Flight Management System
Controls & indicators

Control Display Unit
- CDU display
- Line select keys
- Function keys
- Execute key
- Execute light
- Alphanumeric keys
- Misc. keys
- Brightness control
- Message light
- Offset light
- Call light
- FMC Source Select switch
- FMC Alert light

Flight Management System
Page Components

Page number
Boxes
Dashes
Page title
Line title
Line
Scratchpad
Page prompt
Flight Management System
Control Display Unit
Data entry rules

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<th>9990</th>
<th>00050</th>
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Flight Management System
System Description
The flight management system (FMS) is comprised of the following components:

- flight management computer system (FMCS)
- autopilot/flight director system (AFDS)
- autothrottle (A/T)
- inertial reference systems (IRS)
- global positioning system (GPS).

Each of these components is an independent system, and each can be used independently or in various combinations. The term FMS refers to the concept of joining these independent components together into one integrated system which provides continuous automatic navigation, guidance, and performance management.

Flight Management System
Flight Management Computer System

The FMC uses flight crew-entered flight plan information, airplane systems data, and data from the FMC navigation database to calculate airplane present position, and pitch, roll, and thrust commands required to fly an optimum flight profile. The FMC sends these commands to the autothrottle, autopilot, and flight director. Map and route information are sent to DUs.

The EFIS control panels are used to select the desired information for the navigation displays. The mode control panel is used to select the autothrottle, autopilot, and flight director operating modes.

Control Display Units (CDUs)
Two identical, independent CDUs provide the means for the flight crew to communicate with the FMC. The crew may enter data into the FMC using either CDU, although simultaneous entries should be avoided. The same FMC data and computations are available on both CDUs; however, each pilot has control over what is displayed on an individual CDU.
Flight Management System
FMS Operation
Preflight / POS INIT

Flight Management System
FMS Operation
Preflight / POS REF

Flight Management System
FMS Operation
Preflight / RTE (ACT = Active, MOD = Modified)

Flight Management System
FMS Operation
Preflight / RTE

Flight Management System
FMS Operation
Preflight / DEP ARR INDEX

Flight Management System
FMS Operation
Preflight / DEP ARR
Flight Management System
Thrust management

The autothrottle operates in response to flight crew mode control panel inputs or to automatic FMC commands. Reference thrust can be selected on the N1 LIMIT page. Automatic FMC autothrottle commands are made while VNAV is engaged.

The autothrottle system:
• uses reference thrust limits calculated by the FMC
• commands the thrust levers
• commands thrust equalization through the electronic engine controls.

Thrust limits are expressed as N1 limits.

The FMC calculates a reference thrust for takeoff, derated takeoff, assumed temperature takeoff, climb, reduced climb, cruise, continuous, go-around.

The thrust reference mode automatically transitions for the respective phase of flight. These modes can be selected on the N1 LIMIT page. The selected thrust reference mode is displayed on the thrust mode display.

Navigation Systems
Global Positioning System

Two GPS receivers receive GPS satellite positioning signals. The left and right GPS receivers are independent and each provides an accurate airplane geographical position to the FMC and other aircraft systems. GPS operation is automatic.

GPS operation is automatic. Two GPS receivers receive GPS satellite positioning signals. The left and right GPS receivers are independent and each provides an accurate airplane geographical position to the FMC and other aircraft systems. The displays include a map for airplane orientation and command markers (buoys) on the airspeed and N1 indicators to assist in flying efficient profiles.

The FMS can automatically tune the navigation radios and determine LNAV courses. The FMS navigation database provides the necessary data to fly routes, SIDs, STARs, holding patterns, and procedure turns. Lateral offsets from the programmed route can be calculated and commanded. For vertical navigation, computations include items such as fuel burn data, optimum speeds, and recommended altitudes. Cruise altitudes and crossing altitude restrictions are used to compute VNAV commands. When operating in the Required Time of Arrival (RTA) mode, the computations include required speeds, takeoff times, and enroute progress information.

Navigation Systems
Inertial System

The inertial system computes airplane position, ground speed, and attitude data for the DUs, flight management system, autoflight system, and other systems. The major components of the inertial system are:
- air data inertial reference units (ADIRU)
- an inertial system display unit (ISDU)
- an ISDU transfer switch

The ADIRUs provide inertial position and track data to the FMC, and attitude, altitude, and airspeed data to the CDUs. Each ADIRU has an ISDU section and an air data section.

Inertial Reference System

Two independent IRSs are installed. Each IRS has three sets of laser gyroscopes and accelerometers. The IRSs provide attitude, true and magnetic heading, acceleration, vertical speed, ground speed, track, present position, and wind data to appropriate airplane systems. IRS outputs are independent of external navigation aids.

Navigation Systems
Radio Navigation Systems

Automatic Direction Finding (ADF) System

An automatic direction finding (ADF) system enables automatic determination of magnetic and relative bearings to selected facilities.

One ADF receiver is installed. The ADF bearing signal is sent to the pointer on the DUs and the standby radio magnetic indicator. The audio is heard by using the ADF receiver control on the audio selector panel.

If heading or track information is lost or invalid, ADF bearing pointers on the DUs will be removed, and ADF bearing pointers on the standby radio magnetic indicator will not display correct magnetic bearing. Relative bearings indicated by pointers may be correct if the receiver is operating.
Navigation Systems

Radio Navigation Systems

Distance Measuring Equipment (DME)

Two frequency scanning DME systems are installed.

The FMC autotunes DME receivers as necessary for position updating. During normal operations, two different DME signals or a signal from a collocated VOR/DME pair provide an accurate radio geographical position to the FMC.

The flight crew must manually tune the DME on the VHF navigation control panel and the respective EFIS control panel VOR/ADF switch must be in the VOR position for DME to be displayed on the CDI. DME distance is also displayed on the CDