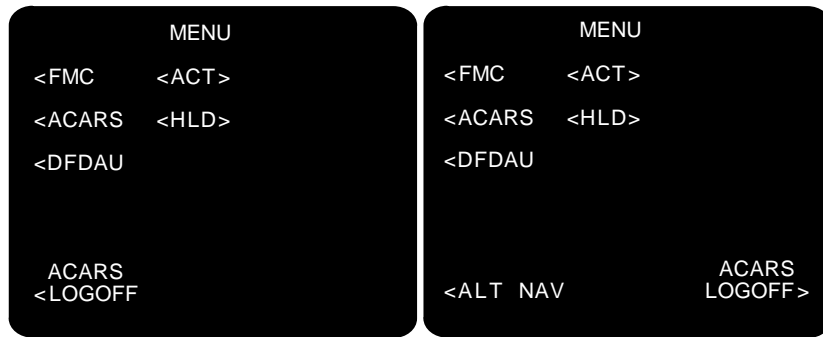


MENU

The Menu page is available when the FMCS includes the MCDU or FANS MCDU. These units are capable of interfacing with other sub-systems in the FMS, allowing the operator to communicate directly with the listed sub-systems.

PAGE ACCESS

- Press  key
- Automatically when the FMC is not communicating with the MCDU.



LCD CDU UPDATE 1

LCD CDU UPDATE 2 OR UPDATE 3

Only one sub-system may be active at a time. The prompts located at LSK 6L or 6R (Update 2 or Update 3) are used to place a sub-system on hold (<HLD>) or log off/log on to a sub-system.

If a sub-system connected to the MCDU is not communicating with the MCDU, the sub-system prompt is blanked.

After activating (<ACT>) a sub-system, selecting the sub-system prompt will connect the operator to that sub-system.

In a single FMCS installation, the FMC prompt (LSK 1L) is blanked when the FMC is not communicating with the MCDU. In a dual installation the FMC prompt is always available.






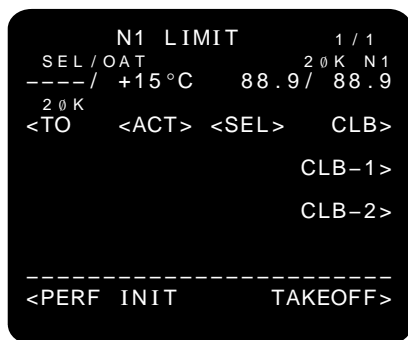
N1 LIMIT

The N1 Limit page allows the flight crew to make selections of the available N1 thrust rating levels displayed on the N1 indicator bug and sent to the autothrottle. The values of N1 are displayed for the various phases of the flight while in the air.

Takeoff thrusts, thrust bump (when available), and climb thrust limits defined by the standard defaults or a custom LDDDB are displayed, and may be selected while on the ground as part of pre-flight initialization.

PAGE ACCESS

- Press  key.
- PERF INIT page N1 LIMIT prompt (LSK 6R).
- TAKEOFF REF page N1 LIMIT prompt (LSK 4L)
NOTE: This prompt is only displayed if a temperature is not available or entered and PERF INIT is completed.
- Press  key from the last TO THRUST SETTING page (Takeoff Auto-Select option).
- Press  key from the first TO THRUST SETTING page (Takeoff Auto-Select option).
- On the Ground – select the desired takeoff thrust rating and climb thrust or thrust limit (if not automatically selected) to pre-plan takeoff.



ON THE GROUND



- In the Air – displays the selected thrust limits for each phase flight phase listed.

N1 LIMIT		1 / 1
<AUTO <SEL>		
<GA	98 . 5 /	98 . 5%
<CON	98 . 5 /	98 . 5%
<CLB	98 . 5 /	98 . 5%
<CRZ	94 . 5 /	94 . 5%
-----REDUCED CLB-----		
<CLB-1		CLB-2>

IN THE AIR



DETAILED OPERATION

ON THE GROUND

SEL/OAT (assumed/outside air temperature) – enter an assumed temperature to enable a reduced thrust takeoff. When a temperature is entered, values for RED xxK N₁ (nn is the engine thrust rating) are computed and displayed along with derate levels. The OAT is automatically displayed when an aspirated TAT probe is installed.

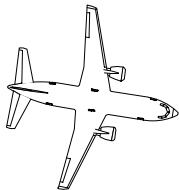
TO and CLB selections – selecting a takeoff thrust results in the <ACT> prompt being displayed next to the selection. When a takeoff thrust derate is selected, a corresponding climb thrust limit is automatically selected (<SEL>). The climb selection is the highest available climb thrust limit that will not cause a throttle push at the transition from takeoff to climb. The flight crew may override the automatic selection.

IN THE AIR

AUTO/GA/CON/CLB/CRZ – the <ACT> prompt indicates which N₁ thrust limits are currently set by the FMCS. When AUTO is active, the FMC automatically selects N₁ thrust limits.

CLB-1 and CLB-2 (LSK 6L or LSK 6R) – the <SEL> prompt indicates which if any reduced climb thrust limit was selected while on the ground. The climb thrust limit <SEL> prompt is removed once full climb thrust is attained.

- CLB-1 N₁ thrust reduction to 10,000 ft, then gradual thrust increase to normal climb N₁ at 15,000 ft.
- CLB-2 N₁ thrust reduction to 5,000 ft, then gradual thrust increase to normal climb N₁ at 15,000 ft.



NOTE

If the N₁ LIMIT page is used to manually select an N₁ setting (e.g. GA, CON, CLB, or CRZ), automatic selection resumes when the autopilot changes autothrottle or pitch modes.



- When takeoff profile is active and OAT is available (manually entered or from the TAT probe), trust reduction altitude (T/R ALT) is displayed in 2R.
- T/R ALT is the baro altitude at which the transition from takeoff thrust to climb thrust limit occurs. The default altitude is equivalent to 1500 feet AGL unless a custom LDDB with a different height is loaded into the FMC.

N1 LIMIT		1 / 1
<AUTO <SEL>		T / R ALT 1642 FT
<GA	98 . 5 /	98 . 5%
<CON	98 . 5 /	98 . 5%
<CLB	98 . 5 /	98 . 5%
<CRZ	94 . 5 /	94 . 5%
-----REDUCED CLB-----		
<CLB-1		CLB-2>

IN THE AIR

- The flight crew can overwrite this default while on the ground. Entries are limited to airport elevation (or actual altitude when ORIGIN is not entered into the RTE page) plus 400 feet, to a maximum of 15,000 feet.
- T/R ALT is always displayed in feet.



- When a thrust bump rating is available for the aircraft/engine configuration and selected, OAT is used and SEL is blanked. Manual entries are not permitted. When a bump takeoff thrust is selected, the full climb thrust rating is automatically selected.

```
N1 LIMIT 1 / 1
SEL / OAT 2 0 K BUMP N1
/ +15 °C 1 0 2 . 5 / 1 0 2 . 5
2 0 K
<TO <SEL> CLB>
1 8 . 5 DETRATE
<TO-1 CLB-1>
CLB-2>
2 0 K BUMP
<TO-B <ACT>
-----
<PERF INIT TAKEOFF>
```


ON THE GROUND



TO THRUST AUTO SELECT OPTION:

When the Takeoff Thrust Auto-Select option is available, the N1 page is expanded to include a list of operator selected airport and runway combinations with appropriate takeoff thrusts. These are automatically selected by the FMC when an airport or an airport/runway combination is entered into the RTE page, or when an uplink is loaded into the flight plan, and the flight plan is EXECuted. When the FMC selects a thrust rating for an airport or an airport/runway combination, the selection is highlighted on this page.

PAGE ACCESS

- Press  key.
- Press  key.

This option requires a custom LDDDB to be loaded into the FMC, as well as changes to other flight related equipment.

Airline operators can request a custom Loadable Defaults Database (LDDDB) with a customized list of 250 airport/runway combinations and allowable thrust ratings for each aircraft configuration.

The available customizations are:

- Global default (DFLT) – the takeoff thrust to be used when the entered origin airport or origin airport/runway combination on the RTE page is not in the data list.
- Airport only – the indicated takeoff thrust will be selected for all runways at the specified airport.
- Airport/Runway – specifies the takeoff thrust for the indicated airport/runway combination. A different thrust rating may be used for each runway at an airport if appropriate.



N1 LIMIT 1 / 3				N1 LIMIT 1 / 3			
SEL / OAT 20 K N1				<AUTO <SEL>			
---- / +15 °C 88.9 / 88.9				<GA 98.5 / 98.5			
20 K				<CON 98.5 / 98.5			
<TO <ACT> <SEL> CLB>				<CLB 98.5 / 98.5			
				<CRZ 94.5 / 94.5			
				-----REDUCED CLB-----			
				<CLB-1 CLB-2>			

<PERF INIT TAKEOFF>							

ON THE GROUND

IN THE AIR

NEXT PAGE

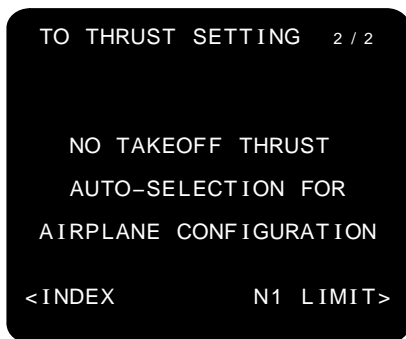
TO THRUST SETTING 2 / 3			
DFLT	ALL	0	KGRR 35 B
KMEM	18R	0	KGRR 26L 2
KMEM	18L	2	
KMEM	36C	B	
KSAN	27	1	
KSFO	1L	1	
KSFO	28L	0	
KSFO	28R	0	
KGRR	8R	0	
KGRR	17	0	
<INDEX			N1 LIMIT>

Each TO THRUST SETTING page displays a maximum of 20 airport or airport/runway combination data records.

Listed entries are displayed for reference and are not selectable or editable by the flight crew. The displayed takeoff thrust ratings in the data list are coded as follows:

- 0 (zero) – Full Rating
- 1 – Fixed Derate 1
- 2 – Fixed Derate 2
- B – Thrust Bump

When the LDDDB does not contain an airport/runway data list and the TO THRUST SETTING page is accessed, the following display is shown.



The FMC will determine the default setting as follows:

- If the origin airport or airport/runway combination is not in the LDDB Airport/Runway Data List, and a default data record is available, the FMCS will default to the takeoff thrust rating specified in the default data record, and display the VERIFY TAKEOFF THRUST message in the FMCS display scratchpad.
- If the origin airport or airport/runway combination is not in the LDDB Airport/Runway Data List, and a default data record is not available, the FMCS will default to the full takeoff thrust rating and display the VERIFY TAKEOFF THRUST message in the FMCS display scratchpad.

If the flight crew manually changes the takeoff thrust or an ACARS route data uplink includes a different rating, the ratings will be used in place of the auto-selected rating.



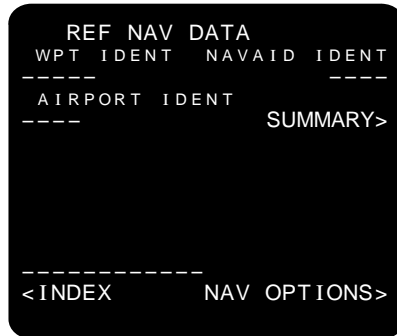
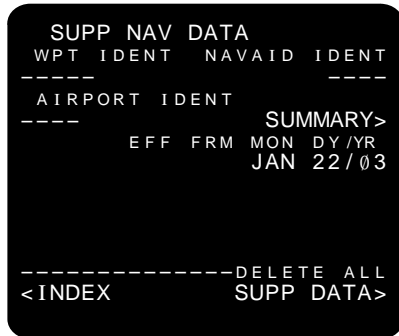
REF NAV DATA

REFERENCE NAVIGATION DATA

The Reference Navigation Data page displays runway data from the permanent database, or waypoints, nav aids, and airports stored in any of the databases. This page also provides the capability to enter waypoints, nav aids, and airports to an internally maintained data base, and will add waypoints defined and entered into the route on the RTE and RTE LEGS page.

PAGE ACCESS

- INIT/REF INDEX page NAV DATA prompt (LSK 1R) to access the REF NAV DATA page.
- INIT/REF INDEX page NAV DATA prompt (LSK 1R) with "SUPP" entered into the scratchpad to access the SUPP NAV DATA page.
- TEMP or SUPP NAV SUMMARY page INDEX prompt (LSK 6L).
- Any REF or SUPP NAV DATA detailed data page INDEX prompt (LSK 6L).



To obtain data from or store data to the this database, enter the waypoint, navaid, airport, or runway identifier into the appropriate data field.

When the supplemental database contains data, an effectivity date is assigned (the date is also displayed on the IDENT page).



DETAILED OPERATION

A pilot controlled reference navigation database area is provided within the FMC. This area is divided into the Supplemental and Temporary databases that may contain the following maximum number of entries:

- 20 waypoints (reserved for temporary navigation database)
- 80 waypoints (shared with supplemental navigation database)
- 40 nav aids (shared with supplemental navigation database)
- 6 airports (shared with supplemental navigation database)

Selecting the NAV DATA prompt (LSK 1R) on the INIT/REF INDEX page displays the REF NAV DATA page (Temporary database). When "SUPP" is entered into the scratch pad prior to selecting the NAV DATA prompt, the Supplemental database page (SUPP NAV DATA) is displayed.

While on the ground, both the Supplemental and Temporary Nav databases may be accessed. Once in the air, only the Temporary Nav database may be accessed.

Editing the temporary database area consists of:

- Adding identifiers that are not found in any other loaded database.
- Removing individual identifiers not entered in the flight plan from the temporary database area. This is performed by pressing the DELETE key, selecting the desired entry (LSK 1L thru 5L), and pressing EXECUTE.
- Adding pertinent information about an identifier entered into the temporary database area.

These databases differ in the fact that the temporary database is automatically cleared at the end of each flight but the supplemental database area must be manually cleared while on the ground.

```

SUPP NAV DATA
WPT IDENT  NAVAID  IDENT
-----
AIRPORT IDENT
-----
SUMMARY>
EFF FRM MON DY YR
JAN 22 / 03

-----DELETE ALL
<INDEX      SUPP DATA>

```

```

REF NAV DATA
WPT IDENT  NAVAID  IDENT
-----
AIRPORT IDENT
-----
SUMMARY>

-----
<INDEX      NAV OPTIONS>

```



- WPT IDENT – allows entry of a waypoint, navaid, or runway.
- AIRPORT IDENT – allows entry of an airport.
- NAVAID IDENT – allows entry of a navaid.

Entering an identifier into one of these fields displays the appropriate airport, navaid, runway, or waypoint identifier display page.

When an identifier is entered into one of the fields and additional information is required (i.e., entering a runway into the WPT IDENT field), the additional data field required will display the BOX prompt.

- SUMMARY – provides access to the appropriate SUPP or TEMP NAV SUMMARY pages. This prompt is only displayed when the temporary database area contains navigation data.
- EFF FRM MON DY/YR – displays the effectivity date entered into the SUPP NAV database. Not displayed on the REF NAV DATA page.
- NAV OPTIONS (LSK 6R) – displayed on the REF NAV DATA page. Selection displays the NAV OPTIONS page.
- DELETE ALL SUPP DATA (LSK 6R) – displayed on the SUPP NAV DATA page. Allows the flight crew to deleted all navigation data stored in the supplemental database area.
- INDEX (LSK 6L) – returns the display to the INIT/REF INDEX page.

The following specific NAV DATA page formats are used to display data about the entered identifier. The INDEX prompt (LSK 6L) on these pages will return the display to the REF or SUPP NAV DATA page.

Airport Format:

When an airport identifier is entered into the AIRPORT IDENT DASH prompt (LSK 2L) the following page is displayed providing data about the entered airport.



```

SUPP NAV DATA
RUNWAY IDENT
-----
AIRPORT IDENT
KMEM
LATITUDE      LONGITUDE
N35°02.6      W089°58.6
ELEVATION
                341FT

MAG VAR
E 1°
-----
<INDEX

```

```

TEMP NAV DATA
RUNWAY IDENT
-----
AIRPORT IDENT
KMEM
LATITUDE      LONGITUDE
N35°02.6      W089°58.6
ELEVATION
                341FT

MAG VAR
E 1°
-----
<INDEX

```

Navaid Format:

When a navaid is entered into the NAVAID IDENT DASH prompt (LSK 1R) the following page is displayed providing data about the entered navaid.

```

SUPP NAV DATA
          NAVAID IDENT
          LAS
          CLASS
          VTHW
LATITUDE  LONGITUDE
N36°04.6  W115°09.5
FREQ      ELEVATION
116.90    2140FT

MAG VAR
E 15°
-----
<INDEX

```

```

TEMP NAV DATA
          NAVAID IDENT
          LAS
          CLASS
          VTHW
LATITUDE  LONGITUDE
N36°04.6  W115°09.5
FREQ      ELEVATION
116.90    2140FT

MAG VAR
E 15°
-----
<INDEX

```

The navaid classification (CLASS) provides basic information about the navaid type. Some possibilities are:

- First Position – Navaid Type.
 - H = NDB
 - M = Marine Beacon
 - V = VOR
- Second Position – Co-Located Equipment.
 - C = Navaid used as ILS Back Course Locator
 - D = DME
 - I = ILS/DME



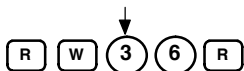
- M = Military TACAN
- O = Navaid used as LOM
- T = TACAN
- Third Position – Altitude or Range Class.
 - H – High Altitude or NDB Range Greater Than 75 NM
 - L = Low Altitude
 - M = NDB Range Between 25 and 49 NM
 - T = Terminal
 - U = Undefined
- Fourth Position – Voice & Weather Capability.
 - A = Automatic Weather Broadcast
 - B = Scheduled Broadcast
 - N = Not Co-Located with TACAN or DME
 - W = No Voice on Navaid Frequency

Runway Format:

This format displays information concerning the indicated runway. A specific airport must be specified.



ENTER THE AIRPORT TO
DISPLAY THE AIRPORT
NAV DATA PAGE

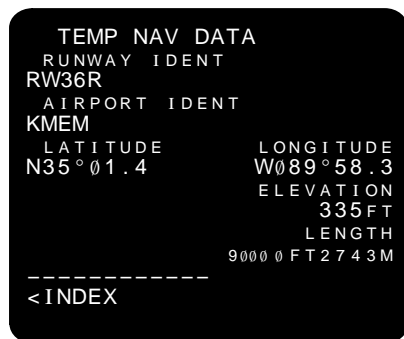
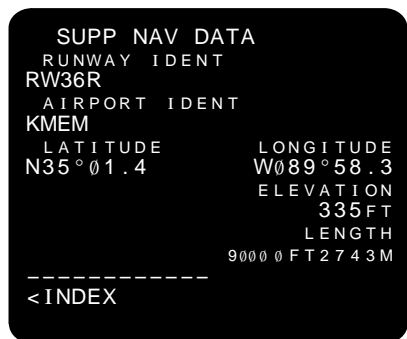


ENTER THE RUNWAY



SELECT THE SCRATCH PAD
TO THE RUNWAY DASH PROMPT

The page will then display the runway data.



If a runway is entered into the WPT IDENT DASH prompt on the initial page, the runway format page is displayed with a BOX prompt in the AIRPORT IDENT line (LSK 2L). An airport identifier must be entered before runway data can be displayed.

Waypoint Format:



The NAV DATA pages will display information about waypoints in the flight plan or from any navigation database loaded into the FMC.

```

SUPP NAV DATA
WPT IDENT
HBU01

LATITUDE      LONGITUDE
N38°26.9      W108°52.1
MAG VAR
E 12°
REF IDENT     RADIAL/DIST
HBU           256° / 86NM
-----
<INDEX
    
```

```

TEMP NAV DATA
WPT IDENT
HBU01

LATITUDE      LONGITUDE
N38°26.9      W108°52.1
MAG VAR
E 12°
REF IDENT     RADIAL/DIST
HBU           256° / 86NM
-----
<INDEX
    
```

SUPP or TEMP NAV SUMMARY page:

When the SUMMERY prompt (LSK 2R) is selected, the SUPP NAV SUMMARY or TEMP NAV SUMMARY page is displayed.

```

SUPP NAV SUMMARY 1 / 1
WAYPOINTS
HBU01 HBU 256 / 86

<INDEX
    
```

```

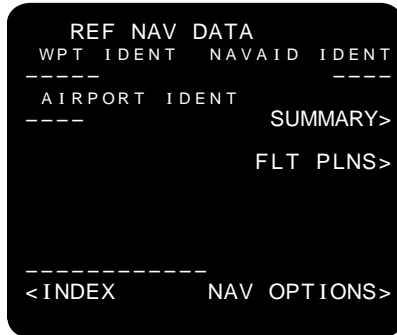
TEMP NAV SUMMARY 1 / 1
WAYPOINTS
HVE01 HVE 254 / 86
HBU01 HBU 256 / 86
ICT01 ICT 065 / 317

<INDEX
    
```

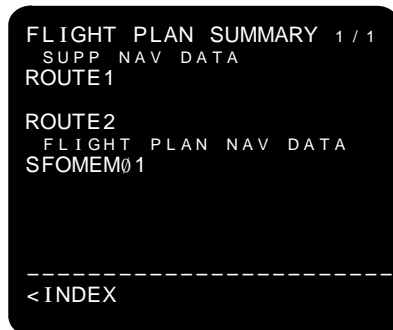
The summary pages display the contents of the pilot controlled database area. Airports, nav aids, runways, and waypoints located in the permanent databases are looked up, and therefore are not stored here.

PILOT-DEFINED COMPANY ROUTE OPTION:

When the pilot defined company route (CO-RTE) option is available, the FLT PLNS prompt (LSK 3R) is displayed. The aircrew can enter and save at least ten flight plans. Flight plans saved in the FMC are permanently retained and may selectively be deleted as required.



Selecting the FLT PLNS prompt displays the FLIGHT PLAN SUMMARY page to allow selecting pre-defined flight plans entered into the reference navigation database area or those flight plans stored into the loadable flight plan database. Selected flight plans or routes may be selected to the RTE page.



The routes entered into the supplemental navigation database can be deleted.

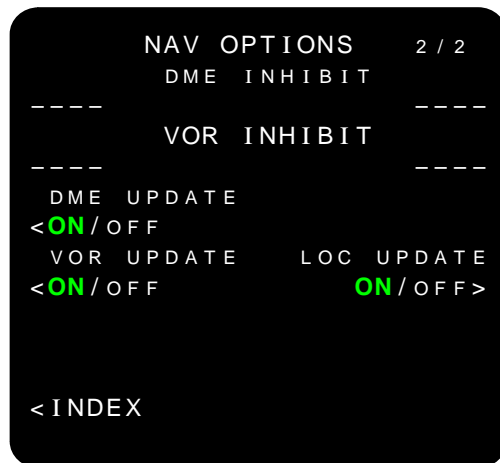


NAV OPTIONS

The Navigation Options page allows the aircrew to control which types of nav aids will be used in the FMC navigation solution. The default condition is to allow all nav aid types. This allows the FMC to compute several navigation solutions to compare results against.

PAGE ACCESS

- REF NAV DATA page NAV OPTIONS prompt (LSK 6R).
- NAV STATUS page  or  keys.



Displays the following:

- Specific nav aids inhibited from navigation solution.
- Update selection for DME, VOR, and GPS (GPS option), and LOC.

Dash prompts: A nav aid identifier can be written into these fields.

Existing identifier(s) may be overwritten.

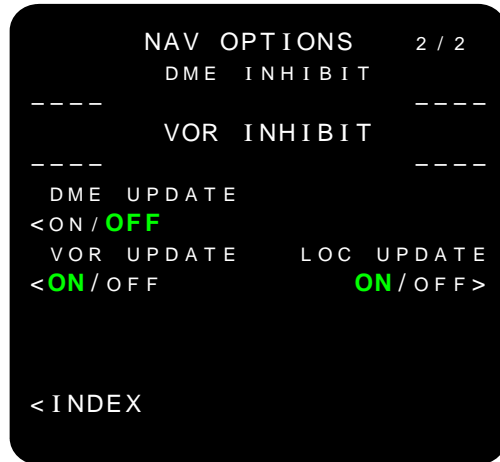
Toggle select the update prompts to enable/disable updates using LSK 3L, LSK 4L, or LSK 3R (GPS option), LSK 4R as appropriate.

The default update state is ON at long term power up and flight complete.

INDEX prompt (LSK 6L) – displays the INIT/REF INDEX page.

DEFAULT DME UPDATE OFF OPTION:

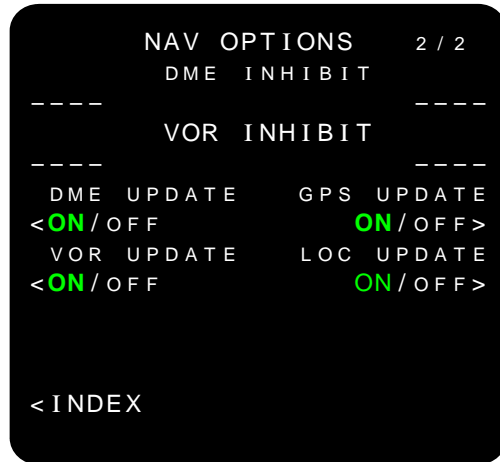
When the Default DME update off option is available, the DME update selection defaults to OFF. Manual selection to ON must be performed by the flight crew.



The DME update selection is OFF at long term power up and flight complete.

GPS OPTION:

When the GPS option is available, the GPS UPDATE toggle is displayed allowing the crew to manually enable or disable GPS updating.



When GPS data is the primary navigation source, the localizer data is not used. If the FMC has not received GPS data or the data is not valid in the past five minutes, the FMC will use localizer data if the LOC UPDATE (LSK 4R) is selected to ON. When LOC UPDATE is selected to OFF, localizer data will not be used under any circumstances.





NAV STATUS

NAVIGATION STATUS

The Navigation Status page displays the navigation aids being tuned by the FMC, including the VHF receiver tuning and the IRS. The stations used in the navigation solution are highlighted to provide an indication.

PAGE ACCESS

- POS SHIFT page NAV STATUS prompt (LSK 5R).
- PROGRESS page NAV STATUS prompt (LSK 6R).
- INIT/REF INDEX page NAV STATUS prompt (LSK 6R) while in the air.
- NAV OPTIONS page  or  keys

NAV STATUS		1 / 2	
ILS-L		ILS-R	
IGUCM 110.50		IGUCM 110.50	
DME-L		DME-R	
IGUC 110.50		IGUC 110.50	
MTJ 117.10		RLG 113.80	
IGUC 110.50		PUB 116.70	
HBU 114.90		BJC 115.40	
DBL 113.00		ALS 113.90	
IRS (2)			
< INDEX			POS SHIFT >

INDEX prompt (LSK 6L) – returns the display to the INIT/REF INDEX page.



DETAILED OPERATION

All navids being tuned are displayed on this page using the following visual indications:

- If the navaid is providing valid data, the identifier and frequency are displayed in large font.
- If the navaid is not providing valid data, the identifier and frequency are displayed in small font.
- If the navaid is used in the navigation solution, it is highlighted to provide an indication.

Line 1 displays the navaid type, the identifier and the frequency tuned corresponding to the VHF/NAV control panel settings. When the frequency set in the VHF/NAV control panel does not correspond to VOR, ILS, or GLS identifier, only the frequency is displayed.

A tuning method indication is also displayed (always in small font) one position to the left of the frequency.

- A = Auto
- M = Manual
- P = Procedural

Lines 2 through 4 display the DME identifiers and frequencies tuned.

NAV STATUS		1 / 2	
ILS-L		ILS-R	
IGUCM110.50		IGUCM110.50	
DME-L		DME-R	
IGUC 110.50		IGUC 110.50	
DVC 114.60		RLG 113.80	
EKR 115.20		HBU 114.90	
JNC 112.40		ALS 113.90	
FMN 115.30		IGUC 110.50	
		IRS (2)	
<INDEX		POS SHIFT>	

If the radio is not sending data, the navaid type and “FAIL” are displayed.

Line 5 indicates the IRSs used in the navigation solution; left (L), right (R), or, in dual installations, both (2).

POS SHIFT prompt (LSK 6R) – displays the POS SHIFT page.



GPS OPTION:

When the GPS option is available, line 5 will indicate which GPS radio is used in the navigation solution. If GPS UPDATE on the NAV OPTIONS page is selected to OFF, the GPS indicator is blanked on this page.

NAV STATUS		1 / 2
ILS-L	ILS-R	
IGUCM110.50	IGUCM110.50	
DME-L	DME-R	
IGUC 110.50	IGUC 110.50	
DVC 114.60	RLG 113.80	
EKR 115.20	HBU 114.90	
JNC 112.40	ALS 113.90	
FMN 115.30	IGUC 110.50	
GPS (2)	IRS (2)	
<INDEX	POS SHIFT>	

The GPS used in the navigation solution is indicated as; left (L), right (R), or, in dual installations, both (2).

When GLS is tuned and the GPS mode is LAAS Precision Approach, the following indications are provided:

- If GLS is tuned, and data from the corresponding GPS is used in the NAV solution, the Identifier is displayed in large green font, and the frequency in large white font.
- If GLS is tuned, and data from the corresponding GPS is not used in the NAV solution, the Identifier and frequency are displayed in large white font.

When GLS is tuned and the GPS mode is not LAAS Precision Approach, the Identifier and frequency are displayed in small white font.



LATERAL OFFSET

The Lateral Offset page provides the aircrew with the capability to initiate an offset from present position, or to plan an offset in the active route.

The page title displays the ACT status and the OFST annunciator is lit when the offset is being flown.

PAGE ACCESS

- RTE page OFFSET prompt (LSK 6L) in air
- INIT/REF INDEX page OFFSET prompt (LSK 5L)



Dash prompts: OFFSET DIST – offset path distance to left or right of active flight path.

Dash prompts: START WAYPOINT – allows entry of a starting waypoint.

Dash prompts: END WAYPOINT – allows entry of an ending waypoint.

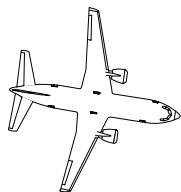
The LATERAL OFFSET may be cancelled by deleting the offset distance.



DETAILED OPERATION

When considering a lateral offset to the active flight path, the offset must begin with, propagate through, and end with offsettable legs. Only waypoints entered into the route will be accepted.

To set up an offset in the flight plan, the OFFSET DIST must be entered. The entry must specify the offset direction; left (L) or right (R), and the distance. The maximum offset distance is 99.9 nm.



NOTE

If an offsettable leg does not exist in the flight plan, the OFFSET DIST DASH prompt is blank.

After entering the OFFSET DIST, the START WAYPOINT and END WAYPOINT lines are displayed.

START WAYPOINT

- The start waypoint must be in the flight plan.
- The BOX prompt is displayed when the active leg is non-off-settable.
- If a waypoint is not entered, the FMC assumes the offset to begin at PPOS.

END WAYPOINT

- The end waypoint must be in the flight plan.
- The end waypoint must fall between the start waypoint and the end of the route.

The OFFSET ENDS ABEAM message is displayed when:

- A non-offsettable leg is encountered in the route between the start and end waypoints.
- A flight plan change is made which inserts a non-offsettable leg between the start and end waypoints.

To cancel an offset:

- Delete the OFFSET DIST.
- Enter zero into the OFFSET DIST.
- Perform a Direct To or Intercept At function from PPOS back to the original flight path.



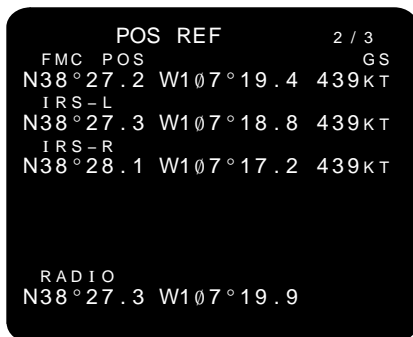
POS REF

The Position Reference page displays the present computed position of each of the navigation subsystems along with the computed ground speed if available. When a position is available while on the ground, that position may be selected to the SET IRS POS BOX prompt (LSK 4R) on the POS INIT page.

PAGE ACCESS

– POS INIT page 

– POS SHIFT page 



- FMC POS – displays the FMC composit position.
- IRS-L and IRS-R – displays the position computed by each IRS.
- RADIO – displays the radio nav aids position computed by the FMC.

When position data is not valid for a specific subsystem, that data line is blanked.

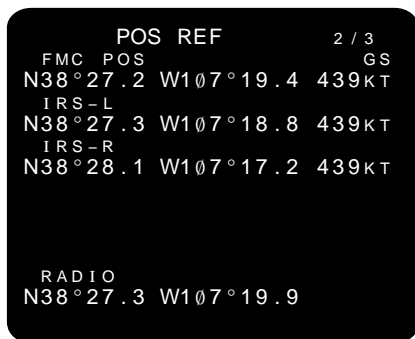
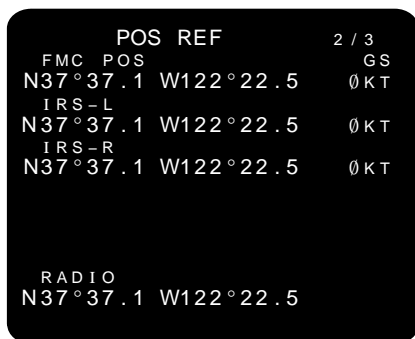


DETAILED OPERATION

While on the ground prior to initialization of the IRSs, the POS REF page does not provide position data.



After initialization is complete, all available nav aids are initialized to the same position for a starting reference point, and then continually updated from the subsystem data.



GPS OPTION:

When the GPS option is available, the GPS positions are displayed whenever they are valid and available. The GPS position may be selected (LSK 4L or 5L) and used to set the IRS position.

```
POS REF      2 / 3
FMC POS      GS
IRS-L
IRS-R
GPS-L
N37°37.1 W122°22.5
GPS-R
N37°37.1 W122°22.5
RADIO
```

After initialization is complete, all available nav aids are initialized to the same position for a starting reference point, and then continually updated from the sub-system data.

```
POS REF      2 / 3
FMC POS      GS
N37°37.1 W122°22.5 0KT
IRS-L
N37°37.1 W122°22.5 0KT
IRS-R
N37°37.1 W122°22.5 0KT
GPS-L
N37°37.1 W122°22.5
GPS-R
N37°37.1 W122°22.5
RADIO
N37°37.1 W122°22.5
```




POS SHIFT



The Position Shift page displays the position difference (bearing/distance) between each of the FMCs and available sensors with respect to the composite FMC POS displayed on line 1 of the POS REF page. Data is not available while the airplane is on the ground.

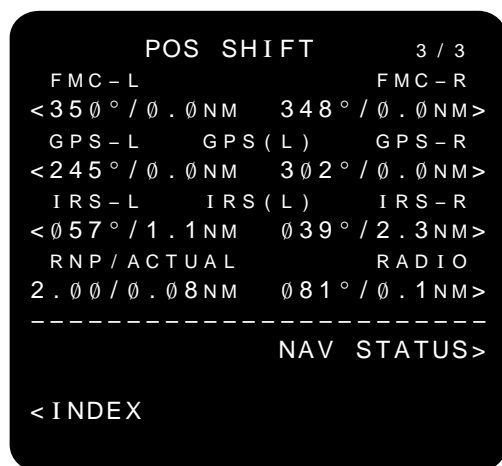
The POS SHIFT page also allows the FMC position to be updated to any of the sensor positions displayed. Such updating is not normally required. A sensor performing poorly enough to corrupt the FMC position would be identified by the FMC and different sensors would be selected.

The required and actual navigation performance values are also displayed. RNP may be the default value for the current phase of flight, the RNP for the active leg defined in the NDB, or a manually entered RNP.

When the update is performed, the primary FMC position is updated, then the secondary FMC and sensor positions are updated relative to the primary FMC position.

PAGE ACCESS

- POS INIT page  key.
- POS SHIFT page  key.
- NAV STATUS page POS SHIFT prompt (LSK 6R)





DETAILED OPERATION

All displayed bearings are from the individual sensor position to the composite position (POS REF page FMC POS) and reflect the position of the MAG/TRUE switch setting. When position inputs are not available or are invalid, the data line for that sensor is blanked.

In a single FMC installation, the FMC headers and data lines are blanked.


The GPS headers and data lines are blanked when GPS is not available.

- FMC–L and FMC–R position – displays the individual position differences between each FMC and the composite position.
- GPS–L and GPS–R – displays the individual GPS position differences between each GPS and the composite position.
- IRS–L and IRS–R – displays the individual IRS position differences between each IRS and the composite position.

Selecting one of the positions displayed causes:

- The selected position to be highlighted.
- The CANCEL prompt (LSK 6R) to be displayed.
- The EXECute annunciator to be lit.
- Halt position updating.

Selecting the CANCEL prompt (LSK 6R) cancels the intended update.

Pressing the  button updates the composite position of the POS REF page by the difference of the selected sensor.



RTE HOLD


The Route Hold page allows the crew to enter a holding pattern fix point from PPOS or from any other fixed geographical point in the flight plan or Nav Database. When a holding fix is entered, the MOD RTE HOLD page is displayed.

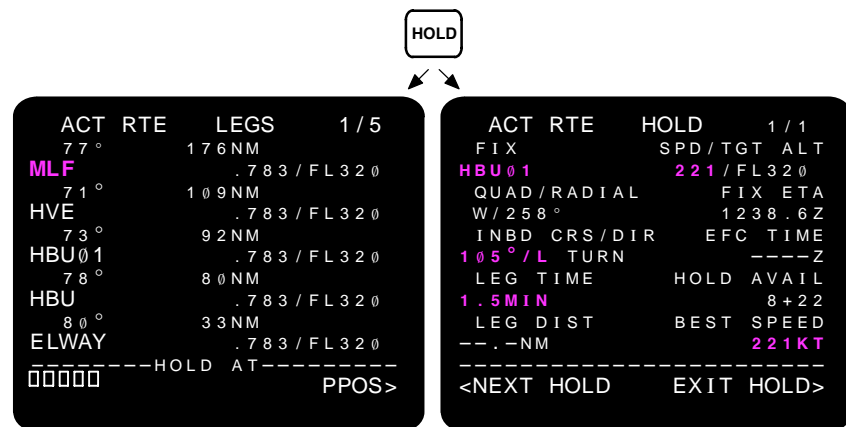
The MOD RTE HOLD page provides the complete specification of the holding pattern parameters. The hold must be made active in the route using the EXECute key.

The RTE HOLD page is not displayed for procedure holds.

When a hold fix waypoint that is not contained in the active route is entered, a disconnect will follow the hold fix. The route may then be linked up with the hold fix using normal RTE and RTE LEGS page editing.

PAGE ACCESS

- Press the  key when a hold already exists in the active flight plan.
- Entering a waypoint into the active RTE LEGS HOLD AT BOX prompt (LSK 6L).



DISPLAYED WHEN A HOLD
DOES NOT EXIST IN THE
ACTIVE FLIGHT PLAN

DISPLAYED WHEN A HOLD
DOES EXIST IN THE
ACTIVE FLIGHT PLAN

A maximum of five hold fix waypoints may be entered into the active flight plan.



DETAILED OPERATION

The hold function displays the active Route Legs page with a HOLD AT box prompt (6L) if a hold is not already entered into the flight plan. Select or enter the desired hold fix waypoint into the box prompt (LSK 6L) to define the hold and add it to the active flight plan.

If a hold is already entered into the active flight plan, the RTE HOLD page is displayed when the HOLD key is pressed. Selecting the NEXT HOLD prompt (LSK 6L) will display the RTE LEGS page with the HOLD AT box prompt to allow entering another hold fix waypoint.

The RTE HOLD page is not displayed for procedure holds.

ACT	RTE	LEGS	1 / 5
	77°	176NM	
MLF		.783 / FL320	
	71°	109NM	
HVE		.783 / FL320	
	73°	92NM	
HBU01		.783 / FL320	
	78°	80NM	
HBU		.783 / FL320	
	80°	33NM	
ELWAY		.783 / FL320	
-----HOLD AT-----			
□□□□			PPOS>

ACT	RTE	HOLD	1 / 1
FIX		SPD/TGT ALT	
HBU01		221 / FL320	
QUAD/RADIAL		FIX ETA	
W/258°		1238 .6Z	
INBD CRS/DIR		EFC TIME	
105° / L TURN		----Z	
LEG TIME		HOLD AVAIL	
1.5MIN		8+22	
LEG DIST		BEST SPEED	
--.-NM		221KT	

<NEXT HOLD		EXIT HOLD>	

- FIX – displays the hold fix waypoint entered or selected into the HOLD AT box prompt on the RTE LEGS page. This entry is not editable.
- QUAD/RADIAL – initially displays the FMC computed holding quadrant. The inbound course is computed based on this entry.
 - “°” is displayed when the north reference is magnetic.
 - “°T” is displayed when the north reference is true.
 - Manual entries and quad/radials retrieved from the navigation databases are displayed in large font.
 - When the hold is placed on a PBD waypoint from a VHF navaid, the radial is set equal to the bearing of the PBD waypoint and is not editable.



- The quadrant is determined by the inbound course as follows:

HOLD INBOUND COURSE	HOLD QUADRANT
158 through 202 degrees	N
203 through 247 degrees	NE
248 through 292 degrees	E
293 through 337 degrees	SE
338 through 022 degrees	S
023 through 067 degrees	SW
068 through 112 degrees	W
113 through 157 degrees	NW

- INBD CRS/DIR – displays the FMC computed inbound holding course and turn direction.
 - The default turn direction is right.
 - Manual entries and holding patterns retrieved from the navigation data bases are displayed in large font.
 - The inbound course is the reciprocal of the radial except for a hold at a PBD waypoint from a VHF navaid.
- LEG TIME – displays the time to fly the leg of the holding pattern.
 - Default leg time is 1.5 minutes above, or 1 minute below 14000 feet.
 - Manual entries or times retrieved from the navigation data bases are displayed in large font.
 - Displays the DASH prompt when LEG DIST is entered.
- LEG DIST – allows entry of the length of the holding pattern leg.
 - Default is a DASH prompt.
 - Manual entries are in nautical miles including tenths of a nm.
 - Manual entries or distances retrieved from the navigation data bases are displayed in large font.



- NEXT HOLD or ERASE – allows adding and removing holding points into the flight plan.
 - NEXT HOLD prompt is displayed during the first four hold waypoint entries. Returns the display to the RTE LEGS HOLD AT page to allow selecting or entering a new hold waypoint.
 - ERASE is displayed when the fifth hold waypoint is entered to allow removing a hold. Selection of the ERASE prompt results in the deletion of the MOD plan.
- SPD/TGT ALT – displays the FMC hold speed and altitude.
 - SPD – displays one of the following:
 - Predicted speed if a speed restriction does not exist for the hold entry waypoint and a manual entry has not been made.
 - A speed restriction from the NDB if one exists for the hold entry waypoint.
 - Manually entered hold speed.
 - After deleting a manually entered or ACARS uplinked speed, the FMC computed BEST SPEED is displayed. In this case, speed is displayed in white font.
 - MCP selected speed when speed intervention is active.
 - Predicted SPD is displayed in white font. Active SPD is displayed in magenta font.
 - TGT ALT – displays one of the following:
 - Predicted altitude if an altitude restriction/constraint does not exist for the hold entry waypoint and a manual entry has not been made.
 - An altitude restriction/constraint from the NDB if one exists for the hold entry waypoint.
 - Manually entered hold altitude.
 - MCP selected altitude when altitude intervention is active.
 - Predicted TGT ALT is displayed in white font. Active TGT ALT is displayed in magenta font.
- FIX ETA – displays the ETA to the hold fix waypoint. The FMC recomputes this time for each pass of the hold fix waypoint.



- EFC TIME – allows entry of a time that a further clearance is expected. When GMT is later than the time entered, the field returns to the DASH prompt. Manual entries and ACARS uplinked EFC TIME can be deleted.
- HOLD AVAIL – displays the time that the airplane can remain in the holding pattern and still be able to reach the destination with the required reserve fuel quantity.
- BEST SPEED – displays the FMC computed best holding speed for the altitude and current wind speed.
- EXIT HOLD prompt – allows arming the automatic exit of the holding pattern at the next transition of the hold fix waypoint. This prompt is only displayed when the hold is active.



HOLD

SELECT OR ENTER
DESIRED FIX WAYPOINT

ACT	RTE	LEGS	1 / 5
	77°	176NM	
MLF		.783 / FL320	
	71°	109NM	
HVE		.783 / FL320	
	73°	92NM	
HBU01		.784 / FL320	
	78°	80NM	
HBU		.784 / FL320	
	80°	33NM	
ELWAY		.784 / FL320	
-----HOLD AT-----			
□□□□□			PPOS>

SELECT THE SCRATCHPAD
TO THE BOX PROMPT
(LSK 6L)

ACT	RTE	LEGS	1 / 5
	77°	176NM	
MLF		.783 / FL320	
	71°	109NM	
HVE		.783 / FL320	
	73°	92NM	
HBU01		.784 / FL320	
	78°	80NM	
HBU		.784 / FL320	
	80°	33NM	
ELWAY		.784 / FL320	
-----HOLD AT-----			
□□□□□			PPOS>
HBU01			

MOD	RTE	HOLD	1 / 1
FIX		SPD / TGT ALT	
HBU01		221 / FL320	
QUAD / RADIAL		FIX ETA	
W / 258°		1238.6Z	
INBD CRS / DIR		EFC TIME	
078° / R TURN		----Z	
LEG TIME		HOLD AVAIL	
1.5MIN		8+10	
LEG DIST		BEST SPEED	
--.NM		221KT	

<NEXT HOLD			

(CONT)

The PPOS prompt (LSK 6R) may also be selected in lieu of a waypoint. When selected, the holding pattern will be at the airplane current position. The holding pattern entry point will move with PPOS until the hold is EXECuted.

When the hold fix waypoint is transitioned, the RTE HOLD page is activated. The EXIT HOLD prompt is then displayed (LSK 6R) to



MAKE ANY ALLOWABLE
CHANGES IF DESIRED

```

MOD RTE HOLD 1/1
FIX SPD/TGT ALT
HBU01 221/FL320
QUAD/RADIAL FIX ETA
W/258° 1238.6Z
INBD CRS/DIR EFC TIME
078°/R TURN ----Z
LEG TIME HOLD AVAIL
1.5MIN 8+10
LEG DIST BEST SPEED
--.-NM 221KT
-----
<NEXT HOLD
    
```

```

MOD RTE HOLD 1/1
FIX SPD/TGT ALT
HBU01 221/FL320
QUAD/RADIAL FIX ETA
W/258° 1238.6Z
INBD CRS/DIR EFC TIME
078°/R TURN ----Z
LEG TIME HOLD AVAIL
1.5MIN 8+10
LEG DIST BEST SPEED
--.-NM 221KT
-----
<NEXT HOLD
8
    
```

↓
8

```

MOD RTE HOLD 1/1
FIX SPD/TGT ALT
HBU01 221/FL320
QUAD/RADIAL FIX ETA
W/258° 1238.6Z
INBD CRS/DIR EFC TIME
078°/R TURN ----Z
LEG TIME HOLD AVAIL
--.-MIN 8+10
LEG DIST BEST SPEED
8.0NM 221KT
-----
<NEXT HOLD
    
```

↓
EXEC

```

RTE HOLD 1/1
FIX SPD/TGT ALT
HBU01 221/FL320
QUAD/RADIAL FIX ETA
W/258° 1238.6Z
INBD CRS/DIR EFC TIME
078°/R TURN ----Z
LEG TIME HOLD AVAIL
--.-MIN 8+10
LEG DIST BEST SPEED
8.0NM 221KT
-----
<NEXT HOLD
    
```

THE HOLD IS NOW INCORPORATED
INTO THE ACTIVE FLIGHT PLAN
BUT IS NOT ACTIVE AT THIS POINT



allow arming an exit from the holding pattern. The FMC will continue to fly the hold pattern until the hold fix waypoint is transitioned after arming the hold.



To immediately exit the hold, select any waypoint from the route (including the hold fix waypoint) and select it to the go to waypoint position (LSK 1L) on the RTE LEGS page (perform a direct to operation) and then press the EXECute key. The FMC will compute and fly the required path to place the airplane back on the original course.



SELECT DESIRED WPT

The Select Desired Waypoint page is displayed any time a non-unique waypoint is entered into one of the FMC display pages (except RTA PROGRESS and LATERAL OFFSET pages).

When this page appears, select the appropriate line using corresponding LSK 1 through LSK 6 (left or right may be used). The display will return to the original page with the selected waypoint available.

A maximum of twelve identifiers (2 pages) can be displayed, and are listed in the order of increasing distance from the reference position.

PAGE ACCESS

- Entering a non-unique waypoint or navaid identifier into a display field on an appropriate page (except RTA PROGRESS and LATERAL OFFSET).



- The title line includes the the identifier that caused this page to be displayed (up to five characters)
- The types of identifiers that may be displayed are:
 - APT
 - DME
 - ILS
 - ILSDME
 - LOC
 - LOCDME
 - NDB
 - VOR
 - VORDME
 - VORTAC
 - WPT

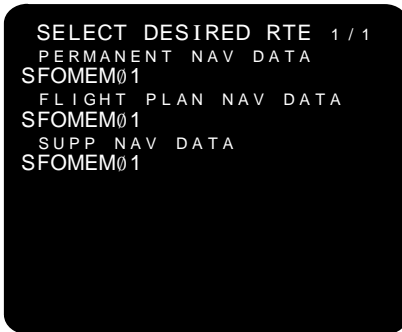
When the identifier facility name is in the navigation database (up to 15 characters) it is displayed next to the identifier.

Pilot-Defined Company Route OPTION:

When the pilot defined company route option is available, the Select Desired Route page is also available. This page functions the same way with route stored in the FMC.

PAGE ACCESS

- Entering a non-unique CO-ROUTE identifier on the RTE page.



Entering a non-unique CO-ROUTE identifier on the RTE page will display this page allowing selection of the desired route data.



ALTERNATE NAVIGATION

(LCD CDU Update 2 or Update 3) ■

The alternate navigation function provides basic backup navigation capability via the MCDUs. The MCDU can hold a flight plan consisting of up to 60 waypoints. After the FMC route is activated it can be crossloaded to the MCDU.

Once initialized, the FMC continues to provide the MCDU with route and position updates each time a waypoint is transitioned. If the FMC fails, the MCDU can still provide basic navigation data to the flight crew on three display pages; Alternate Navigation LEGS, Alternate Navigation WPT DATA, and Alternate Navigation PROGRESS.

The following depicts accessing the alternate navigation function.



MENU

MENU

	<FMC	<ACT>
	<ACARS	<HLD>
	<DFDAU	
	<ALT NAV	ACARS LOGOFF>

FLIGHT PLAN LOADED AND ACTIVE

FLIGHT PLAN NOT LOADED OR NOT ACTIVE

ACT GPS PROGRESS

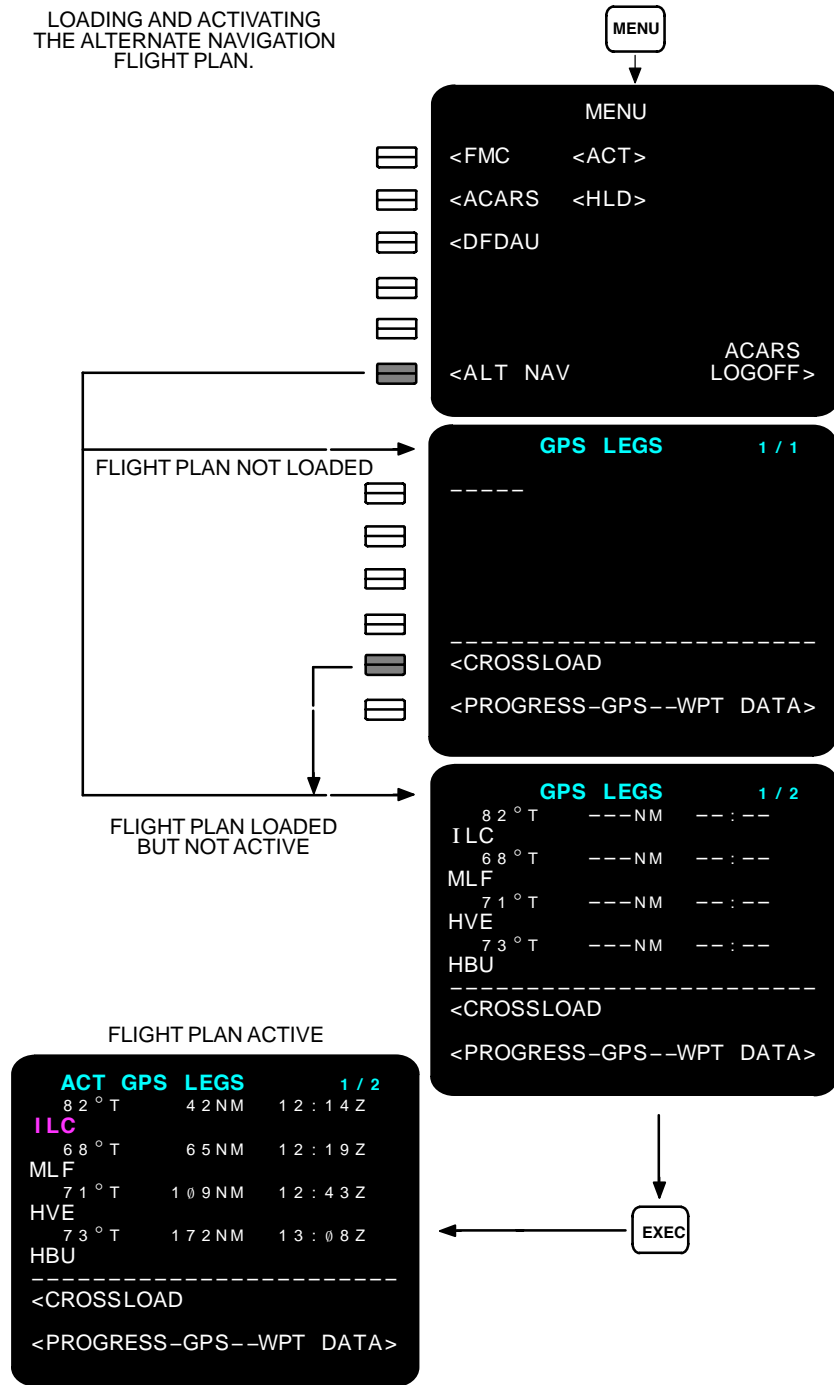
TO	DTG	ETA
ITC	81NM	12:14Z
TK/DTK	XTK	ERROR
82°T/ 82°T	L 0.1	NM
GS		
310KT		
GPS R		
N38°15.0 W114°23.7		

<LEGS-----GPS--WPT DATA>		

SEE NEXT PAGE



LOADING AND ACTIVATING THE ALTERNATE NAVIGATION FLIGHT PLAN.





LEGS

Alternate Navigation LEGS

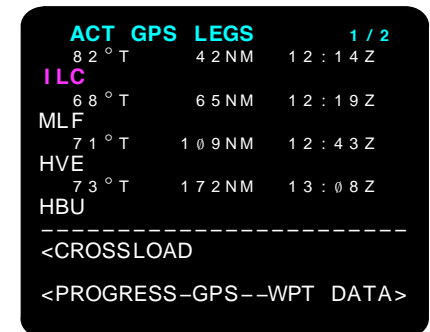
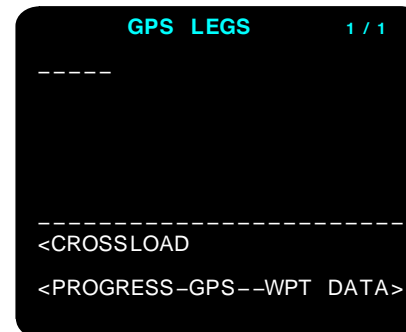
The alternate navigation LEGS page performs the same function as the standard RTE LEGS page. The flight plan may be manually entered, or crossloaded from the primary FMC.

The primary differences between this page and the normal RTE LEGS page is that the estimated time of arrival (ETA) to the waypoint is displayed instead of the estimated time enroute (ETE) to the waypoint, and the altitudes are not displayed (does not account for wind data).

Manual flight plan entries and edits are performed the same as for the FMC.

PAGE ACCESS

- MENU page ALT NAV prompt (LSK 6L).
- Alternate navigation WPT DATA page LEGS prompt (LSK 6L).
- Alternate navigation PROGRESS page LEGS prompt (LSK 6L).
- Displayed when the FMC fails and a flight plan is not contained in the MCDU.



- Displays
 - Waypoint identifier
 - Leg direction
 - Leg distance
 - ETA





The FMC flight plan may be also be crossloaded to the MCDU using the CROSSLOAD prompt (LSK 5L). If the FMC should fail, the CROSSLOAD prompt changes to the LAST FMC PLAN prompt. When selected, th MCDU will use the last valid flight plan received by the FMC.

- Flight plan modifications may be made as usual.
- Inspect waypoints and data to confirm flight plan.
- Update flight plan as necessary.
- The on–side GPS must be available.

If the FMC route is not crossloaded to the MCDU prior to an FMC failure, the alternate navigation function will not be available.

To load the FMC route:

- Enter or load the flight plan into the FMC and active.
- Press  key.
- Select the ALT NAV prompt (LSK 6L).
- On the alternate navigation LEGS page, select the CROSS-LOAD prompt (LSK 5L).
- Press  key.



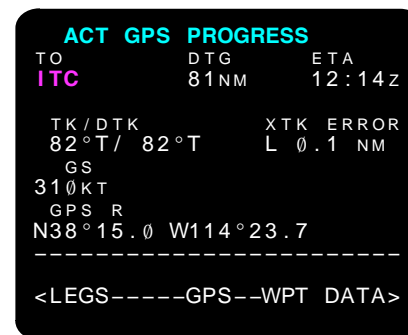
PROGRESS

Alternate Navigation PROGRESS

The alternate navigation PROGRESS page provides in-flight status of the aircraft's progress along the active lateral route. This page does not allow editing.

PAGE ACCESS

- MENU page ALT NAV prompt (LSK 6L)
(ALT NAV Flight Plan is already active)
- Alternate navigation LEGS page PROGRESS prompt (LSK 6L)
- Alternate navigation WPT DATA page PROGRESS prompt (LSK 6R)



Displays the following information:

- TO – displays the go to waypoint.
- TK/DTK – actual track and desired track displayed in true north heading.
- GS – ground speed.
- GPS x – PPOS latitude, longitude, and receiver data source.
- DTG – distance to go to the go to waypoint.
- ETA – estimated time of arrival to the go to waypoint.
- XTK ERROR – cross-track error direction and magnitude.

LEGS prompt (LSK 6L) – displays the alternate navigation LEGS page.

WPT DATA (LSK 6R) – displays the alternate navigation WPT DATA page.



WPT DATA

The alternate navigation Waypoint Data page lists all waypoint identifiers loaded or entered into the MCDU flight plan. Identifiers loaded from the FMC will have the latitude and longitude displayed. Manually entered identifiers will have to have the latitude and longitude entered along with the identifier.

PAGE ACCESS

- GPS LEGS page WPT DATA prompt (LSK 6R)
- GPS PROGRESS page WPT DATA prompt (LSK 6R)

	ACT	GPS	WPT	DATA	1 / 2
ILC	N38°15.0	W114°23.7			
MLF	N38°21.6	W113°00.8			
HVE	N38°25.0	W110°42.0			
HBU	N38°27.1	W107°02.4			

<CROSSLOAD
<LEGS-----GPS--PROGRESS>

- Displays
 - Waypoint identifier
 - Latitude
 - Longitude
- FMC flight plan may be crossloaded to the ALT NAV plan using the CROSSLOAD prompt (LSK 5L).
- Flight plan modifications may be made as usual.
- Inspect waypoints and data to confirm flight plan.



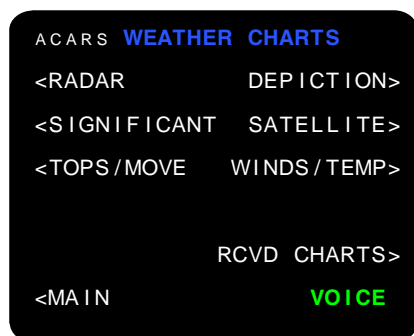
MAPS OPTION

Weather Maps Option

The LCD CDU Update 2 (only) can provide weather map uplink capability covering the continental United States. These maps are displayed on the MCDUs. To exit the weathermaps, select any mode key to return to an FMC page.

PAGE ACCESS

- MENU page ACARS prompt (LSK 2L)



The WEATHER MAPS pages provide the crew with up-to-date weather information that may be displayed on the MCDU. For detailed operation of the display functions, refer to the systems operations manual.

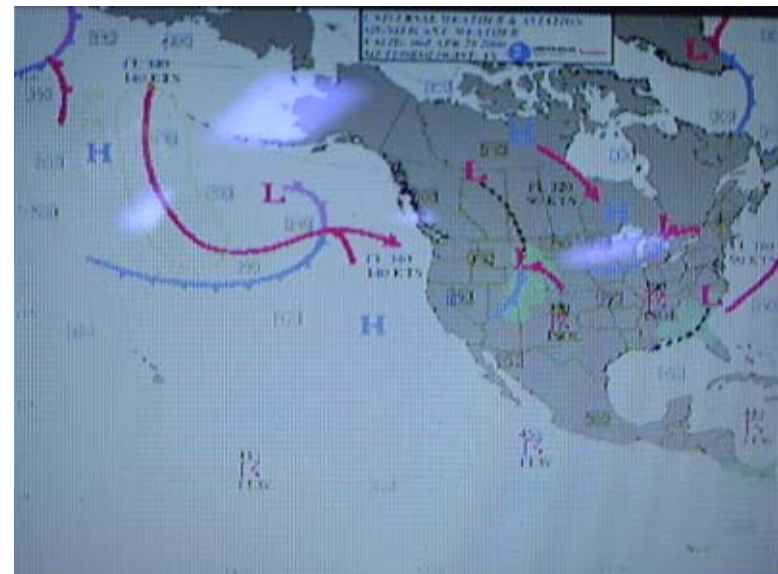
Typical examples of different types of weather maps and charts available are shown on the following pages.



Radar Image

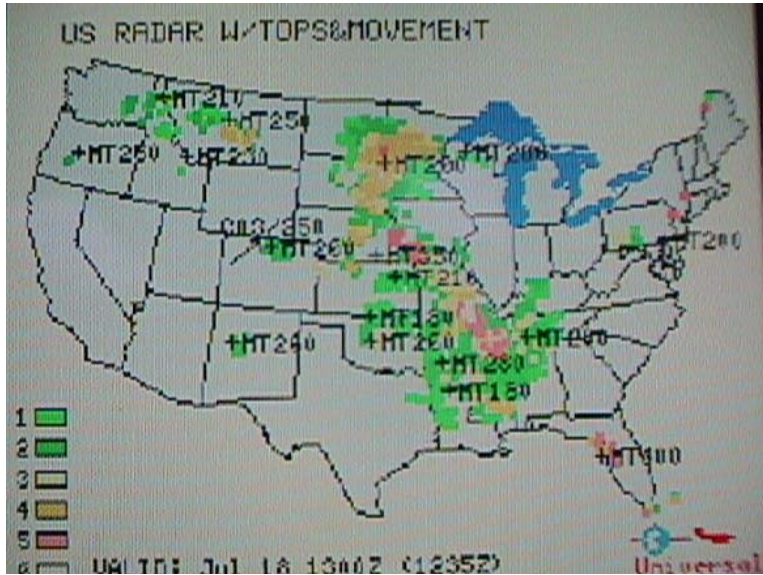


Significant Image

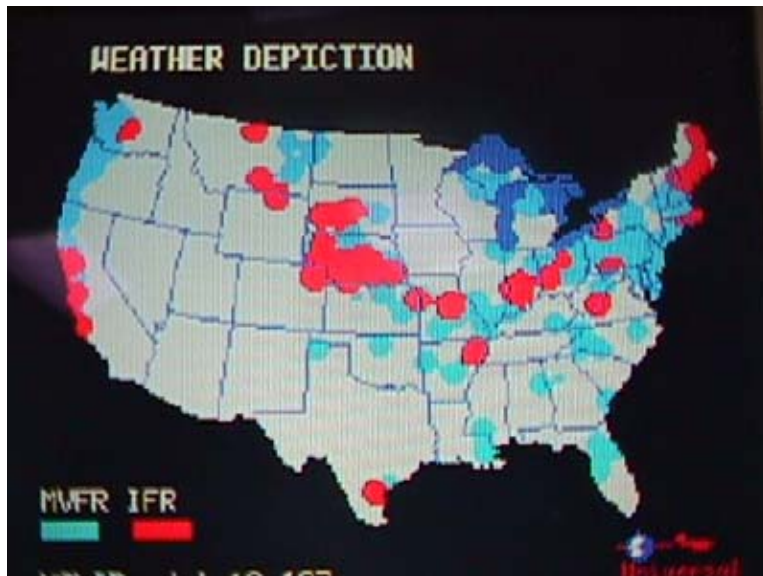




Tops/Move

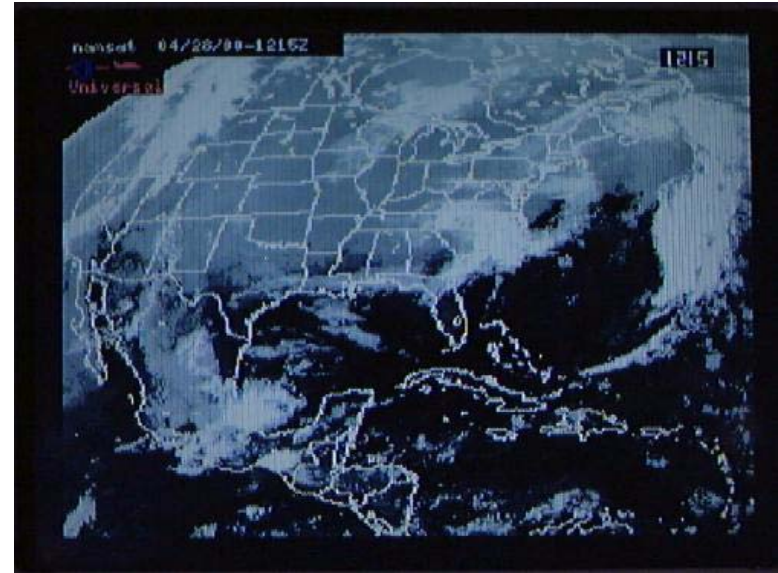


Depiction





Satellite Image



Wind/Temp Charts





PART 3

FMCS MESSAGES

ALERTING AND ADVISORY MESSAGES

FMCS MESSAGES

Messages are displayed in the LCD scratch pad line to inform the flight crew of incorrect manual entries, improper FMS operation, route status, and data transmissions (ACARS or ATC). The scratch pad works as a queue for all entries and messages.

There are several categories of messages generated or displayed by the FMCS.

- FMCS Alerting Messages – identify a condition which must be corrected before further FMCS-guided flight is advisable or possible. Alerting messages also cause the “FMC” annunciators to light on the FMA or AA panels.
- FMCS Advisory Messages – inform the flight crew that changes made cause unattainable conditions, or are used to verify the changes.
- FMCS Entry Error Messages – inform the flight crew of LCD entry errors. When the CLR key is used to clear the message, the original data that caused the message is displayed.
- ACARS/ATC Alerting Messages – provide system level alerts concerning transmissions (selectable option and requires at least one of the FMCS displays is an MCDU type).
- ACARS/ATC Advisory Messages – provide error information concerning transmissions (selectable option and requires at least one of the FMCS displays is an MCDU type).
- ACARS/ATC Annunciation Messages – provide status of the ACARS System and data transmissions (selectable option and requires at least one of the FMCS displays is an MCDU type).

When multiple messages are generated, they are queued for display in a prioritized sequence. Messages of the same category are placed in the order of their occurrence at the assigned level of priority.

Alerting and advisory (except entry error advisory) messages cause the LCD MGS annunciator to be lit. The MSG annunciator will remain lit until all alerting and advisory are cleared from the queue.



Messages are removed from the queue when manually cleared using the CLR key, or automatically removed when the cause of the message is no longer true. When a message is cleared manually and the cause of the message is still valid, the message is re-queued. The queue is layered in the following sequence:

- ATC Uplink Pending Messages
- Entry Error Messages (only displayed on the LCD the error was generated on.)
- Manually entered data
- ACARS Uplink Alerting Messages
- Alerting Messages – Active Flight Plan
- Alerting Messages – MOD Flight Plan
- Advisory Messages (if these messages pertain to specific data on a specific display page, the message is only displayed when that page is viewed.)
- ACARS System Level Messages.

When the Message Recall selectable option is enabled, the message queue may be viewed prior to end of flight by selecting the MSG RECALL prompt (LSK 2R) on the INIT/REF INDEX page. The MESSAGE RECALL page is cleared of all but system status messages at the end of the flight.

The following pages provide a complete list of FMCS messages, their causes, and the recommended corrective actions. Messages are in alphabetic sequence by message name.

The following notations are used in the messages:

- Airports are represented by nnnn
- Altitudes are represented by zzzzz
- Nav aids are represented by nnnnn
- Runways are represented by rrrrrr
- Speed is represented by xxx
- Waypoints are represented by yyyyy



FMCS Alerting Messages

The following list contains the FMCS alerting messages.

<u>MESSAGE</u>	<u>CAUSING CONDITION</u>	<u>FLIGHT CREW ACTION</u>
CHECK ALT TGT	VNAV is disengaged and invalid. The airplane is between the MCP ALT window setting and the FMC target altitude.	Correct discrepancy between altitude targets. Engage VNAV. Clear message.
CRZ ALT CHANGED TO zzzzz	A flight plan MOD contains an altitude constraint that conflicts with the cruise altitude. EXECuting the MOD will automatically change the cruise altitude to the new altitude constraint.	Review the change and: Reject/alter the MOD. or EXECute the MOD. Clear message.
CUTBACK DISARMED	While preparing for takeoff, a runway change was made.	Reset the CUTBACK selection to ON. Clear message.
	NOTE: This message	will follow the TAKE-OFF SPEEDS DELETED message.
CUTBACK UNAVAILABLE	All required data is available to compute an N1 cutback thrust limit, but the FMC is unable to determine a the cutback N1 thrust limit.	Clear message.
CYCLE IRS OFF-NAV	IRS requires manual restarting to reset alignment.	On the IRS Mode Panel, move the IRS mode control knob to OFF, then to NAV.



<u>MESSAGE</u>	<u>CAUSING CONDITION</u>	<u>FLIGHT CREW ACTION</u>
DATA BASE INVALID	The NDB is not usable.	Reload permanent navigation data base.(or crossload – dual FMC installation) (on the ground only)
DISCO INSRTD AFTR yyyyy	A flight plan edit caused a lateral discontinuity to be inserted into the flight plan ahead of the airplane because more than two waypoints would be bypassed. or The FMC predicts the lateral geometry in the flight path is indeterminate.	Cancel the flight plan MOD or amend the flight plan and remove the DISCO.
DISCONTINUITY	Passing last waypoint in the plan prior to a route discontinuity.	Select RTE or RTE LEGS to specify the waypoints for a continuous plan.
DRAG REQ AFTER yyyyy	A speed discontinuity of greater than 10 kts exists at the indicated waypoint.	Apply a speed correction. or Clear message.
END OF OFFSET	There are 2 minutes remaining to the offset path termination point and an end waypoint has not been specified on the LATERAL OFFSET page.	Enter an end of offset waypoint. Clear message.



<u>MESSAGE</u>	<u>CAUSING CONDITION</u>	<u>FLIGHT CREW ACTION</u>
END OF ROUTE	Passing last route leg termination.	Go to RTE or RTE LEGS and execute a route modification or Clear message.
ENG OUT SID MOD	An engine out SID exists for the selected runway and was automatically inserted into the flight plan.	Clear message.
ENTER IRS POSITION	An IRS needs to be initialized to a position.	Enter IRS POS on POS INIT page.
FMC APP/TUNE DISAGREE	An FMS approved non-precision approach is in the active flight plan and an ILS/MLS/GLS approach Navaid is being tuned with G/S ON.	Tune NAV radio to correct Navaid. or Select G/S OFF. Clear message.



<u>MESSAGE</u>	<u>CAUSING CONDITION</u>	<u>FLIGHT CREW ACTION</u>
FMC DISAGREE	While on the ground the FMCs in a dual installation have position or navigation solution differences that will prevent proper dual FMC operation.	Investigate source of disagreement and correct.
	or	
	During approach, the FMCs in a dual installation have a disagreement in the navigation solutions.	Initiate a GA unless suitable visual references can be established and maintained.
	or	
	During an FMC RNP approach, the FMCs in a dual installation have a disagreement in the navigation solutions.	If time permits, use the FMC source select switch to try forcing the FMCs to synchronize.
		Clear message.
	NOTE: In all cases, this message will clear when the causing condition is corrected or the airplane is flown out of the approach environment. If the causing condition still exists when returning to the approach, the message will be re-displayed.	
FMC DISAGREE – VERTICAL	While in Descent, the FMCs have an unresolved VDEV valid condition error.	Determine the source of the error. Correct as needed.
	or	
		Clear message.



<u>MESSAGE</u>	<u>CAUSING CONDITION</u>	<u>FLIGHT CREW ACTION</u>
FMC DISAGREE – VERTICAL (Cont.)	or While in Descent, VDEV is valid and; The FMCs have an unresolved Altitude error. or The FMCs have an unresolved Airspeed error. or The FMCs have an unresolved MACH Speed error. NOTE: This message is inhibited when the FMC DISAGREE message is displayed.	
FMC POS/RW DISAGREE	While attempting to perform a runway position update, a position difference between the FMC position and the se- lected runway posi- tion exceeds 10 nm.	Verify the correct positions are se- lected. Clear Message.
	NOTE: Displayed on the ground only.	



<u>MESSAGE</u>	<u>CAUSING CONDITION</u>	<u>FLIGHT CREW ACTION</u>
GPS-L INVALID	<p>The data received from the left GPS is unusable for:</p> <p>10 minutes while on the ground.</p> <p>or</p> <p>30 seconds while in the air.</p> <p>NOTE: This message will automatically clear when GPS data becomes valid again.</p> <p>NOTE: This message is inhibited when VOR/LOC and G/S are engaged while on approach.</p>	Clear Message.
GPS-R INVALID	<p>The data received from the right GPS is unusable for:</p> <p>10 minutes while on the ground.</p> <p>or</p> <p>30 seconds while in the air.</p> <p>NOTE: This message will automatically clear when GPS data becomes valid again.</p> <p>NOTE: This message is not displayed in single GPS installations.</p> <p>NOTE: This message is inhibited when VOR/LOC and G/S are engaged while on approach.</p>	Clear Message.
<p>NOTE: If both GPS-L INVALID and GPS-R INVALID messages are displayed, refer to the aircraft FMC Navigation Check Supplemental Procedures.</p>		



<u>MESSAGE</u>	<u>CAUSING CONDITION</u>	<u>FLIGHT CREW ACTION</u>
INSUFFICIENT FUEL	A change in conditions or a change in the flight plan route causes predictions to show not enough fuel onboard to reach destination with 2000 lbs of fuel remaining.	Modify flight plan. or Change cruise altitude. or Divert for additional fuel.
IRS MOTION	IRS has detected motion during alignment.	Clear message.
IRS POS/ORIGIN DISAGREE	The position difference between the IRS(s) and the selected ORIGIN airport position is more than 4 nm.	Verify the IRS(s) are aligned to the ORIGIN airport.
	NOTE: Displayed on the ground only.	
LNAV BANK ANGLE LIMITED	The airplane is in or within 5 minutes of a non-fly over roll-up turn that is less than or equal to 135 degrees, and the performance bank angle limit will cause the airplane to exceed the airspace containment area.	Disconnect LNAV, modify turn, reconnect LNAV. or Clear message.
MAX ALT zzzzz	Attempted to raise cruise altitude using altitude intervention and the MCP is set above the airplane maximum altitude.	Reset MCP altitude at or below maximum altitude. Clear message.



<u>MESSAGE</u>	<u>CAUSING CONDITION</u>	<u>FLIGHT CREW ACTION</u>
MISSED CAPTURE	A localizer capture maneuver was performed, but the capture did not occur.	Verify: LNAV is engaged. or The airplane is within 2 nm of the FMCS approach course. or Localizer beam centerline has not been crossed. or Airplane was on the correct side of the localizer beam.
MODEL/ENG DATA INVALID	The Model/Engine data base is not loaded or is not usable.	Reload MEDB.
NAV DATA OUT OF DATE	The current NDB effectivity date is expired.	Select a current NDB on the IDENT page if available. or Load a current NDB.
NAV INVALID -TUNE nnnnn	The RNAV or VOR approach procedure requires a specified Navaid that is not tuned or is not receiving valid data.	Cross-check radios and manually tune specified Navaid.



<u>MESSAGE</u>	<u>CAUSING CONDITION</u>	<u>FLIGHT CREW ACTION</u>
OVERSPEED DISCONNECT	During descent, the airport speed restriction is exceeded by 15 kts or more while below speed restriction altitude. NOTE: This message is inhibited when using speed intervention.	Slow aircraft to within 10 kts of speed target and re-engage VNAV.
PARTIAL ROUTE LOADED	A route is loaded from the Flight Plan DB or the SUPP NAV DB that contains references not contained in any data bases.	Modify flight plan. or Verify navigation databases are correct and up to date. Clear message.
PERF DEFAULTS INVALID	Loaded Performance Defaults data base is unusable.	Reload PDDB. Clear message.
RESET MCP ALT	The airplane is less than 5 nm from T/D and the MCP altitude is within 90 feet of the CRZ altitude.	Lower the altitude in the MCP ALT window. Clear message.
RTA UNACHIEVABLE	RTA does not fall within the computed RTA window.	Check RTA PROGRESS page and enter an achievable RTA. or Select another performance mode.
RW/APP CRS ERROR	While on approach, the MCP selected course does not match the front course of the selected approach in the active flight plan.	Correct the MCP selected course to within 5 degrees of the front course for the selected approach.



<u>MESSAGE</u>	<u>CAUSING CONDITION</u>	<u>FLIGHT CREW ACTION</u>
RW/APP TUNE DISAGREE	An ILS/GLS tuning error exists.	Check Navaid tuning for correct frequency or channel tuning.
SCANNING DME FAIL	Both Scanning DME radios have failed to provide the FMCs with inputs.	Verify radios are powered up. or Report failures to maintenance group. Clear message.
SELECT MODE AFTER RTA	The RTA waypoint was deleted from the active plan or sequenced.	Select another performance mode. or Clear message.
SINGLE FMC OPERATION	In a dual FMC installation, the primary FMC has determined that the secondary FMC has failed.	Clear message. Report failure to maintenance group.
SW OPTIONS INVALID	The software options database CRC check failed.	Reload SW Options Database. Clear message.
TAKEOFF SPEEDS DELETED	A runway change caused the manually entered takeoff speeds to be replaced by the QRH computed takeoff speeds. or Manually entered takeoff speeds do not meet the $V_1 \leq V_R < V_2$ requirement.	Check all entries on the TAKEOFF REF pages for errors.



<u>MESSAGE</u>	<u>CAUSING CONDITION</u>	<u>FLIGHT CREW ACTION</u>
THRUST REQUIRED	While in PATH descent the airplane is 17 kts below the highest target speed.	Increase speed to target speed.
UNABLE xxxKTS AT yyyy	The next waypoint speed restriction cannot be met due to airplane performance or a conflict with another speed restriction.	Clear message.
UNABLE HOLD AIRSPACE	An FMS generated hold pattern (using performance bank angle limits) contains a turn radius that exceeds allowable hold airspace.	Redefine or remove the hold. or Clear message.
UNABLE NEXT ALTITUDE	CLB: The next climb altitude restriction cannot be met due to undershoot. or DES: The next descent altitude restriction cannot be met due to overshoot.	Make manual corrections to meet the altitude restrictions.
UNABLE PROC AIRSPACE	The airplane is within 5 minutes of an active procedure turn entry waypoint, or an active procedure turn intercept waypoint, and the FMC turn geometry will exceed the required excursion distance.	Clear message.



<u>MESSAGE</u>	<u>CAUSING CONDITION</u>	<u>FLIGHT CREW ACTION</u>
UNABLE REQD NAV PERF-RNP	The displayed FMC ANP is not sufficient for current specified RNP values (pilot-entered).	Clear message. When entering data on ground, check accuracy. In flight, check the position differences on POS SHIFT page; if FMCS position is clearly corrupted, update FMCS to best sensor position source.
	<p>Messages inhibited in approach environment when:</p> <p>VOR/LOC mode is engaged.</p> <p style="text-align: center;">or</p> <p>VOR/ILS is selected on EFIS.</p> <p style="text-align: center;">or</p> <p>Both VOR radios are manually tuned to the procedure Navaid.</p> <p style="text-align: center;">or</p> <p>G/S mode is engaged.</p>	
VERIFY GW AND FUEL	The FMCS has not received a total fuel input, or it has been 30 minutes since a manual entry of fuel was made.	Enter fuel weight on PERF INIT page.
	<p>NOTE: This message is inhibited in descent when VREF is selected.</p>	
VERIFY POS: FMC-FMC	A position difference exists between the two FMC positions.	Use the FMC source select switch to force resynchronization.
	<p>NOTE: This message is inhibited while in approach.</p>	





<u>MESSAGE</u>	<u>CAUSING CONDITION</u>	<u>FLIGHT CREW ACTION</u>
VERIFY POS: FMC–GPS	A position difference exists between the FMCS composite position and the GPS position exceeds the elliptical RNP.	Perform a manual position update as required.
	NOTE: This message is inhibited while in approach.	
VERIFY POS: FMC–RADIO	A position difference exists between the radio position and the FMC position, and the radio position exceeds the larger of RNP or 0.5 nm.	Perform a manual position update as required.
	NOTE: The FMCS is performing radio updating. This message is inhibited while in approach.	
VERIFY POS: IRS–FMC	A position difference of more than 10 nm exists between the FMC composite position and both IRS positions.	Check the IRSs and perform a manual position update as required.
	NOTE: This message is inhibited while in approach.	
VERIFY POS: IRS–IRS	A position difference of more than 10 nm exists between the two IRSs.	Check the IRSs and perform a manual position update as required.
	NOTE: This message is inhibited while in approach.	



<u>MESSAGE</u>	<u>CAUSING CONDITION</u>	<u>FLIGHT CREW ACTION</u>
VERIFY POS: IRS-RADIO	A position difference of more than 4 nm exists between the radio position and the two IRS positions.	Check the IRSs and perform a manual position update as required.
	NOTE: The FMCS is not performing radio updating. This message is inhibited while in approach.	
VERIFY POSITION (on the ground)	One of the following POS Differences is detected: ORIGIN Airport position – IRS position is >4 nm. or FMCS position – Runway update is >10 nm.	When entering data on ground, check data accuracy. If the FMC position is clearly corrupted, update FMC to best sensor position source.
VERIFY RNP	The manually entered RNP is greater than the NDB defined RNP or default RNP for the current environment.	Enter an RNP smaller than the default or NDB RNP. or Delete the manually entered RNP. Clear message.
VERIFY TAKEOFF SPEEDS	The GW, PLAN FUEL, or ZFW has been changed after manually entering takeoff speeds.	Review GW, PLAN FUEL, ZFW, and takeoff speeds.



VERIFY TAKEOFF THRUST	The auto-selected takeoff thrust rating is not compatible with the airplane/engine configuration.	Manually select the correct takeoff thrust rating. Clear message.
	NOTE: The LDDDB thrust ratings for the airport/runway combination must be corrected.	
VERIFY VERT RNP	While in descent, a manually entered VRNP is greater than the NDB RNP.	Enter smaller VRNP or use NDB VRNP.
VNAV DISCONNECT	VNAV disengages. The airplane is between the MCP ALT window setting and the FMC target altitude.	Correct discrepancy between altitude targets. Re-engage VNAV. Clear message.
VNAV INVALID-PERF	An unexpected software exception occurred while: Flying the active flight plan. or VNAV switch on the MCP is pressed before PERF INIT is complete.	Re-enter COST INDEX on the PERF INIT page. or Complete PERF INIT.



FMCS Advisory Messages

The following list contains the FMCS advisory messages.

<u>MESSAGE</u>	<u>CAUSING CONDITION</u>	<u>FLIGHT CREW action</u>
ABOVE MAX CERT ALT	The current altitude exceeds the airplanes maximum certified altitude by more than 500 feet.	Descend to an altitude below maximum certified altitude.
ALT CONSTRAINT yyyyy	The modified flight plan caused an altitude constraint conflict with existing constraints in the flight plan beginning with the indicated waypoint.	Review altitude constraints beginning with the waypoint displayed in the message. Correct flight plan as required.
APPRCH VREF NOT SELECTED	The airplane is in the approach environment with VNAV engaged, and VREF has not been selected or entered.	Select VREF on APPROACH REF page.
ARR N/A FOR RUNWAY	The selected runway or approach is not compatible with the selected arrival procedure.	Select a different runway or approach as required. Clear message.
BUFFET ALERT	The airplane speed is either faster than the high speed buffet limit or slower than the low speed buffet limit, or the altitude is higher than the buffet limited maximum altitude.	Bring aircraft back to within operating envelope.
CHECK FMC FUEL QUANTITY	FMC has detected a significant decrease in fuel quantity.	Investigate fuel system. Clear message.



<u>MESSAGE</u>	<u>CAUSING CONDITION</u>	<u>FLIGHT CREW action</u>
DRAG REQUIRED	Due to unforeseen conditions, the airplane is over speeding.	Adjust airplane speed as required. Clear message.
ENTER EO CRZ SPD AND ALT	The airplane leveled off in CRZ and only one engine is running. or All ENG mode was selected and executed with one engine running.	Enter EO cruise speed and altitude on the CRZ page.
FMC APP MODE UNAVAIL-GP	An approved final approach is in the flight plan and the leg FPA is zero.	Verify final approach and correct flight path as necessary. Clear message.
FMC APP MODE UNAVAIL-QFE	An approved non-precision final approach is in the flight plan and QFE is selected on the APPROACH REF page.	Select QNH on APPROACH REF page. or Select a localizer based based approach into the flight plan.
INVALID INACTIVE PLAN	An unexpected software fault occurred before the flight plan is activated.	Re-enter or load flight plan
INVALID MOD PLAN	An unexpected software fault occurred while performing a flight plan modification.	Re-enter same or different MOD.



<u>MESSAGE</u>	<u>CAUSING CONDITION</u>	<u>FLIGHT CREW action</u>
INVALID OFFSET	A START waypoint was entered and the associated leg is non-offsettable or any flight plan mod that causes the start of offset to become non-offsettable.	Enter a different START waypoint. or Correct the flight plan. or Delete the offset. Clear message.
KEY/FUNCTION INOP	A key associated with an inactive mode or function was pressed.	Clear message.
LOC CAP ACTIVE	The airplane is on course and within 17 nm from the localizer or GLS intercept point.	Clear message.
LOC CAP CANCELLED	The localizer capture was armed but the capture did not occur.	Check: LNAV disengaged. or Active waypoint was changed. or LOC DEV signal lost. or Localizer not tuned. or Localizer capture was disarmed.



<u>MESSAGE</u>	<u>CAUSING CONDITION</u>	FLIGHT CREW action
MAX ALT zzzzz	<p>The The entered CRZ ALT is above the maximum ECON mode CRZ ALT.</p> <p>or</p> <p>The ECON mode maximum CRZ ALT is recomputed and the new altitude is lower than the current CRZ ALT.</p> <p>or</p> <p>The The entered STEP TO CRZ ALT is above the maximum ECON mode CRZ ALT.</p>	Amend altitude entry.
<p>MAX CAS xxx</p> <p>or</p> <p>MAX MACH .xxx</p>	<p>The entered CRZ ALT will cause the CRZ TGT SPD to be greater than the maximum buffet speed, V_{MO}, or M_{MO} at the CRZ ALT.</p> <p>or</p> <p>The entered CRZ TGT SPD is greater than the maximum buffet speed, V_{MO}, or M_{MO} at the CRZ ALT.</p>	<p>Clear message.</p> <p>Accept limited speed for new altitude</p> <p>or</p> <p>Modify selected altitude or speed.</p>
MCP APP DISARM REQD	The approach in the flight plan was changed to GP with G/S armed and GP not armed.	Arm GP.

This message is only displayed in non-economy mode CLB, CRZ and DES pages.



<u>MESSAGE</u>	<u>CAUSING CONDITION</u>	<u>FLIGHT CREW action</u>
MIN CAS xxx or MIN MACH .xxx	The entered CRZ ALT will cause the CRZ TGT SPD to be less than the minimum buffet speed or minimum flaps up maneuver speed at CRZ ALT. or The entered CRZ TGT SPD is less than the minimum buffet speed or minimum flaps up maneuver speed at CRZ ALT. This message is only displayed in non-economy mode CLB, CRZ and DES pages.	Accept limited speed for new altitude or Modify selected altitude or speed.
NO DES PATH AFTER yyyyy	The profile constraints cannot be achieved and the path maintained as planned after the named waypoint.	Modify the flight path as necessary to meet the FPA limits.
NOT ON INTERCEPT HEADING	INTC function was used when the airplane is not within leg capture criteria when LNAV is engaged.	Manually steer aircraft onto a heading which will intercept the active leg of the planned route and engage LNAV.
OFFSET DELETED	The START of offset waypoint has been deleted from the flight plan through an edit on any page other than the LATERAL OFFSET page.	Delete offsets from the LATERAL OFFSET page.



<u>MESSAGE</u>	<u>CAUSING CONDITION</u>	FLIGHT CREW action
OFST ENDS ABEAM yyyyy	The entered END of offset waypoint will cause the return transition path to be constructed with an angle less than 45 degrees.	Review offset plan. Enter a valid END waypoint.
	or	
	The entered END of offset waypoint is at the beginning of a turn that is greater than 135 degrees.	
	or	
	An END of offset waypoint is not designated and the offset ends in two minutes plus the time to fly the offset distance.	
OFST ENDS ABEAM yyyyy	A MOD flight plan causes the END of offset waypoint to be deleted.	Review and change offset plan as required.
	or	
	A non–offsettable leg exists between the START and END of offset.	
PERF DEFAULTS DELETED	Performance default database has been automatically deleted due to a conflict with performance data base limits.	Load correct MEDB. Clear message.



<u>MESSAGE</u>	<u>CAUSING CONDITION</u>	<u>FLIGHT CREW action</u>
POS SHIFT OVER 50 NM	A sensor selected position on the POS SHIFT page will cause a position shift of 50 nautical miles or more if EXECuted.	Verify change is de- sired and EXECute. or Select a different sen- sor position. or Display another page (leaving the POS SHIFT page erases any selections made).
PROGRAM PIN ERROR	FMC connector wiring problem.	FMC not operational. Inform maintenance personnel.
PROGRAM PIN NOT IN DB	The Airframe/Engine program pins at the FMC connector do not correspond to data in the loadable performance data base.	Load correct data base.
RESET MCP ALT	Entering a higher or lower CRZ ALT during normal cruise while flying the FMC alti- tude and the MCP al- titude is within 100 feet.	Adjust the MCP alti- tude to the desired FMC altitude. or Reset the FMC CRZ ALT back to the origi- nal altitude.
RESET MCP APP MODE	During a non-localiz- er approach, a change to the ap- proach requires verti- cal approach control to be changed from G/S to G/P.	Engage G/P.



<u>MESSAGE</u>	<u>CAUSING CONDITION</u>	<u>FLIGHT CREW action</u>
ROUTE FULL	The maximum allowable number of holding patterns or waypoints are used and the vertical flight plan cannot generate required phantom waypoints.	Edit flight plan to make room. Clear message.
RUNWAY N/A FOR SID	Runway selection is not compatible with departure procedure selected on the RTE page.	Select a different runway or SID as required. Clear message.
SELECT ACTIVE WPT/LEG	While in the air, the FMC is power-up or a different flight plan is activated.	Execute a direct-to or intercept leg to define the active leg in the route.
STEEP DES AFTER yyyyy	The descent path after the indicated waypoint is steeper than the idle descent path by at least 200 feet.	Maneuver toward the descent path. Clear message.
TAI ON ABOVE 10 °C	Airplane is being operated in thrust limit mode with anti-icing system on and TAT above 10°C.	Verify use of anti-icing for engine cowl or wing surfaces is required.
UNABLE CRZ ALTITUDE	The FMC predicts the entered CRZ ALT will result in zero cruise time or cannot be achieved because of performance limitations.	Enter a lower CRZ ALT.



<u>MESSAGE</u>	<u>CAUSING CONDITION</u>	<u>FLIGHT CREW action</u>
UNABLE MACH .xxx	The MACH TGT SPD entry is impossible to achieve at the present airplane weight and altitude.	Enter a different target speed. Clear message.
UNABLE TO OFFSET	A valid offset cannot be constructed from the entered offset parameters.	Review offset and re-enter valid data.
USING RSV FUEL	A change in flight conditions or the route causes fuel burn to exceed total fuel minus reserves.	Edit the active flight plan if possible. Clear message.
V SPEEDS UNAVAILABLE	The FMC is unable to compute takeoff speeds.	Verify GW is above minimum GW. Check altitude and temperature entries, check selected derates. Clear message.
VERIFY RNP VALUE	The manually entered RNP is larger than the default RNP. or The manually entered RNP is less than ANP.	Re-enter a different value for RNP. Clear message.
VERIFY VERT RNP	With CDS LNAV/VNAV deviation scales enabled, a vertical RNP was entered that is greater than the default vertical RNP or is less than ANP.	Re-enter a different value for RNP. Clear message.



<u>MESSAGE</u>	<u>CAUSING CONDITION</u>	<u>FLIGHT CREW action</u>
nnnn	The indicated airport identifier is entered on the POS INIT page but not in the ORIGIN field on RTE page 1.	Select the airport identifier in the scratch pad to ORIGIN (LSK 1L) on the RTE page 1.
zzzzz	While on the CRZ page, the MCP altitude in the message does not match CRZ ALT.	Set the MCP altitude to the CRZ ALT. or Set the CRZ ALT to the MCP altitude. Clear message.



FMCS Entry Error Messages

The following list contains the entry error messages.

<u>MESSAGE</u>	<u>CAUSING CONDITION</u>	<u>FLIGHT CREW ACTION</u>
ALT CONSTRAINT yyyyy	An added or changed altitude constraint or cruise altitude conflicts with the altitude constraint of other waypoints in the route beginning at the waypoint indicated in the message.	Amend the entry to clear the conflict. Clear message.
DATA BASE FULL	An attempt was made to enter a waypoint, Navaid, or airport and has exceeded capacity of the Temporary or Supplemental Navigation Data Base. or An attempt was made to confirm a route save which exceeds the capacity of the Temporary or Supplemental Navigation Data Base.	Go to REF NAV DATA or SUPP NAV DATA pages and delete unneeded temporary waypoints, nav aids, or airports. Clear message.
DUPLICATE FLIGHT PLAN ID	An attempt was made to save a flight plan and the Flight Plan ID entered is already contained in the Flight Plan Nav Database.	Enter a different name for the flight plan. Clear message.
INVALID DELETE	An attempt was made to delete a system or default data field.	Clear message.



<u>MESSAGE</u>	<u>CAUSING CONDITION</u>	<u>FLIGHT CREW ACTION</u>
INVALID ENTRY	The entry attempted has an incorrect format or range for the selected data field.	Repeat entry with correct data for desired field. Clear message.
INVALID QUAD	An attempt was made to enter a QUAD on a PBD hold fix from a VHF Navaid that didn't correspond to the RADIAL or the reciprocal of the RADIAL.	Repeat entry with correct QUAD. Clear message.
NO OFFSET AT LEG yyyyy	An attempt was made to start or end an offset on a non-offsettable leg.	Enter a valid offset start or end waypoint. Clear message.
NOT IN DATA BASE	An attempt was made to enter an identifier and the FMC could not find it in any of the navigation or route databases.	Verify identifier is entered correctly. or Enter required information into temporary or supplemental navigation data base via REF NAV DATA or SUPP NAV DATA page. Clear message.
NOT IN FLIGHT PLAN	An attempt was made to enter an RTA waypoint or lateral offset start/end waypoint that was not found in the flight plan.	Enter a valid waypoint which is in the flight plan. or Add the desired waypoint to the flight plan, and reenter the RTA or offset start/end waypoint . Clear message.



<u>MESSAGE</u>	<u>CAUSING CONDITION</u>	<u>FLIGHT CREW ACTION</u>
ROUTE FULL	An attempt was made to enter more than 99 waypoints or a sixth hold.	Review existing and desired route segments for possible deletions. Clear message.
SUPP RTE DATA BASE FULL	An attempt was made to save an 11th route in the supplemental flight plan data base.	Delete unused or unwanted flight plans to make room for new ones. Clear message.



ACARS/ATC Messages

ACARS/ATC Alerting Messages.

The following is a list of the ACARS/ATC alerting messages.

<u>MESSAGE</u>	<u>CAUSING CONDITION</u>	<u>FLIGHT CREW ACTION</u>
ALTN DEST UPLINK	A non-ATC message containing alternate airport data is being or has been loaded into the flight plan.	Wait for loading to complete. or Review and accept or reject the data. or Suspend loading using the MCDU long delete.
ATC COMM ESTABLISHED	The ATC datalink log on was successful.	Clear message.
ATC COMM TERMINATED	The ATC datalink is closed. Some of the more common reasons are: A valid END of SERVICE message is sent. An invalid transfer was attempted. There has been no communications activity for 16 minutes. The flight number or airplane tail number was changed on the LCD. The flight crew terminated communications using the ATC COMM OFF prompt.	Clear message.



<u>MESSAGE</u>	<u>CAUSING CONDITION</u>	<u>FLIGHT CREW ACTION</u>
ATC MESSAGE	A valid ATC datalink message has been received.	Clear message.
ATC REPORT LIST FULL	Ten reports have been generated in response to an ATC report or confirm message and are still queued.	Close report list and send.
ATC ROUTE DATA UPLINK	ATC route data has been loaded into the flight plan.	Review and accept or reject the data. or Suspend loading using the MCDU long delete.
ATC ROUTE UPLINK LOADING	ATC route data or flight plan with route data is being loaded into the flight plan.	Wait for loading to complete. or Suspend loading using the MCDU long delete.
ATC ROUTE UPLINK READY	ATC route data has been loaded into the FMC and requires flight crew attention.	Load and review the route data on the RTE or RTE LEGS pages.
ATC RTA DATA UPLINK	ATC RTA data is being or has been loaded into the flight plan.	Wait for loading to complete. or Review and accept or reject the data. or Suspend loading using the MCDU long delete.



<u>MESSAGE</u>	<u>CAUSING CONDITION</u>	<u>FLIGHT CREW ACTION</u>
ATC RTA UPLINK READY	ATC RTA data has been loaded into the FMC and requires flight crew attention.	Load and review the RTA data on the RTA PROGRESS page.
ATC UPLINK WAITING	An ATC message has been received and re- quires flight crew attention.	Review and proceed accordingly.
CRZ WIND UPLINK LOADING	A non-ATC message containing cruise wind data is being loaded into the flight plan.	Wait for loading to complete. or Suspend loading us- ing the MCDU long delete.
CRZ WIND UPLINK READY	A non-ATC message containing cruise wind data has been loaded into the FMC and requires flight crew attention.	Load and review the cruise wind data on the RTE DATA page.
CRZ WIND zzzzz UPLINK	A non-ATC message containing en-route cruise wind data has been loaded into the flight plan for the alti- tude indicated in the message.	Review and accept or reject the data. or Suspend loading us- ing the MCDU long delete.
DATALINK CONFIG INVALID	The datalink configu- ration data base is unusable.	Reload datalink con- figuration data base. Clear message.



<u>MESSAGE</u>	<u>CAUSING CONDITION</u>	<u>FLIGHT CREW ACTION</u>
DESCENT FORECASTS UPLINK	A non-ATC message containing descent forecast data is being or has been loaded into the flight plan.	Wait for loading to complete. or Review and accept or reject the data. or Suspend loading using the MCDU long delete.
FORECASTS UPLINK READY	A non-ATC message containing descent forecasts data has been loaded into the FMC and requires flight crew attention.	Load and review the descent forecasts data on the DES FORECASTS page.
INVALID ATC ROUTE UPLINK	The ATC route data uplink contained errors resulting in the route data being rejected.	Clear message.
INVALID ATC RTA UPLINK	The ATC RTA data uplink contained errors resulting in the entire RTA data being rejected.	Clear message.
INVALID ATC UPLINK	An ATC message was received which contained fatal errors.	Clear message.



<u>MESSAGE</u>	<u>CAUSING CONDITION</u>	<u>FLIGHT CREW ACTION</u>
INVALID TAKEOFF rrrrrr	A non-ATC message containing takeoff data has been loaded into the flight plan, however, the airplane is performance limited for the requested runway. This message can only occur on the ground.	Request different runway. Clear message.
MESSAGE LIMIT EXCEEDED	More than five elements were selected for a downlink message.	Limit the number of elements to five. Clear message.
NAV DATA LOADING	A non-ATC message containing supplemental navigation data is being loaded into the SUPP NAV Database.	Wait for loading to complete. or Suspend loading using the MCDU long delete.
NAV DATA UPLINK	A non-ATC message containing supplemental navigation data has been loaded into the SUPP NAV Database.	Clear message.
PARTIAL ALTN DEST UPLINK	A non-ATC message containing alternate airport data has been partially loaded into the flight plan due to errors in the uplink data.	Review and accept or reject the data. or Suspend loading using the MCDU long delete.



<u>MESSAGE</u>	<u>CAUSING CONDITION</u>	<u>FLIGHT CREW ACTION</u>
PARTIAL ATC ROUTE UPLINK	ATC route data has been partially loaded into the flight plan due to errors in the uplink data.	Review and accept or reject the data. or Suspend loading using the MCDU long delete.
PARTIAL CLEARANCE LOADED	An ATC message containing loadable variables failed to completely load.	Clear message.
PARTIAL FORECASTS UPLINK	A non-ATC message containing descent forecast data has been partially loaded into the flight plan due to errors in the uplink data.	Review and accept or reject data. or Suspend loading using the MCDU long delete.
PARTIAL LIMITS UPLINK	A non-ATC message containing performance limits data has been partially loaded into the flight plan due to errors in the uplink data.	Review and accept or reject data. or Suspend loading using the MCDU long delete.
PARTIAL NAV DATA UPLINK	A non-ATC message containing navigation data has been partially loaded into the SUPP NAV Database due to errors in the uplink data or insufficient room to store the data.	Clear message.



<u>MESSAGE</u>	<u>CAUSING CONDITION</u>	<u>FLIGHT CREW ACTION</u>
PARTIAL PERF INIT UPLINK	A non-ATC message containing performance initialization data has been partially loaded into the flight plan due to errors in the uplink data.	Review and accept or reject data. or Suspend loading using the MCDU long delete.
PARTIAL ROUTE UPLINK	A non-ATC message containing route data has been partially loaded into the flight plan due to errors in the uplink data.	Review and accept or reject the data. or Suspend loading using the MCDU long delete.
PERF INIT UPLINK	A non-ATC message containing performance initialization data is being or has been loaded into the flight plan.	Wait for loading to complete. or Review and accept or reject the data. or Suspend loading using the MCDU long delete.
PERF INIT UPLINK READY	A non-ATC message containing performance initialization data has been loaded into the FMC and requires flight crew attention.	Load and review the performance initialization data on the PERF INIT page.



<u>MESSAGE</u>	<u>CAUSING CONDITION</u>	<u>FLIGHT CREW ACTION</u>
PERF LIMITS UPLINK	A non-ATC message containing performance limits data is being or has been loaded into the flight plan.	Wait for loading to complete. or Review and accept or reject the data. or Suspend loading using the MCDU long delete.
PERF LIMITS UPLINK READY	A non-ATC message containing performance limits data has been loaded into the FMC and requires flight crew attention.	Load and review the performance limits data on the PERF LIMITS page.
RE-LOGON TO ATC COMM	An attempt to log on to the ATC datalink failed. or An ATC message is sent containing a different flight number or airplane tail number. or The ATC Center did not respond on time.	Clear message. Verify flight number and tail number are correctly loaded into the LCD. Log onto ATC datalink.
RESEND MESSAGE	A downlink message is initiated but the FMC is unable to send the message to the MU.	Clear message.
RESPOND TO ATC UPLINKS	The ATC uplink message queue is full.	Clear message. Respond to pending uplink messages to clear the queue.



<u>MESSAGE</u>	<u>CAUSING CONDITION</u>	<u>FLIGHT CREW ACTION</u>
ROUTE DATA UPLINK	A non-ATC message containing route data has been loaded into the flight plan.	Review and accept or reject the data. or Suspend loading using the MCDU long delete.
ROUTE UPLINK LOADING	A non-ATC message containing route data is being loaded into the flight plan.	Wait for loading to complete. or Suspend loading using the MCDU long delete.
ROUTE UPLINK READY	A non-ATC message containing route data has been loaded into the FMC and requires flight crew attention.	Load and review the route data on the RTE or RTE LEGS pages.
RTA DATA UPLINK	A non-ATC message containing RTA data is being or has been loaded into the flight plan.	Wait for loading to complete. or Review and accept or reject the data. or Suspend loading using the MCDU long delete.
RTA UPLINK READY	A non-ATC message containing RTA data has been loaded into the FMC and requires flight crew attention.	Load and review the RTA data on the RTA PROGRESS page.



<u>MESSAGE</u>	<u>CAUSING CONDITION</u>	<u>FLIGHT CREW ACTION</u>
TAKEOFF DATA LOADED	A change in the flight plan runway or runway intersection is made and the corresponding takeoff data is already loaded into the FMC. This message only can only occur on the ground.	Review and accept or reject the data. Clear message.
TAKEOFF DATA UPLINK	A non-ATC message containing takeoff data has been loaded into the flight plan. This load contains at least one runway and/or a CG value. This message only can only occur on the ground.	Review and accept or reject the data.
UNABLE TO LOAD CLEARANCE	The FMC received an ATC message but was unable to load any of the data.	Clear message.
UNABLE TO SEND MSG	The flight crews downlink message failed to send.	Verify MU is operational. or Too many messages are queued in the FMC. Wait for FMC queue to empty, then resend message.



ACARS/ATC Advisory Messages.

The following is a list of the ACARS/ATC advisory messages.

<u>MESSAGE</u>	<u>CAUSING CONDITION</u>	<u>FLIGHT CREW ACTION</u>
ALT CONSTRAINT yyyyy	A non-ATC uplink of performance initialization or route data changed or added an altitude constraint that conflicts with existing constraints beginning with yyyyy.	Review and accept or reject data. Review flight plan and correct conflicts.
ARR N/A FOR RUNWAY	A non-ATC uplink of runway/approach data being loaded contains a runway/approach that is not compatible with the arrival already loaded or selected.	Reject uplink, request correct runway/approach/arrival advice.
INVALID ALTN DEST UPLINK	A non-ATC uplink contained errors in the alternate airport data. The entire uplink was rejected.	Clear message. Request re-send uplink.
INVALID CRZ WIND UPLINK	A non-ATC uplink contained errors in the wind data. The entire uplink was rejected.	Clear message. Request re-send uplink.
INVALID FORECASTS UPLINK	A non-ATC uplink contained errors in the descent forecast data. The entire uplink was rejected.	Clear message. Request re-send uplink.



<u>MESSAGE</u>	<u>CAUSING CONDITION</u>	<u>FLIGHT CREW ACTION</u>
INVALID LIMITS UPLINK	A non-ATC uplink contained errors in the performance limits data. The entire uplink was rejected.	Clear message. Request re-send uplink.
INVALID NAV DATA UPLINK	A non-ATC uplink contained errors in the supplemental navigation data. The entire uplink was rejected.	Clear message. Request re-send uplink.
INVALID OFFSET	A non-ATC uplink containing an offset in the route data is invalid.	Clear message.
INVALID PERF INIT UPLINK	A non-ATC uplink contained errors in the performance initialization data. The entire uplink was rejected.	Clear message. Request re-send uplink.
INVALID ROUTE UPLINK	A non-ATC uplink contained errors in the route data. The entire uplink was rejected.	Clear message. Request re-send uplink.
INVALID RTA UPLINK	A non-ATC uplink contained errors in the required time of arrival data. The entire uplink was rejected.	Clear message. Request re-send uplink.
INVALID TAKEOFF UPLINK	A non-ATC uplink contained errors in the takeoff data. The entire uplink was rejected.	Clear message. Request re-send uplink.



<u>MESSAGE</u>	<u>CAUSING CONDITION</u>	<u>FLIGHT CREW ACTION</u>
MAX ALT zzzzz	A non-ATC uplink of performance initialization or route data being loaded contains a cruise altitude above maximum altitude.	Correct cruise altitude.
ROUTE FULL	A non-ATC uplink contained a sufficient quantity of data to fill the allowable storage area. or There are too many holds in the flight plan data. or There is not enough space for automatically generated guidance data.	Remove unrequired information in the flight plan to make room. Clear message.
RUNWAY N/A FOR SID	A non-ATC uplink of route data being loaded contains a runway that is not compatible with the departure already loaded or selected.	Reject uplink, request correct runway/departure advice.



ACARS/ATC Annunciation Messages.

The following is a list of the ACARS annunciation messages.

<u>MESSAGE</u>	<u>CAUSING CONDITION</u>	<u>FLIGHT CREW ACTION</u>
ACARS ALERT	An ACARS message is received which requires flight crew action.	Select ACARS management unit on an MCDU and perform necessary action.
ACARS CALL	The ACARS MU is requesting service from the crew.	Select the ACARS MU on the MCDU Menu page.
ACARS MU FAIL	The ACARS MU has suffered a hardware failure or was turned off.	Verify ACARS MU is powered.
ACARS NO COMM	An ACARS link is presently not available.	Verify operation of SAT, VHF, and/or Mode S transceivers.
ACARS UPLINK	An ACARS message was received.	Select ACARS management unit on an MCDU and perform necessary actions.
ACARS VOICE	VHF Transceiver set to voice.	Clear message.
ACARS VOICE BUSY	All VHF voice circuits are busy.	Message will clear when a circuit becomes available or message may be cleared with CLR key.
PRINTER FAIL	Cockpit printer has failed.	Check printer. Clear message.
PRINTER UPLINK	An ACARS uplink print message has been received	Clear message.

ALTERNATE NAVIGATION MESSAGES

NOTE: This section only applies to an MCDU or FANS MCDU with Update 2 or Update 3 installed. ■

When the alternate navigation MCDU is being operated as a normal MCDU (displaying the normal FMC pages), the previous list of FMCS messages apply.

When the MCDU is displaying the alternate navigation pages, a unique set of messages are displayed when conditions warrant. These messages cause the MSG annunciator to illuminate just as FMC operations would and are in addition to the previous list of messages.

<u>MESSAGE</u>	<u>CAUSING CONDITION</u>	<u>FLIGHT CREW ACTION</u>
INVALID ENTRY	An attempt was made to enter data having an invalid format or range for the data field selected.	Clear message. Correct entry error.
GPS FAIL	GPS data is not being received.	Clear message. ALT NAV processing halts.
GPS INTEGRITY LOST	GPS data received is invalid or the GPS HIL value is greater than two times RNP for the current navigation environment.	None.
LO POS ACCURACY	The GPS horizontal figure of merit is greater than RNP for the current navigation environment.	None.



ROUTE FULL

An attempt was made to enter more than 60 waypoints.

Clear message. If more waypoints are required, review the ALT NAV flight plan for possible deletions.

WAYPOINT NOT DEFINED

An attempt was made to enter a waypoint that does not have a known LAT/LON.

Clear message. Correct entry error.

WPT PREVIOUSLY DEFINED

An attempt to enter an existing identifier using a LAT/LON that is different from the currently stored LAT/LON.

Clear message, then:
Correct possible error in desired LAT/LON data.

or

Delete stored waypoint and re-enter desired data.

or

Select another name for the desired waypoint.



FMCS POWER LOSS AND SENSOR FAILURE RECOVERY

The FMCS is designed to survive power transients and interruptions without suffering permanent loss of its navigation and guidance capabilities. Three modes of power loss recovery are possible:

- If the system's primary operating power has been interrupted for less than 10 seconds, the system recovers automatically and continues to operate normally.
- If the power has been interrupted for 10 seconds or more while the aircraft is on the ground, the system goes through a complete power-up procedure. All preflight data and flight plan entries must be re-entered.
- If the power has been interrupted for 10 seconds or more while the aircraft is in the air, the system retains all loaded data, disengages, and displays the MOD RTE LEGS 1/1 page on the LCD with a SELECT ACTIVE WPT/LEG message in the scratch pad. The system will not turn on the EXEC key light until or unless a TO waypoint has been defined.

System recovery to full operation is dependent upon the status of other aircraft sensor and flight control system.

Failures of the FMCS itself will completely stop the FMCS from supplying flight management information.

FMCS failures are indicated by the LCD display and lighted alert indicators.

The following are FMCS failure indicators:

LIGHTS: Amber FMC Alert on FMA or AA and amber FAIL light on LCD indicate FMC failure.

CDU DISPLAY: Blank –LCD failure (if dual LCDs are installed, use remaining LCD; FMCS is still operational); pull faulty LCD circuit breaker.

“FMC” – FMC failure; pull FMC circuit breaker.

Failures of FMC memory are indicated by the LCD display: OP PROGRAM INVALID. Pull FMC circuit breaker for 20 seconds and reset. If still in failed condition reload operational flight program via portable or airborne disk loader.

Reductions of FMCS capabilities are many times attributable to failures of other aircraft sub-systems. It is important to note this characteristic in postflight reports to Maintenance Personnel.



FMC FAILURE WITH AN ALT NAV MCDU INSTALLED

One function of the ALT NAV MCDU is to provide basic backup navigation capability should the FMC fail. The ALT NAV flight plan is maintained current as long as the FMC is operational. After a failure of the FMC, the ALT NAV MCDU will perform basic computations and sequence the active flight plan.

NOTE: The ALT NAV computations do not use wind data.

When the ALT NAV MCDU has the FMC flight plan loaded and activated prior to an FMC failure, the ALT NAV MCDU will display the active ALT NAV LEGS page when the ALT NAV prompt (LSK 6L) on the MENU PAGE is selected.

If the flight plan was not loaded and activated prior to the FMC failure, the ALT NAV MCDU will display the inactive ALT NAV LEGS page when the ALT NAV prompt (LSK 6L) on the MENU PAGE is selected. Selecting the LAST FMC PLAN prompt (LSK 5L) will display the inactive ALT NAV flight plan as it was crossloaded. Verify and correct (if required) the TO waypoint, then execute the plan to make it active.

Once the ALT NAV flight plan is active, the ALT NAV MCDU will continue to provide advisory lateral path guidance information to the ESAI.

NOTE: For an accurate and up-to-date ALT NAV flight plan, it is important to crossload and activate the FMC flight plan as soon as it is activated in the FMC.



ALTERNATE NAVIGATION MCDU POWER LOSS

The alternate navigation MCDU is designed to survive power transients and interruptions without suffering permanent loss of its navigation and guidance capabilities. Three modes of recovery after a complete power loss are implemented.

- If the power to the MCDU is interrupted for less than 10 seconds, the unit recovers automatically and continues to operate normally.
- If the power is interrupted for 10 seconds or more while the aircraft is on the ground, the MCDU performs a full power-up cycle, including a complete self check. All pre-flight entries must be repeated.
- If the power is interrupted for 10 seconds or more while the aircraft is in the air, the MCDU requests the FMC to crossload the flight plan. The alternate navigation pages may then be accessed via the ALT NAV prompt on the MENU page, reviewed, updated or corrected if necessary, and re-activated.

SOURCE RECEIVER FAILURE

If the on-side receiver fails, the MCDU will no longer be able to provide an alternate navigation solution. The ALT NAV prompt on the MENU page is blanked as well as all data fields in the alternate navigation pages that require the receivers input data.



PART 4

DATALINK OPERATION

The FMS provides three methods of communication between the airplane and the airlines ground stations or the Air Traffic Control (ATC) ground system. These are airline selectable options which must be set up with the airframe manufacturer and are not available with the basic installation.

ACARS DATALINK

The ACARS datalink is available to provide digital communications between the airplane and the airlines ground station. The requirements to use this system are;

- An ACARS Management Unit (MU) installed.
- The AOC Datalink software option enabled.

FANS DATALINK

The FANS Datalink is available to provide digital communications between the airplane and an ATC ground station. The requirements to use this system are;

- A Communications Management Unit (CMU) or ACARS MU installed.
- At least one FANS MCDU installed.
- The AOC Datalink software option enabled.
- The ATS Datalink software option enabled.
- An FMC loaded with 10.5 FMC Operational Flight Software (OFP).

MAP DATA (BBJ NAVLINK PHASE 2)

MAPS Datalink is available to provide digital MAP data to the flight crew. The requirements to use this system are;

- Updated TeleLink Router Management Unit (RMU).
- At least one MCDU or FANS MCDU installed with LCD CDU Update 2 software.
- GPS



ACARS DEFINITION

The FMCS interface with the Aircraft Communication, Addressing, and Reporting System (ACARS) provides datalink capability between the airplane and the airline's ground station for requesting, sending, and receiving flight related information.

This document explains the general operation as it is implemented in the default configuration. Each airline has the ability to modify the header and prompt, to determine the actions of the associated key presses, and to program the desired data or request to be transmitted. The airline also has the ability to define automatic trigger events during the flight that would automatically provide data transmissions without pilot intervention. The following discussion covers the GE Aviation default setup and is intended to show the available pages and the type of data that may be transferred between the FMC (via the ACARS MU) and the ground station.

PAGE DISPLAYS

Several display page locations contain reserved spaces for ACARS headers and prompts to accommodate data requesting and reporting and are defined in the default configuration.

<u>PAGE</u>	<u>FIELD(S)</u>
• ALTERNATE DESTS	6L
• DES FORECASTS	6L
• FMC COMM (FANS MCDU only)	1L through 5L 1R through 6R
• INIT/REF INDEX**	4R
• PERF INIT	5R
• PERF LIMITS	5L, 5R
• PROGRESS	5L, 5R, 6L, 6R
• RTE	3R
• RTE DATA	6R
• SUPP NAV DATA	4L, 4R
• TAKEOFF REF	4L

**This prompt is current undefined in the default configuration.

On the ground, all information required to prepare for takeoff may be uploaded. The same information that must be manually entered



(displayed in large font) is automatically loaded and identified by being displayed in small font until the flight plan is executed.

During the flight, proposed changes in the flight plan are identified on the appropriate pages by highlighting and the title line indicates the MOD plan status.

DEFAULT CONFIGURATION

The FMC is delivered to the airline with a default datalink configuration which is described during the following discussion (the ACARS option must be enabled by the airlines to activate). It is important to note that each airline has the capability of modifying this default configuration to meet individual needs, therefore, the display discussions may not precisely describe the datalink configuration installed in the airplane.

DATA TYPES

The following types of data can be uplinked and loaded into the FMC:

- Uplinks
 - Route data (initial or MOD)
 - RTA points and time error tolerance
 - Flight number
 - Wind speed and direction (CRZ)
 - Performance and performance limits data
 - CAS and MACH limits for all phases of the flight
 - Complete runway data
 - Complete takeoff requirements data
 - Cruise altitude
 - Supplemental navigation data and effectivity date
 - Alternate destination data
 - Datalink configuration data



- Downlinks
 - All current flight status and airplane status.

AUTO-TRIGGERS

The airlines have the ability to define auto-triggers in the FMCS ACARS function. The auto-triggers can be used to predetermine what information will be sent to the ground station for a specific event. Examples of auto-triggers that can be enabled are:

- A change in the destination airport or runway
- A change in the ETA at destination
- Entering or exiting a holding pattern
- A change in the flight plan
- Position shifts to any radio, GPS, or IRS
- When the VERIFY POSITION or INSUFFICIENT FUEL message is displayed in the scratch pad
- FMS equipment failures
- Transition to in-air status
- At specified time intervals (max 5) to the destination airport

ACARS SYSTEM STATUS

The FMC displays the datalink status in the scratch pad of the display unit.

The datalink operational status is:

- ACARS MU FAIL – the ACARS MU is failed or powered down.
- ACARS NO COMM – the ACARS MU is operational but a datalink is not established.
- ACARS VOICE – the VHF transceiver is set to voice only mode.
- ACARS VOICE BUSY – all VHF voice circuits are in use.
- UNABLE TO SEND MSG – the ACARS MU did not acknowledge receiving the message from the FMC.
- MESSAGE LIMIT EXCEEDED – the number of elements composing the message exceeds maximum message limits.



- ACARS DATALINK FULL – the downlink queue is full. New messages cannot be queued until current messages are sent.

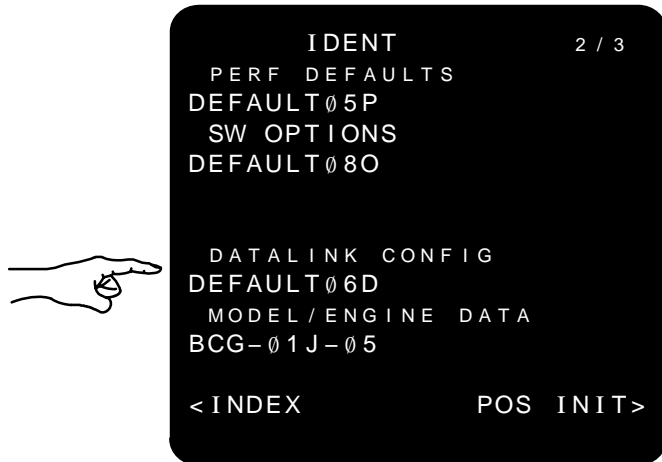
In addition to the scratch pad annunciations, the airlines may also configure the prompts and prompt headers to display the status.

The datalink functional status is:

- ACARS ALERT – an ACARS message has been received and requires attention.
- ACARS CALL – the ACARS MU is requesting service and access to the MCDU.
- ACARS UPLINK – the ACARS MU has received a message.

OPERATION

ACARS messages sent by the FMC are automatic in nature and do not require the flight crew to “build” the message or its contents. This is controlled by the datalink configuration file. The datalink configuration file is loaded into the FMC via the ARINC 615 data loader and displayed on the IDENT page with other loaded data bases. The default configuration file is DEFAULT03D (4L). An airline wishing to create a unique configuration can generate and load a data base in place of the default data base.



The ACARS data is uplinked to the FMC, and in some cases, automatically loaded (such as wind data), or the flight crew must select a LOAD prompt to initiate loading the data (such as flight plan or route modification data).



ACARS uplinked data font size for different pages will vary. Currently, it is required to know what data is uplinked and on what page the data is loaded. In general, uploaded data is identified by these three methods:

- Displayed in small font (until executed)
- Title lines on pages show the MOD flight plan status when the flight plan is active prior to loading the uplink.
- Data is highlighted.

Flight plan MODs are highlighted after loading the uplink into the FMC just as a manual change would be. The highlighting is removed after the uplink is executed.

ACARS PROMPT OPERATION

The ACARS prompt normal operation is request or send dependent.

- When the prompt is a request;
 - The prompt is highlighted until the requested uplink data message is received and loaded into the FMC.
 - The caret (< or >) is removed until the request is sent to the ACARS MU (minimum 3 seconds).
- When the prompt is a send;
 - The prompt is highlighted and the caret (< or >) is removed until the message is sent to the ACARS MU (minimum 3 seconds).

During the time the ACARS prompt is highlighted and the caret is removed, the LSK and EXEC keys are inoperable to prevent interfering with the data being loaded.

LOAD PROMPT

The LOAD prompt is displayed when the uplinked data results in a MOD flight plan. Selecting the LOAD prompt loads the data into the FMC.

ERASE PROMPT

For all messages that generate a MOD flight plan, an ERASE prompt is available on the display page after the uplink is loaded



into the FMC flight plan. This prompt is to be used to remove the modification data from the flight plan and place the message back into the message queue when the uplink data is not desired. The display page title line returns to the ACT state and the LOAD prompt returns.

EXEC KEY

The EXEC annunciator is lit for ACARS uplink MODs just as for a manual entry MOD. Pressing the EXEC key incorporates the modification into the active flight plan.

ACCEPT PROMPT

The ACCEPT prompt is displayed for ACARS messages that do not result in a MOD flight plan. Selecting the ACCEPT prompt loads the data into the FMC.

REJECT PROMPT

The REJECT prompts are displayed for ACARS messages that do not result in a MOD flight plan. Selecting the REJECT prompt places the message back into the message queue and does not load the uplink data into the FMC. Typical messages of this nature are wind data and data base data.

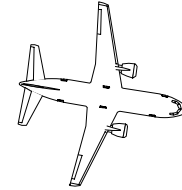
SUSPENDING A LOAD OPERATION

The MCDU and FANS MCDU provides a Long Delete function which may be used to suspend load operations when an active flight plan is available. This is accomplished by pressing and holding the DEL key for 1 second when the UPLINK LOADING or UPLINK LOADED messages are displayed in the scratch pad.

Executable uplinks (title line changes to MOD state) return to the ACT state, and the LOAD prompt returns. For these types of messages, all of the new data is removed from the FMC.



Non-executable uplinks (i.e., wind data and data base data) will temporarily halt the loading process. After 30 seconds of no activity on the MCDU, the load operation will automatically continue where it left off. For these messages, data already loaded into the FMC prior to suspending the load operation is retained.



NOTE

Wind data uplinked prior to activating the flight plan cannot be suspended.

DISPLAYS

The following pages contain sample display pages showing the ACARS prompts and the types of data associated with them. These are the manufacturer's default set ups, and as noted earlier, may be changed by the airline.



ARRIVALS PAGE

Though an ACARS Flex prompt does not appear on this page, approaches, approaches with a transition, and runways may be uploaded and entered into the route.

```

KMEM ARRIVALS      1 / 1
STARS              RUNWAYS
GQE3<SEL>          <SEL>36R
TRANS
RZC<SEL>
RWY  EXT
-- .-NM
  FPA
  - .--
-----
<INDEX>           ROUTE>

```

```

KMEM ARRIVALS      1 / 1
STARS              APPROACHES
GQE3               <ACT>ILS 18C
                  G / S
HLI1              ON / OFF>
                  TRANS
UJM3              RZC
WLDER4
-----
<INDEX>           ROUTE>

```




INIT/REF INDEX PAGE

The INIT/REF INDEX page maintains a space located at 4R for an ACARS prompt. The GE Aviation default configuration does not define this location, and unless an airline specifies a definition in the DATALINK CONFIG data base, this location is blank.

```
INIT/REF INDEX 1 / 1
<IDENT          NAV DATA>
<POS REF       MSG RECALL> **
<PERF          ALTN DEST> **
<TAKEOFF       REQUEST>
<APPROACH     SEL CONFIG>
<OFFSET       MAINT>
```

** OPTIONS:
MESSAGE RECALL
ALTERNATE DESTINATIONS



ALTERNATE DESTS PAGE

When the alternate destinations option is available, an ACARS weather data prompt is displayed to request weather data for any alternate destination points listed on the ALTERNATE DESTS summary page (page 1). The uplinked wind data is displayed on the individual ALTERNATE DESTS pages 2 through 6 as EST WIND (2R).

ALTERNATE DESTS					1 / 6
ALTN	VIA	DTG	ETA	FUEL	
KALM	D	3.4	1525z	40.0>	
KNQA	D	21	1525z	40.0>	
KOLV	D	26	1525z	40.0>	
-----					>
-----					>
WEATHER					
<REQUEST NEAREST ARPTS>					

When a route is active and contains a destination airport, alternate destinations may be uplinked from the AOC with other route data. The uplinked alternates are loaded using the following rules:

- Uplinked alternates will not overwrite manually entered alternates.
- Uplinked alternates will only fill empty positions (dash prompt) on the ALTERNATE DESTS summary page (maximum of 5).
- New uplinked alternates will overwrite previous uplinked alternates.
- Uplinked data is displayed in large font.

REQUEST prompt:

- The WEATHER prompt (LSK 6L) may be used to request wind data at the alternate airports entered on the ALTERNATE DESTS page.

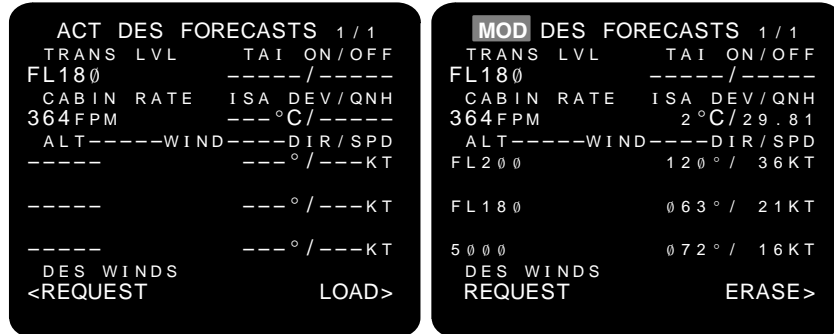


DES FORECASTS PAGE

The descent forecasts page contains a descent winds data request prompt to upload the forecasted descent wind profile for the destination airport. Forecasts data may be uplinked at any time after a destination has been entered on the RTE page.

Uplinks occurring prior to activating the route cannot be suspended (MCDU long delete function). The ERASE prompt does not get displayed and the EXEC annunciator does not get lit. These functions are available when the uplink occurs after the route is activated.

All data uplinked is displayed in small font until executed.



REQUEST prompt:

- The DES WIND prompt (LSK 6L) may be used to request wind profile data at the destination or any alternate airports entered into the flight plan.

LOAD prompt:

- Selecting the LOAD prompt loads the uplinked data into the FMC.



FMC COMM PAGE (FANS MCDU ONLY)

The FMC COMM page provides user defined ACARS links to allow pre-defined data to be communicated between the AOC and the airplane. Selecting the available prompts initiates transmissions of the data type indicated in the header line for the selected prompt.

The FMC Communications page may display up to eleven user defined ACARS prompts.



The default requests are FLIGHT PLAN and WINDS. The flight plan is uplinked and loaded into the FMC. The RTE or RTE LEGS page must be selected after loading, the plan must then be activated and executed to make the route active.

WINDS data loaded into the FMC flight plan does not generate a MOD flight plan and the EXEC annunciator does not light prior to activating the route.



PERF INIT PAGE

The required performance initialization data may be uplinked using the request prompt at LSK 5R prior to takeoff.

All fields showing box or dash prompts may be uplinked and loaded into the PERF INIT page. Loaded data is displayed in small font until the EXEC button is pressed.

TRIP altitude is computed as soon as the performance data is loaded into the FMC.

PERF INIT		1 / 2
GW/CRZ CG	TRIP/CRZ ALT	
□□ .□ / 15.0%	/□□□□	
PLAN/FUEL	CRZ WIND	
---.-/---.-	---°/---	
ZFW	T/C OAT	
□□□ .□	---°F ---°C	
RESERVES	TRANS ALT	
□□ .□	18000	
COST INDEX	PERF INIT	
□□□	REQUEST>	

<INDEX	N1 LIMIT>	

PERF INIT		1 / 2
GW/CRZ CG	TRIP/CRZ ALT	
111.0/10.0	FL367/FL365	
FUEL	CRZ WIND	
31.0	122°/ 23	
ZFW	T/C OAT	
80.0	-74°F -59°C	
RESERVES	TRANS ALT	
4.0	18000	
COST INDEX	PERF INIT	
87	REQUEST>	

<INDEX	N1 LIMIT>	

REQUEST prompt:

- The PERF INIT prompt (LSK 5R) may be used to request initialization data for the airplane and the flight.



PERF LIMITS PAGE

The performance limits data may be uplinked.

Loaded speeds are displayed in small font until executed.

```

PERF LIMITS 2 / 2
TIME ERROR TOLERANCE
 30 SEC AT RTA WPT
MIN SPD --CLB-- MAX SPD
--- / . ---
MIN SPD --CRZ-- MAX SPD
--- / . ---
MIN SPD --DES-- MAX SPD
--- / . ---
PERF LIM      PERF LIM
<REPORT      REQUEST>
-----
<INDEX      RTA>

PERF LIMITS 2 / 2
TIME ERROR TOLERANCE
 30 SEC AT RTA WPT
MIN SPD --CLB-- MAX SPD
210 / .400      340 / .820
MIN SPD --CRZ-- MAX SPD
210 / .700      340 / .820
MIN SPD --DES-- MAX SPD
210 / .400      340 / .820
PERF LIM      PERF LIM
<REPORT      REQUEST>
-----
<ERASE      RTA>

```

REQUEST prompt:

- The PERF LIM REQUEST prompt (LSK 5R) initiates a request for performance limits data to be uplinked.

REPORT prompt:

- Performance limits data that is already entered may also be downlinked by selecting the PERF LIM REPORT prompt (LSK 5L). When selected the downlink message is sent by the FMC.



PROGRESS PAGE

Progress page 2 contains four ACARS prompts.

```
PROGRESS 2 / 4
HEADWIND CROSSWIND
17KT R 13KT
WIND SAT/ISA DEV
123° / 22 -57°C/+00°C
XTK ERROR VERT DEV
R 0.01NM 5HI
GPS-L TRK TAS
84°T 458KT
PRE-FLIGHT PROGRESS
<REPORT REPORT>
WEATHER POSITION
<REQUEST REPORT>
```

REQUEST prompt:

- The WEATHER prompt (LSK 6L) may be used to request weather conditions at the destination or any alternate airports entered into the flight plan.

REPORT prompts:

- Prior to takeoff, the PRE-FLIGHT prompt (LSK 5L) may be used to report general pre-flight information.
- The PROGRESS prompt (LSK 5R) may be used to report predicted flight information relative to the destination airport.
- The POSITION prompt (LSK 6R) may be used to report current position information.



RTE and RTE LEGS Pages

The route page provides a flight plan prompt (LSK 3R) that sends a request for flight plan data to be uplinked. The flight plan data may be anything from a basic ORIGIN/DEST and an intermediate waypoint to a complete flight plan including missed approach information and alternate destinations.

The image shows three screenshots of the RTE and RTE LEGS pages. The top two screenshots are side-by-side, and the third is centered below them.

Top Left Screenshot: Shows the RTE page with the following text:


```

  RTE                               1 / 2
  ORGIN                             DEST
  -----                            □□□□□
  FLT PLAN
  REQUEST>
  -----
  
```

Top Right Screenshot: Shows the RTE page with the following text:


```

  RTE                               1 / 2
  ORGIN                             DEST
  -----                            □□□□□
  CO ROUTE
  -----
  FLT PLAN
  REQUEST>
  -----
  
```

Bottom Center Screenshot: Shows the RTE page with the following text:


```

  RTE                               1 / 2
  ORGIN                             DEST
  -----                            □□□□□
  FLT NO.
  -----
  FLT PLAN
  REQUEST>
  -----
  
```

Intermediate waypoints and destination runway are listed beginning on RTE page 2 (VIA and TO).

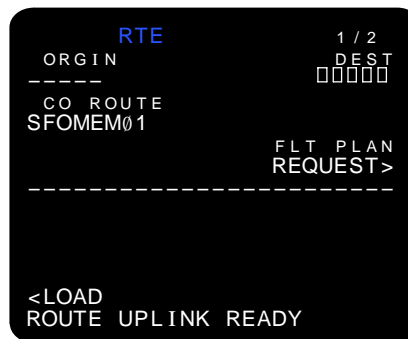
When the VIA identifier or TO identifier are not located in the navigation data base, a special disconnect is created which includes the uplinked identifier in the disconnect header line.

When an approach procedure contains missed approach data, the missed approach is automatically filled in immediately following the runway.

CO ROUTE and REF CO ROUTE (option) – when the pilot defined company route option is available, company routes can be uplinked and loaded into the FMC.



- To request a company route that is not in the FMCS data base, enter the company route identifier and select it to the CO ROUTE DASH prompt (LSK 2L). The header line will change from CO ROUTE to REF CO ROUTE. Select the FLT PLAN REQUEST prompt (LSK 3R). The FMC will send a route request message using the entered route identifier.
- If an uplinked company route is not found in the FMC data base, and it contains a valid origin, the company route identifier is displayed on line 2L, however, the remaining data is not loaded. Any route data stored in the FMC prior to the uplink remains undisturbed. Under these conditions the message NOT IN DATA BASE is not displayed in the scratchpad.



All route data uplinked and loaded into the FMC is displayed on the RTE and RTE LEGS pages.

FLT NO. (option) – when the flight number option is available, the flight number may be uplinked and loaded into the FMC. The flight number will then be displayed on RTE page 1 (2R), and the PROGRESS page title line.



RTE DATA PAGE

The route data page provides an ACARS prompt located at 6R to request cruise wind data for the waypoints in the cruise segment of the flight plan. Non-cruise waypoints remain blank.

ACT	RTE	DATA	2 / 5
		ETA	WIND
ILC		1125Z	
MLF		1134Z	
HVE		1149Z	
HBU		1213Z	
ELWAY		1217Z	
-----WINDS			
<LEGS			REQUEST>

MOD	RTE	DATA	2 / 5
		ETA	WIND
ILC		1125Z	123° / 22
MLF		1134Z	123° / 22
HVE		1149Z	128° / 32
HBU		1213Z	121° / 39
ELWAY		1217Z	123° / 21
-----MOD WINDS			
<ERASE			REQUEST>

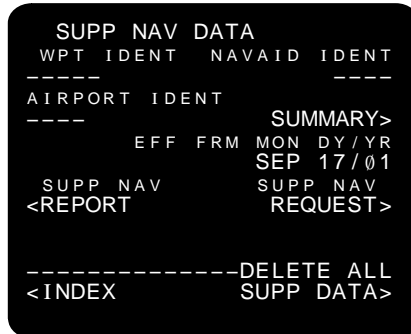
REQUEST Prompt:

- The WINDS REQUEST prompt is displayed before and after the route is activated. Selecting the WINDS REQUEST prompt (LSK 6R) sends a request for wind data at each cruise waypoint in the flight plan.
- The MOD WINDS REQUEST prompt is displayed when the RTE DATA page is in the MOD state.



SUPP NAV DATA PAGE

The SUPP NAV DATA page provides both REPORT (LSK 4L) and REQUEST (LSK 4R) prompts to facilitate uplinking and downlinking supplemental data for the flight.



REQUEST Prompt:

- SUPP NAV REQUEST prompt (LSK 4R) initiates a downlink request message for supplemental navigation data.

REPORT Prompt:

- SUPP NAV REPORT prompt (LSK 4L) initiates a downlink message containing the contents of the supplemental navigation data stored in the FMC.



TAKEOFF REF PAGE

The takeoff reference page data may be uplinked, including the data for the customer selectable options. When an uplink has been loaded into the FMC, and is pending an ACCEPT/REJECT decision, the title line changes to TAKEOFF REF UPLINK. All uplinked data is displayed in small font until accepted by the flight crew.



The takeoff N1 may be automatically computed as a result of the uplinked takeoff data received.

The following types of information may be uplinked:

- Page 1
 - FLAPS
 - INTERSECT
 - V₁, V_R, and V₂
- Page 2
 - RW WIND
 - RW SLOPE/HDG
 - SEL (assumed OAT)
 - OAT
 - RW COND



In addition, when selectable options are enabled, the following types of information may also be uplinked.

- QFE/QNH REF
- Thrust Bump N1 values
- Cutback N1 values
- Selected climb rating
- Cutback and restoration altitudes



FANS DATALINK

FANS Definition

The Future Air Navigation System (FANS) function within the FMC is provided through the use of two applications; Automatic Dependent Surveillance (ADS) and ATC Datalink (ATC DL). Currently these applications utilize the ACARS datalink to transmit and receive messages between a specific ATC ground station and the airplane.

ADS

The ADS application generally operates independent of flight crew action allowing the ATC ground station to query the FMC for specific information including, but not limited to; flight plan, aircraft position, weather information, fuel remaining, ETAs, etc.

This information is requested via an ATC uplink message known as an event contract. The FMC may be required to send the data once in response to the uplink (on-demand report), at periodic rates (periodic reports), or in response to meeting specific criteria such as at a specified time, at a specific waypoint, or at a specific altitude (event reports).

ATC DL


The ATC DL application allows the ATC ground station and the flight crew to communicate a typical flight clearance in digital format using the digital datalink. Instead of the ATC Center using the radio to provide a clearance to climb to and maintain 32,000 feet, the clearance would be transmitted to the flight crew over the digital datalink and displayed in the ATC message log accessed via the MCDU. The flight crew would then select the appropriate response which is sent back to the ATC ground station.

ATC Message Log

The FANS FMCS maintains an ATC message log which stores the ATC message headers along with the current message status (specific message status is covered with the ATC LOG page).



ATC Datalink Access

The ATC datalink interface is accessed by pressing the  button on the FANS MCDU keyboard.

- Before a data link is established, the MCDU displays the ATC LOGON/STATUS page.
- After the log-on is completed:
 - Displays the ATC INDEX page if there are no new messages.
 - Displays an appropriate ATC page when a new message is pending.
 - Displays the ATC message log when more than one new messages are queued.

Data Link Status

Many of the ATC pages display the status of the airplanes data link system. Data link status indications are as follows:

- NO COMM – displayed when the FMCS has detected a NO COMMunications condition from the ACARS MU or CMU.
- READY – displayed after the FMCS established a link with the ACARS MU or CMU.
- VOICE – displayed when the radio is set to voice.
- FAIL – displayed when the FMCS has determined that the ACARS MU or CMU has failed.
- NO ATC COMM – the FMCS has an operating link with the ACARS MU or CMU, however, a connection with an ATC center is not available.

In many cases, these are displayed in place of a SEND prompt.

European Message Transmission Delay

A maximum uplink time delay allows operation in European domestic airspace. The maximum delay time received from ATCC is en-



tered into the LOGON/STATUS page. The FMCS uses this delay in message tagging and message construction.

Emergency Reporting

Emergency reporting may be quickly selected by pressing and holding (minimum of one second) the key anytime a data link connection is established.

Request and Reporting Message Construction

The request and report type message construction pages provide selectable prompts, manual entries, and “free text” areas (referred to as message elements or data items) to use in the construction of a message. A total of five data items may be used to generate a single message. An attempt to enter more than 5 data items result in the MESSAGE LIMIT EXCEEDED message displayed on the MCDU.

Message construction pages display selectable prompts in small font size. After selecting the prompt, it changes to large font size and the caret is removed (and is no longer selectable). To deselect the prompt, press the key, then select the desired prompt.

Manual entries are allowed in fields where the DASH prompt is displayed and are displayed in large font size. A new entry can be selected over the existing entry to change it, or the key can be used to remove it (returns to the DASH prompt).

Dual Status and Prompt Locations

Several of the ATC pages provide status and selectable prompts at the same location in the display. To distinguish between the two, prompts are displayed with the caret.

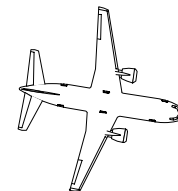
Manual Entry Format

Formats for entering altitudes, speeds, GMT, and waypoints are the same as for the FMCS flight plan pages.



Logging On

To begin the log-on process, the FMC must first be aligned to present position. This requires entering the position into the POS INIT page.

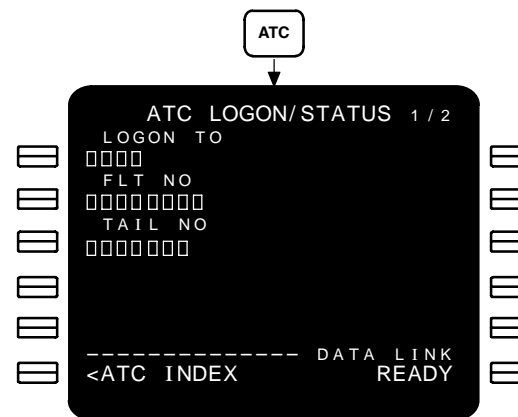


NOTE

Anytime the aircraft position is invalid, the ATC LOGON/STATUS page LOGON TO field (LSK 1L) is blank.

Press the ATC button to display the ATC LOGON/STATUS page.

If the FMC does not have the airplane tail number stored in memory, or the tail number has not been manually entered, the ATC LOGON/STATUS page will appear as follows:

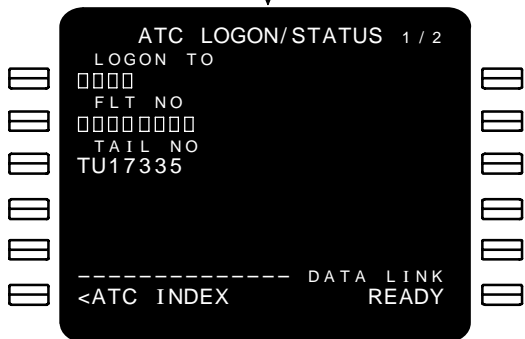


ADS and DATA LINK status – until the FMC completes a communication link via the ACARS MU or CMU, the ADS status line (5L) indicates INOPerable.

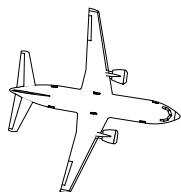
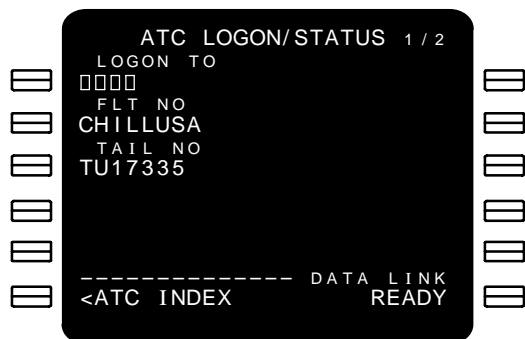
Normally, the ATC LOGON/SATAUS page appears as follows. The tail number is obtained from the ACARS MU or CMU and inserted by the FMC.



ATC



FLT NO – enter the flight number if not already displayed.



NOTE

When the flight number option is available, the flight number entered here is also displayed on the RTE, PROGRESS, and POS REPORT pages.

When the flight number is entered on the RTE page first, it is dis-

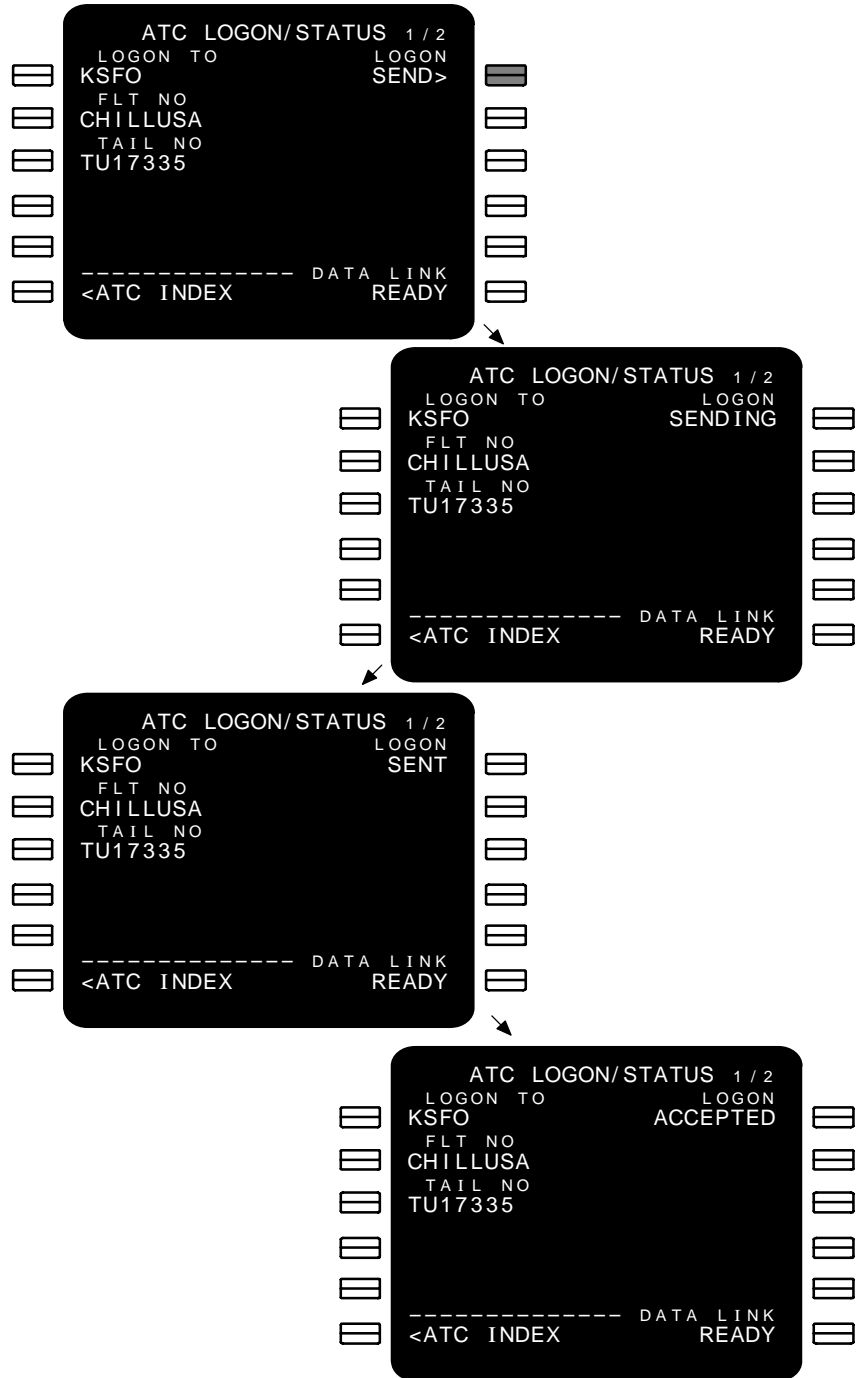


played on the PROGRESS page, here and on the POS REPORT page.

LOGON TO – enter the ATC Center identifier for the departure airport.

Once these entries are made, the LOGON status is displayed at LSK 1R. Initially, the SEND prompt is displayed to initiate a log-on.

Select the SEND prompt (LSK 1R) to transmit the log-on request. After the SEND prompt is selected the status of the request is displayed. Prompts and status displayed are explained on the ATC LOGON/STATUS page description.





Once the log-on process is complete, maximum uplink delay (MAX U/L DELAY), ATC COMM, the active center (ACT CTR) identifier, and when available, the next scheduled ATC Center (NEXT CTR) identifier are displayed. When logging into a European domestic ATCC, the uplink message should provide the time delay to enter into LSK 4L.

```

      ATC LOGON/STATUS 1 / 2
LOGON TO
= KSFO =
= FLT NO =
= CHILLUSA =
= TAIL NO =
= TU17335 =
= MAX U/L DELAY = ACT CTR =
= ---SEC = KSFO =
= ATC COMM =
= <SELECT OFF =
= ----- DATA LINK =
= <ATC INDEX READY =
= ATC COMM ESTABLISHED =

```


From this point on, pressing the ATC button displays the ATC pages as previously described (ATC Datalink Access).

As the flight progresses:

- The active ATC Center may terminate the connection by sending an End Service uplink.
- The active ATC Center may uplink the next scheduled ATC Center identifier (displayed at 4R).
- The active ATC Center may automatically transfer control to a new center.

To manually log onto another center, enter the ICAO identifier and select it to the LOGON TO field (LSK 1L).

As messages are received from the ATC Center, an alert (ATC MESSAGE) is displayed in the MCDU scratch pad or on the PFD depending on the airplane configuration or software options. To

view the message, press the  key.

FANS DISPLAYS




The following pages provide a detailed discussion of each of the ACT Datalink pages.



ATC LOGON/STATUS Pages

The ATC LOGON/STATUS pages are used to initiate an AFN down-link to a specified ATC center, display ATC COMM and Datalink status, turn off ATC COMM, enter a message maximum time delay for European messages time tagging, and ADS control.

PAGE ACCESS

- Press the  key when a center is not logged into.
- ATC INDEX page LOGON/STATUS prompt (LSK 5L).
- Press the  or  key from ATC LOGGON/STATUS page 2.

```

ATC LOGON/STATUS 1 / 2
LOGON TO          LOGON
KSFO              SEND>
FLT NO
CHILLUSA
TAIL NO          ACT CTR
TU17335         KSFO
MAX U/L DELAY   NEXT CTR
---SEC
ATC COMM
<SELECT OFF
----- DATA LINK
<ATC INDEX      READY
  
```

```

ATC LOGON/STATUS 2 / 2
ADS (ACT)        ADS EMERG
<SELECT OFF     SELECT ON>
----- DATA LINK
<ATC INDEX      READY
  
```

ATC LOGON/STATUS page 1

- LOGON TO – four character ICAO identifier for the ATC Center.
 - Displays box prompt when an ATC COMM connection is not established.
 - Display is blank prior to initializing present position on the POS INIT page.
 - Displays dash prompt when ATC COMM is established and DELETE is selected to LSK 1L)
- FLT NO – maximum eight character flight number. May be manually entered, pre-loaded via AOC flight number uplink, or pre-loaded from the RTE page (when flight number option available).



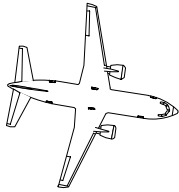
- TAIL NO – maximum seven character tail number. May be manually entered or pre-loaded. This is normally stored in the CMU and sent to the FMCS for display.
- MAX U/L DELAY – allows entry of 1 to 999 seconds as directed by Ueropean domestic ATCC for use by the FMC to compute message times and control message traffic.
- ATC COMM – display is blank when communications link is not established. Once established, the SELECT OFF control prompt is displayed allowing the aircrew to log off.
- LOGON – blank until LOGON TO, FLT NO, and TAIL NO are entered/loaded. Status and prompts are displayed at 1R as follows:
 - SEND prompt – displayed when LOGON TO, FLT NO, and TAIL NO are entered. Selecting the SEND prompt initiates sending the log-on request.
 - SENDING – displayed during the log-on request message transmission.
 - RESEND prompt – the ATC Center did not acknowledge the log-on request within the allotted time frame.
 - SENT – the ATC Center acknowledged receiving the log-on request.
 - ACCEPTED – the ATC Center acknowledged the log-on request and established the network link.
 - REJECTED – the ATC Center acknowledged the log-on request and denied the network link. Contact the ATC Center by radio to determine the reason.
- ACT CTR – display is blank when communications link is not established. After ATC COMM is established, the ICAO identifier of the ATC Center logged into is displayed.
- NEXT CTR – display is blank when communications link is not established. After ATC COMM is established, the ICAO identifier of the next scheduled ATC Center, when provided, is displayed.
- DATA LINK status – displays the status of the airplane data link system at 6R (ref page 4-34).

ATC LOGON/STATUS page 2

- ADS status – displays the status of the automatic dependence surveillance network.



- ADS (INOP) – displayed prior to establishing a communications link. A control prompt is not displayed at LSK 5L.
- ADS (ARM) – the ADS reporting system is ready, however, a communications link has not been established. The SELECT OFF control prompt is displayed at LSK 5L.
- ADS (ACT) – the ADS is armed and a communications link is established. The SELECT OFF control prompt is displayed at LSK 5L. Selecting the SELECT OFF control prompt will terminate all ADS communications links and halt ADS reporting.
- ADS (OFF) – the ADS reporting network is off. The SELECT ARM control prompt is displayed at LSK 5L. Selecting the SELECT ARM control prompt will re-arm the ADS reporting system, and will return to the active state when a communications link exists.



NOTE

When an ATC Datalink is established and a MAYDAY message is initiated, the ADS will automatically be placed into the ARM mode if the aircrew has turned ADS off.


- ADS EMERG – displayed when the ADS status is active or armed. Selecting the SELECT ON prompt at LSK 5R places the ADS in the emergency mode.

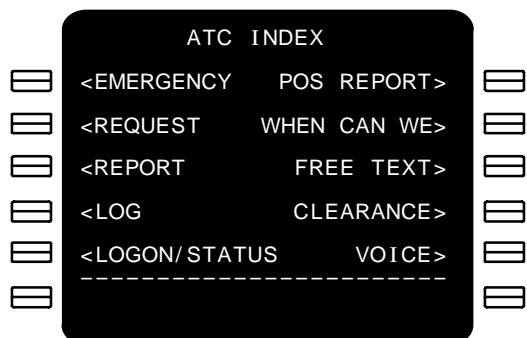


ATC INDEX Page

The ATC INDEX page contains a list of prompts to provide access to the air crew initiated pages and functions of the ATC Datalink. All ATC INDEX prompts (LSK 6L) on any ATC page returns the display to this page.

PAGE ACCESS

- Press  key after log-on is complete and:
 - An ATC uplink response is not pending.
 - New messages have not been received.
- ATC INDEX prompt (LSK 6L) on any ATC COMM page displaying the prompt.



The ATC INDEX prompts provide access to pages as follows:

- EMERGENCY (LSK 1L) – displays the EMERGENCY REPORT page.
- REQUEST (LSK 2L) – displays the ATC REQUEST page.
- REPORT (LSK 3L) – displays the ATC REPORT list page.
- LOG (LSK 4L) – displays the ATC LOG page.
- LOGON/STATUS (LSK 5L) – displays the ATC LOGON/STATUS page.
- POS REPORT (LSK 1R) – displays the POS REPORT page.
- WHEN CAN WE (LSK 2R) – displays the WHEN CAN WE EXPECT page.



- FREE TEXT (LSK 3R) – displays the VERIFY REPORT page with only the free text space displayed.
- CLEARANCE (LSK 4R) – displays the VERIFY REQUEST page with a clearance request.
- VOICE (LSK 5R) – displays the VERIFY REQUEST page with a voice contact request.



ATC LOG Page

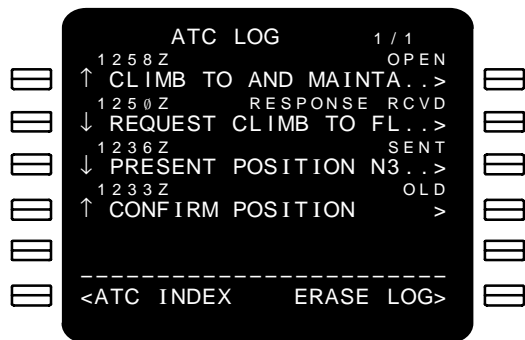
The ATC LOG page maintains a list of the messages and the current status of each message. It also allows the aircrew to access or delete messages from the list.

Each message in the list occupies two lines. The first line displays the GMT that the message was sent or received and the message status. The second line begins with an uplink (↑) or downlink (↓) indicator, the first 19 characters (maximum) of the message, and a selection caret.


Log entries are listed in GMT sequence with the latest entry listed in the first line of the first page. When required, multiple pages are generated.

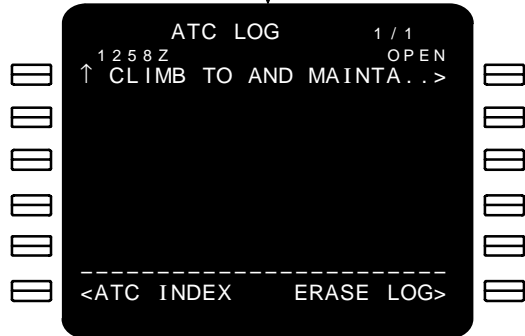
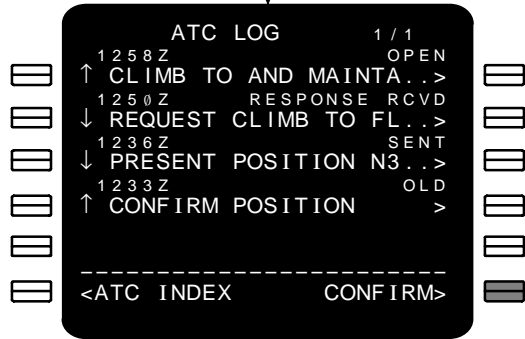
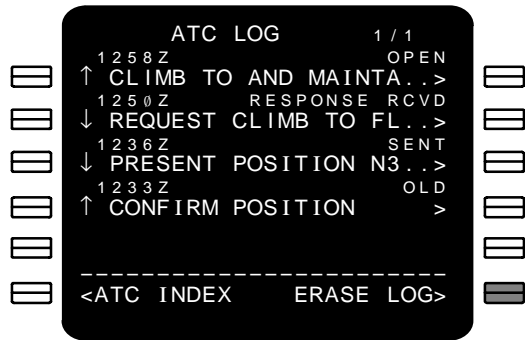
PAGE ACCESS

- ATC INDEX page LOG prompt (LSK 4L)
- ATC UPLINK page LOG prompt (LSK 6R)
- ATC REQUEST page LOG prompt (LSK 6R)
- ATC REPORT page LOG prompt (LSK 6R)
- ATC EMERGENCY page LOG prompt (LSK 6R)
- Press ATC key after log-on is complete and at least one new message is in the log.
- Press ATC key after log-on is complete and at least one message in the log is pending a response or action.





- LSK 1L thru LSK 5L – allows removing individual log entries. Press the  key and select the LSK adjacent to the desired message to delete the entry from the log. Deleted entries cannot be recovered.
- LSK 1R thru LSK 5R – displays the complete message adjacent to the LSK.
- ERASE LOG prompt (LSK 6R) – initiates deleting all non-pending entries in the log. Selecting another page prior to confirming the erase operation will cancel the operation.



- The following defines the status indications for uplinked messages:



STATUS	DEFINITION	STATE
NEW	Message has not been reviewed.	Pending
OLD	Message has been reviewed, a response is not required.	Non-Pending
OPEN	Message has been reviewed, response is still required or has not been acknowledged by the ATC Center.	Pending
ACCEPTED	ATC Center has acknowledged receipt of the flight crew's acceptance response message to an uplink message.	Non-Pending
REJECTED	ATC Center has acknowledged receipt of the flight crew's rejection response message to an uplink message.	Non-Pending
ABORTED	Message was pending when ATC COMM was terminated or control was transferred to a different ATC Center.	Non-pending

- The following defines the status indications for downlinked messages:

STATUS	DEFINITION	STATE
SENDING	Message is being queued for transmission to ATC Center.	Pending
SENT	Message was sent to ATC Center.	Non-Pending
OPEN	Message was sent to ATC Center and a response is required.	Pending



STATUS	DEFINITION	STATE
DEFERRED	Message is acknowledged by the ATC Center without a response.	Pending
RESPONSE RCVD	Message is acknowledged by the ATC Center with a response.	Non-Pending
ABORTED	Message was pending when ATC COMM was terminated or control was transferred to a different ATC Center.	Non-Pending

- ATC INDEX prompt (LSK 6L) - returns the display to the ATC INDEX page.



ATC REPORT List Page

The ATC REPORT list page(s) displays a maximum of ten ATC REQUEST reports, confirmation messages, and WHEN CAN YOU ACCEPT response messages. The listed in maintained in reverse chronological order and each line may be selected to view the corresponding VERIFY REPORT page for the uplink message received.

Listed items are cleared from the list when an appropriate response to an uplink message has been sent.

If an attempt to generate a combined total of more than ten active reports is made, the message ATC REPORT LIST FULL is displayed in the MCDU scratch pad. Messages at this point are not retained.

PAGE ACCESS

- ATC INDEX page REPORT prompt (LSK 3L)
- ATC UPLINK page REPORT prompt (LSK 6R)
- VERIFY REPORT page REPORT prompt (LSK 6L)



- LSK 1L thru LSK 5L
 - Selecting a line containing a message displays the appropriate VERIFY REPORT page, WE CAN ACCEPT, or POS REPORT page.
 - Selecting DELETE to a line containing a message deletes the line and eliminates the corresponding message.
 - A message armed for automatic transmission displays ARMED in the header line above that message.





ATC REQUEST Page

The ATC REQUEST page provides access to the different types of request pages and provides a place to enter an altitude, a speed, or an offset. Entries into these fields follow the same format as regular FMCS entries. Block altitude entries must be in feet or flight level. A total of five data elements from the ATC ALT REQUEST, ATC SPEED REQUEST, ATC OFFSET REQUEST, and ATC ROUTE REQUEST pages can be entered and/or selected for a message.

PAGE ACCESS

- ATC INDEX page REQUEST prompt (LSK 2L)
- VERIFY REQUEST page REQUEST prompt (LSK 6L)

The ATC REQUEST page operates as an index page for the request pages. Once a specific request page is selected, the  and  keys may be used to maneuver between them in circular queue fashion. The following are listed in the sequence they are cycled through.

- ATC ALT REQUEST page REQUEST prompt (LSK 6L)
- ATC SPEED REQUEST page REQUEST prompt (LSK 6L)
- ATC OFFSET REQUEST page REQUEST prompt (LSK 6L)
- ATC ROUTE REQUEST page REQUEST prompt (LSK 6L)



- LSKs 1L, 2L, and 3L
 - Selecting one of these prompts while the DASH prompt is displayed will display the appropriate ATC REQUEST page.



- Entering a value into one of these DASH prompts will display the appropriate ATC REQUEST page with that value inserted.
 - ALTITUDE (LSK 1L) – allows single altitude or block altitude entry in feet or flight level. Only single altitude entries are allowed when using meters.
 - SPEED (LSK 2L) – allows entry of a three character speed. MACH entries display the decimal point and two digits.
 - OFFSET (LSK 3L) – allows entry of a distance (1 to 99 miles) and a direction (left (L) or right (R)).
- ROUTE REQUEST prompt (LSK 4L) – selecting the ROUTE REQUEST prompt displays the ATC ROUTE REQUEST page.
- ERASE REQUEST prompt (LSK 5L) – displayed after an entry is made on any of the ATC REQUEST pages. Selecting the ERASE REQUEST prompt will remove all entries on all of the request pages.





ATC ALT REQUEST Page

The altitude request page is used to request altitude clearances from the ATC Center. The format for altitude, position, and GMT entries are the same as for the FMCS flight plan page displays.

When an altitude is entered into the DASH prompt on the ATC REQUEST page, this page is displayed with the altitude entered and the remaining selection prompts displayed.

When the ALTITUDE DASH prompt is selected on the ATC REQUEST page, this page is displayed with the DASH prompt only. After an altitude is entered at LSK 1L the remaining selection prompts are displayed.

PAGE ACCESS

- ATC REQUEST page ALTITUDE prompt (LSK 1L) or entry of an altitude into the DASH prompt.
- ATC ROUTE REQUEST page  key.
- ATC SPEED REQUEST page  key.



- ALTITUDE (LSK 1L) – allows single altitude or block altitude entry in feet or flight level. Only single altitude entries are allowed when using meters.

When the entered altitude differs more than 150 feet from the current altitude, the STEP AT and REQUEST headers are displayed. When the entered altitude differs by less than 150 feet from the current altitude, these are blanked.



- STEP AT – displays a DASH prompt (LSK 2L) allowing entry of a waypoint or time (GMT).
- REQUEST – displays the CRZ CLB selection prompt (LSK 1R) for inclusion into the request message.
- REQUEST prompt (LSK 6L) – returns the display to the ATC REQUEST page.
- VERIFY prompt (LSK 6R) – displays the VERIFY REQUEST page.





ATC SPEED REQUEST Page

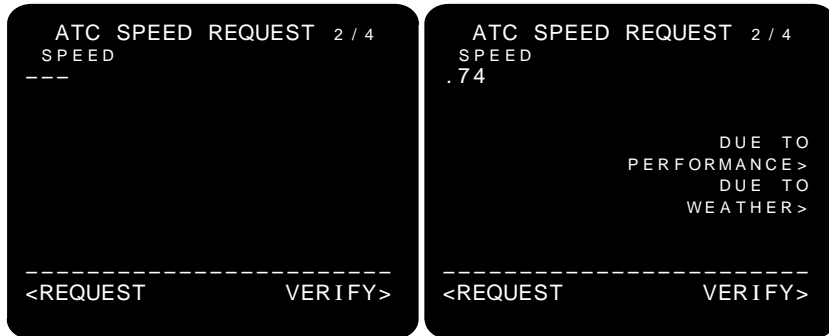
The ATC SPEED REQUEST page allows entry of a speed and selection of a reason.

When a speed is entered into the DASH prompt on the ATC REQUEST page, this page is displayed with the speed entered and the remaining selection prompts displayed.

When the SPEED DASH prompt is selected on the ATC REQUEST page, this page is displayed with the DASH prompt only. After a speed is entered at LSK 1L the remaining selection prompts are displayed.

PAGE ACCESS

- ATC REQUEST page SPEED prompt (LSK 2L) or entry of a speed into the DASH prompt.
- ATC ALT REQUEST page  key.
- ATC OFFSET REQUEST page  key.



- SPEED (LSK 1L) – allows entry of a three character speed. MACH entries display the decimal point and two digits.
- REQUEST prompt (LSK 6L) – returns the display to the ATC REQUEST page.
- VERIFY prompt (LSK 6R) – displays the VERIFY REQUEST page.



ATC OFFSET REQUEST Page



The ATC OFFSET REQUEST page allows entering an offset direction and distance, a beginning offset point, and a reason. The offset can be in a left-of-track (L) or right-of-track (R) direction and from 1 to 99 miles.

When an offset is entered into the DASH prompt on the ATC REQUEST page, this page is displayed with the offset entered and the remaining selection prompts displayed.

When the OFFSET DASH prompt is selected on the ATC REQUEST page, this page is displayed with the DASH prompt only. After an offset is entered at LSK 1L the remaining selection prompts are displayed.

The offset must comply with the offset requirements for the FMCS flight plan pages.

PAGE ACCESS

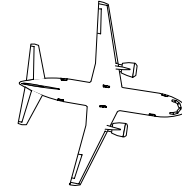
- ATC REQUEST page OFFSET prompt (LSK 1L) or entry of an offset into the DASH prompt.
- ATC SPEED REQUEST page  key.
- ATC ROUTE REQUEST page  key.



- OFFSET AT – displayed after the offset direction and distance is entered. Enter the waypoint identifier or time (GMT) at



which the offset is to start. The entered waypoint identifier must be in the active route. When multiple identifiers are in the NDB, the SELECT DESIRED WAYPOINT page is displayed. The message will then contain the latitude/longitude and identifier of the selected waypoint.



NOTE

If an entry is not made
it is assumed to start at PPOS.



- REQUEST prompt (LSK 6L) – returns the display to the ATC REQUEST page.
- VERIFY prompt (LSK 6R) – displays the VERIFY REQUEST page.

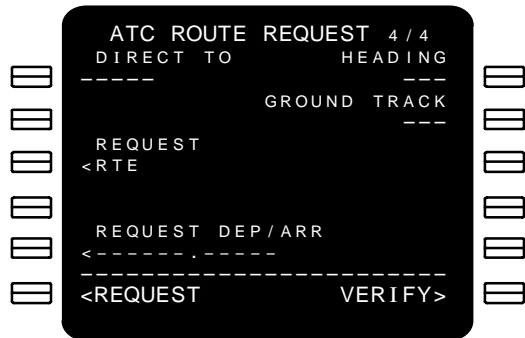


ATC ROUTE REQUEST Page

The ATC ROUTE REQUEST page allows requesting direct-to and route clearances, departure and arrival procedures, transitions, heading, and ground track.

PAGE ACCESS

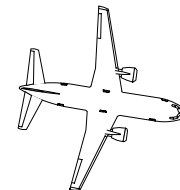
- ATC REQUEST page ROUTE REQUEST prompt (LSK 4L).
- ATC OFFSET REQUEST page  key.
- ATC ALT REQUEST page  key.



- DIRECT TO – allows entry of a fix, navaid, airport, latitude/longitude, or PBD. The entered identifier must be in the active route. When multiple identifiers are in the NDB, the SELECT DESIRED WPT page is displayed. The message will contain the latitude/longitude and name of the selected waypoint.
- RTE (LSK 3L) – selecting the RTE prompt includes a route request in the message.
- REQUEST DEP/ARR – may display one of the following:
 - While on the ground:
 - The departure procedure and transition selected on the DEPARTURES page.



- DASH prompts when a departure procedure and transition were not selected on the DEPARTURES page.
- While in the air:
 - The approach or arrival procedure and transition selected on the ARRIVALS page.
 - DASH prompts when an approach and departure procedure and transition were not selected on the ARRIVALS page.



NOTE

Procedure names are limited to six characters, and transition are limited to five character for use with the ATC data link.

- HEADING (LSK 1R) – allows entry of a heading in magnetic or true depending on the position of the MAG/TRUE switch.
- GROUND TRACK (LSK 2R) – allows entry of a ground track heading in magnetic or true depending on the position of the MAG/TRUE switch.
- REQUEST prompt (LSK 6L) – returns the display to the ATC REQUEST page.
- VERIFY prompt (LSK 6R) – displays the VERIFY REQUEST page.



ATC UPLINK Page

The ATC UPLINK page provides the aircrew with information, instructions, and status from the active ATC Center. When a response is required, the appropriate prompts are also displayed. Each message is tagged with the GMT when it is received, and the GMT for each message is displayed in the title line.

The number of pages will vary with the amount of content in the message.

The response prompts are always located on the last page containing space at LSKs 4L, 5L, 4R, and 5R.

PAGE ACCESS

- Press ATC key when:
 - There are no other messages pending a response.
 - No new messages have been received.
- Selecting the message from the ATC LOG page.
- VERIFY RESPONSE page UPLINK prompt (LSK 6L).
- REJECT DUE TO page UPLINK prompt (LSK 6L).
- ATC REQUEST page UPLINK prompt (LSK 6L).

```
1149z ATC UPLINK 1 / 2
DISPLAY          STATUS
<REQUEST        OPEN
PROCEED TO REBAS .
AT SFO-04 BEGIN CLIMB TO
6000 .
AT REBAS BEGIN CLIMB TO
FL180 .
REPORT WHEN AT FL . . ARM>

----- CONTINUED -----
LOG>
```

```
1149z ATC UPLINK 2 / 2

STANDBY
<SEND          LOAD>
               ACCEPT
<REJECT        SEND>
-----
LOG>
```

- DISPLAY – when the ATC UPLINK message is in response to a request message, the display request message selection is available. Selecting the REQUEST prompt (LSK 1L) displays



the ATC REQUEST message providing it has not been deleted from the ATC message log.

- STATUS – the message status displayed at LSK 1R is consistent with the status displayed on the ATC LOG page.
- ARM prompt – when a message contains a condition that can be automatically triggered, the ARM prompt is displayed on the right side of the message line. Selecting the ARM prompt arms the response for automatic transmission when the trigger condition is satisfied.
- LSK 6R – may display one of the following:
 - LOG prompt – selecting the LOG prompt (LSK 6R) returns the display to the ATC LOG page.
 - REPORT prompt – displayed when a report has been generated for the displayed message. Selecting the REPORT prompt (LSK 6R) displays the report from the Report List.

The response prompts (LSKs 4L, 5L, 4R, 5R) are displayed when appropriate to the message and always appear on the last page of the message.

- 4L – may display one of the following:
 - (blanked) – nothing is displayed when another response has been selected or the standby response is not appropriate for the message.
 - SEND prompt – displayed when another response has not been selected and the standby response is appropriate for the message. The header displays the STANDBY response. Selecting the SEND prompt (LSK 4L) initiates sending a standby response message to the ATC Center.
 - Data link status – When the data link is not available, the header displays DATA LINK and the appropriate data link status is displayed at 4L (ref page 4-34).
- 5L – may display one of the following:
 - (blanked) – nothing is displayed when another response has been selected or the reject response is not appropriate for the message.
 - REJECT prompt – displayed when another response has not been selected and the reject response is appropriate for the message. Selecting the REJECT prompt (LSK 5L) displays the REJECT DUE TO page to generate the response message.



- LSK 4R – displays the LOAD prompt when the message contains loadable data. Selecting the LOAD prompt loads the data as a MOD plan into the FMC.
- 5R – may display one of the following:
 - (blanked) – nothing is displayed when another response has been selected or the accept response is not appropriate for the message.
 - SEND prompt – displayed when another response has not been selected and the accept response is appropriate for the message. The header display ACCPT. Selecting the SEND prompt initiates sending an appropriate WILCO, ROGER, or AFFIRM response message to the ATC Center.

After the uplink message has been responded to, the response is included and the status (1R) is updated.

```
1149z ATC UPLINK 1/1
DISPLAY          STATUS
<REQUEST        ACCEPTED
PROCEED TO REBAS.
AT SFO-04 BEGIN CLIMB TO
6000.
AT REBAS BEGIN CLIMB TO
FL180.
REPORT WHEN AT FL. . ARM>
---- RESPONSE 1155Z----
WILCO

LOG>
```



When the maximum uplink delay is exceeded, the message is annotated to indicate this.

```
1149Z ATC UPLINK 1/1
DISPLAY STATUS
<REQUEST ACCEPTED
-UPLINK DELAY EXCEEDED--
PROCEED TO REBAS.
AT SFO-04 BEGIN CLIMB TO
6000.
AT REBAS BEGIN CLIMB TO
FL180. ARM>
---- RESPONSE 1155Z----
WILCO
```

LOG>




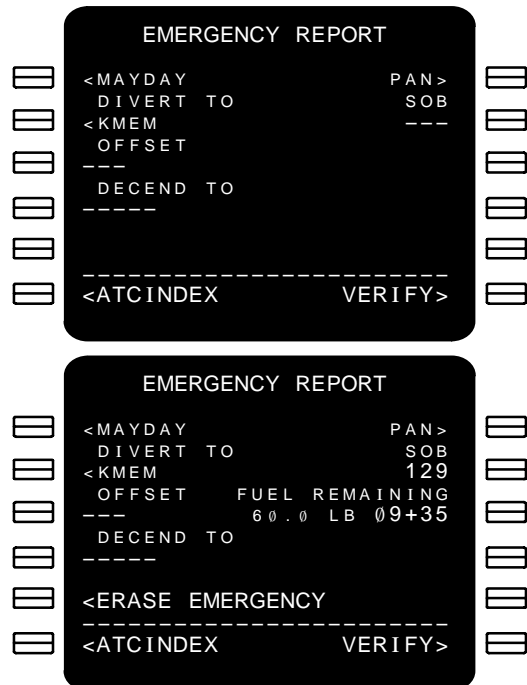
EMERGENCY REPORT Page

The EMERGENCY REPORT page allows the flight crew to create a downlink message to alert the active ATC Center of an emergency condition on board, and allows the flight crew to indicate any emergency maneuvering intentions.

Selected and entered items are displayed in large font size and will be included in the emergency message. A maximum of five data items (including free text) may be constructed for each message.

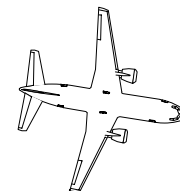
PAGE ACCESS

- ATC INDEX page EMERGENCY prompt (LSK 1L)
- VERIFY EMERGENCY page EMERGENCY prompt (LSK 6L)
- Press and hold the  key when a data link connection is active.





- DIVERT TO – a diversion point may be displayed or may be entered at 2L. Selected or manually entered identifiers are displayed in large font size and may be one of the following:
 - Destination airport if entered into the active flight plan.
 - Destination point from a MOD flight plan.
 - DASH prompt when a destination is not specified in the active or MOD flight plan.



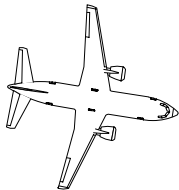
NOTE

When duplicate identifiers are contained in the NDB, the SELECT DESIRED WPT page is displayed. The selected waypoint latitude, longitude and identifier are included in the message.

- OFFSET – allows entering an offset assumed to be from PPOS into 3L.
- DECEND TO – allows entry or selection of an altitude at 4L.
 - DASH prompt – displayed when the MCP altitude is at or above the FMC altitude. Allows entry of an altitude in feet, flight level, or meters.
 - MCP altitude – when the MCP altitude is below the current altitude, the MCP altitude is displayed.
- SOB (Souls On Board) – displays the DASH prompt at 2R for entry of the number of passengers and crew on board.
- FUEL REMAINING – displayed after SOB is entered. Displays the fuel quantity from the FQIS (displayed in thousands of pounds or kilograms) and remaining fuel in hours and minutes.



- MAYDAY (LSK 1L) and PAN (LSK 1R) prompts – selection displays the VERIFY EMERGENCY page with the appropriate MAYDAY or PAN message line.



Select and/or enter all data items in the desired sequence then select the MAYDAY or PAN prompt last. The VERIFY EMERGENCY page is displayed with the data items ready for review.

- LSK 5L (ERASE/CANCEL EMERGENCY) – displays one of the following:
 - (blanked) – nothing is displayed prior to making a selection or entry on the page.
 - ERASE EMERGENCY prompt – is displayed prior to sending the emergency message and after selections or entries have been made. Selecting the ERASE EMERGENCY prompt causes all selections and entries to be removed.
 - CANCEL EMERGENCY prompt – is displayed after the message has been sent to the ATC Center and before any other selections or entries are made. Selecting the CANCEL EMERGENCY prompt initiates a downlink message with the cancel notification included.
- VERIFY prompt (LSK 6R) – selection displays the VERIFY EMERGENCY page.

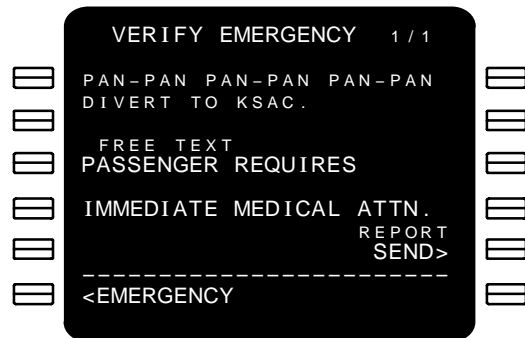


VERIFY EMERGENCY Page

The VERIFY EMERGENCY page displays the complete emergency message content as it will be sent to the ATC Center. The message can be reviewed, corrected if necessary, and free text may be added when four or fewer data items are in the message.

PAGE ACCESS

- EMERGENCY REPORT page MAYDAY prompt (LSK 1L)
- EMERGENCY REPORT page PAN prompt (LSK 1R)
- EMERGENCY REPORT page VERIFY prompt (LSK 6R)



- EMERGENCY prompt (LSK 6L) – selection of the EMERGENCY prompt returns the display to the EMERGENCY REPORT page.
- REPORT – may display one of the following:
 - (blanked) – nothing is displayed when this page is entered and there have not been option selections or manual entries made.
 - SEND prompt – selecting the SEND prompt (LSK 6R) performs the following functions:
 - Generates the emergency report message.
 - Generates a position report message.



- Initiates transmission of both messages to the ATC Center.
- SENDING – displayed while the message is being transmitted to the ATC center.
- DATA LINK status – displays the status of the airplane data link system (ref page 4-34).



POS REPORT Page

The POS REPORT page provides position, time, and fuel data to both the AOC and ATC.

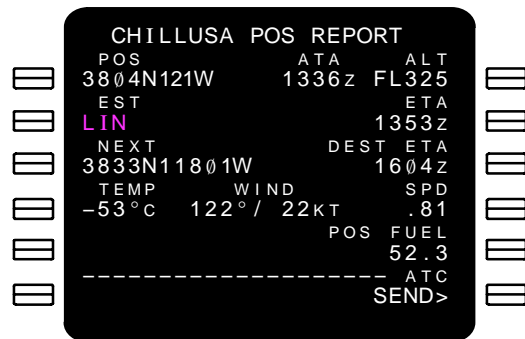
ETAs and ATAs are displayed in standard GMT format. Positions are displayed as latitude degrees and minutes, N or S, longitude degrees and minutes, E or W. When the minutes are zero, they are not displayed (i.e., 38 degrees 4 minutes north and 121 degrees 0 minutes west is displayed as 3804N121W).

When an ATC UPLINK message is received requiring a POS REPORT at a specific point, that point may be entered into next waypoint line (LSK 2L). If this point does not exist in the current flight plan, a fix waypoint may be added to the active flight plan and then entered into the next waypoint line.

The title line will contain the flight number from the RTE page when the flight number option is available.

PAGE ACCESS

- ATC INDEX page POS REPORT prompt (LSK 1R)
- Selecting a message on the ATC LOG page which contains report position type content.



- Line 1 – displays:
 - POS – latitude and longitude of the waypoint last sequenced.



- ATA – actual time that the POS waypoint was sequenced.
- ALT – the altitude at the time the POS waypoint was sequenced.
- Line 2 – displays:
 - EST – the next (active go to) waypoint in the route, or may be used to enter a reporting fix waypoint. Any manual entries made in this field must be a standard waypoint or fix waypoint already entered into the active flight plan.

The active go to waypoint is displayed in magenta text, manual entries are displayed in white text.
 - ETA – the estimated time of arrival to the waypoint displayed in EST.
- Line 3 – displays:
 - NEXT – latitude and longitude of the waypoint or fix waypoint displayed at EST
 - DEST ETA – the estimated time of arrival at the destination if one is included in the active flight plan.
- Line 4 – displays:
 - TEMP – current Static Air Temperature
 - WIND – the wind speed and direction from the RTE LEGS page(s). These fields are blank when wind data has not been entered or loaded on the RTE LEGS page.
 - SPD – current FMC target speed, or can be manually entered. The manual speed entry range is .61 to .82 MACH.
- POS FUEL (line 5) – displays the fuel quantity remaining at the last sequenced waypoint or fix waypoint.
- ATC – displays:
 - SEND prompt (LSK 6R) – displayed when POS, ATA, and ALT (line 1) are entered. Selecting the SEND prompt initiates transmission of the POS REPORT to the ATC Center.
 - After selecting the SEND prompt, status of the downlink is displayed (i.e., SENDING, SENT, etc.)
 - DATA LINK status – displays the status of the airplane data link system (ref page 4–34).

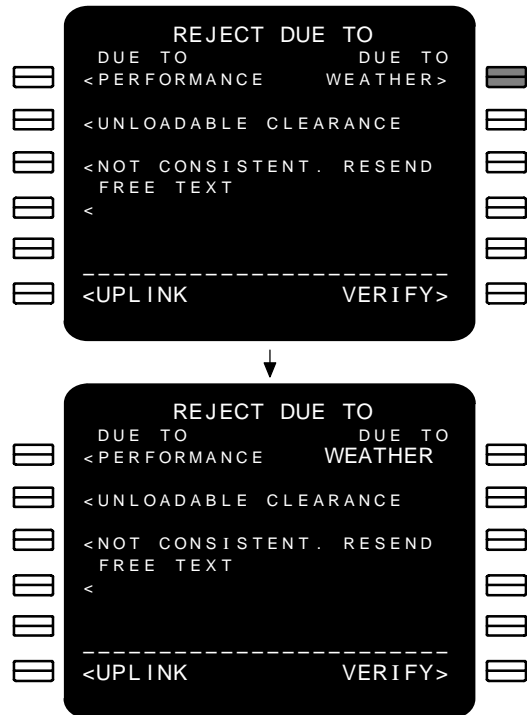


REJECT DUE TO Page

The REJECT DUE TO page provides a selection dialog type display to allow including a reason with the rejection response to an ATC UPLINK message. Free text may be added when four or fewer data items are in the message.

PAGE ACCESS

- ATC UPLINK page REJECT prompt (LSK 5L)
- VERIFY RESPONSE page REJECT DUE TO prompt (LSK 6L)



Pre-determined selections (1L, 2L, 3L, and 1R) are selectable when displayed in small font, and can be deselected using the DELETE key.

Free test may be entered and selected to the open caret (4L).

- UPLINK prompt (LSK 6L) – selecting the UPLINK prompt displays the ATC UPLINK message for this response.
- VERIFY prompt (LSK 6R) – selecting the VERIFY prompt displays the VERIFY RESPONSE page to allow viewing and sending the message.



VERIFY REPORT Page

The VERIFY REPORT page displays the text of a message that is in response to a report, confirmation, or WHEN CAN YOU ACCEPT request from the active ATC Center.

The aircrew can review, change, and/or add free text to the response prior to sending the report.

Data items displayed will depend upon selections made prior to selecting the VERIFY prompt on the originating page.

PAGE ACCESS

- Selection of a message on the ATC REPORT list page (LSK 1L thru LSK 5L).
- ATC INDEX page FREE TEXT prompt (LSK 3R).



- LSK 1L thru LSK 4L
 - Entered items may be changed as necessary by entering the desired information into the scratch pad and selecting the appropriate line select key adjacent to the data item to be changed.
 - FREE TEXT – a total of 23 characters including spaces and the period (line terminator) may be entered into the scratch pad and selected to the line below the FREE TEXT header.
- REPORT prompt (LSK 6L) – returns the display to the ATC REPORT list page.



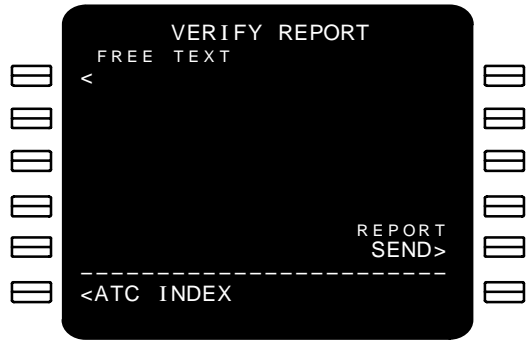
When the VERIFY REPORT page is displayed from a WHEN CAN YOU ACCEPT page:



- LSK 1L and LSK 2L. These entries may be entered or changed when:
 - Displays a DASH prompt.
 - Displays a BOX prompt.
 - Displays manually entered data (large font size).
- CANNOT ACCEPT prompt – becomes the message when selected. If a time is displayed in 2L when this prompt is selected, 2L reverts to a BOX prompt. The CANNOT ACCEPT prompt may be deselected by entering DELETE into the scratch pad and selecting LSK 3L.
- REPORT prompt (LSK 6L) – returns the display to the ATC REPORT list page.



When the VERIFY REPORT page is displayed from the ATC INDEX page FREE TEST prompt (LSK 3R), only the free text line is available.



- ATC INDEX prompt (LSK 6L) - returns the display to the ATC INDEX page.

When the message selected on the ATC REPORT list page contains a triggerable condition, 1R displays:

- ARM prompt - when not already selected. The ARM prompt may be selected on this page to arm the auto-trigger.
- ARMED status - when already armed on the ATC UPLINK page.





VERIFY REQUEST Page

The VERIFY REQUEST page displays the message text of a request as it will be sent to the ATC Center. The message text is displayed in the sequence that the data items we selected or entered on the request page(s). The flight crew can also add free text to the message when there are four or fewer data items in the message.

All data items selected or entered on the ATC ALT REQUEST, ATC OFFSET REQUEST, ATC ROUTE REQUEST, and ATC SPEED REQUEST pages are combined into one message to be sent to the ATC Center.

PAGE ACCESS

- ATC INDEX page CLEARANCE prompt (LSK 4R) or VOICE prompt (LSK 5R).
- ATC REQUEST page VERIFY prompt (LSK 6R)
- ATC ALT REQUEST page VERIFY prompt (LSK 6R)
- ATC OFFSET REQUEST page VERIFY prompt (LSK 6R)
- ATC ROUTE REQUEST page VERIFY prompt (LSK 6R)
- ATC SPEED REQUEST page VERIFY prompt (LSK 6R)
- WHEN CAN WE EXPECT page VERIFY prompt (LSK 6R)



- LSK 6L – displays:
 - ATC INDEX – when this page was accessed from the ATC INDEX page (CLEARANCE or VOICE prompts).



- ATC REQUEST – when this page was accessed from the ATC REQUEST, ATC ALT REQUEST, ATC OFFSET REQUEST, ATC ROUTE REQUEST, or ATC SPEED REQUEST pages.
 - WHEN CAN WE – when this page was accessed from the WHEN CAN WE EXPECT page.
- REQUEST/DATALINK – displays:
- SEND prompt – initiates sending the request message to the ATC Center.
 - Message transmission status.
 - Datalink status (ref page 4–34).

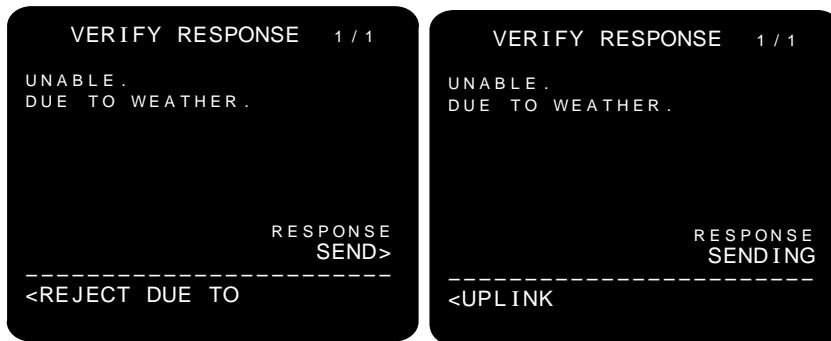


VERIFY RESPONSE Page

The VERIFY RESPONSE page displays the contents of the reject message for review, correction, and sending. Components of the message are displayed in the order selected on the REJECT DUE TO page.

PAGE ACCESS

- ATC UPLINK page REJECT prompt (LSK 5L) when the response message is being sent.
- REJECT DUE TO page VERIFY prompt (LSK 6R).



- LSK 6L – will display one of the following:
 - REJECT DUE TO prompt – displayed prior to sending the message. Selecting the REJECT DUE TO prompt (LSK 6L) returns the display to the REJECT DUE TO page to allow editing and correcting the contents of the message.
 - UPLINK prompt – displayed while the message is being sent to the ATC Center. Selecting the UPLINK prompt (LSK 6L) displays the ATC UPLINK message corresponding to this message.
- LSK 5R – will display one of the following:
 - SEND prompt – selecting the SEND prompt (LSK 6R) sends the message to the ATC Center.
 - DATA LINK status – displays the status of the airplane data link system (ref page 4–34).



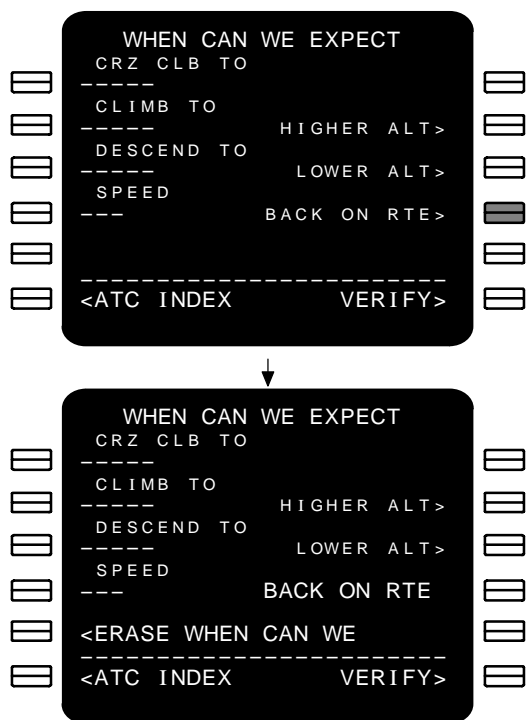
WHEN CAN WE EXPECT Page

The WHEN CAN WE EXPECT page is used to quarry the governing ATC Center concerning pending clearances. A maximum of five data items (entered and selected) can be included.

To clear or deselect a single item, press the **DEL** key and then select the desired item.

PAGE ACCESS

- ATC INDEX page WHEN CAN WE prompt (LSK 2R)
- VERIFY REQUEST page WHEN CAN WE prompt (LSK 6L)



- CRZ CLB TO, CLIMB TO, and DESCEND TO:
 - An altitude may be entered in feet, flight level, or meters.
 - Block altitude entries are not accepted.
 - Entering an altitude in one position or selecting the HIGHER ALTITUDE (LSK 2R) or LOWER ALTITUDE (LSK 3R)



prompts causes the other selections and headers to be blanked.

- HIGHER ALT, LOWER ALT
 - Allows selection of a non-specific altitude change.
 - Entering an altitude in CRZ CLB TO (LSK 1L), CLIMB TO (LSK 2L), DESCEND TO (LSK 3L), or selecting one of these prompts causes the other selections and headers to be blanked.
- ERASE WHEN CAN WE prompt (LSK 5L) – displayed after an entry or selection is made. Will set all items back to the defaults.
- VERIFY prompt (LSK 6R) – displays the VERIFY REQUEST page.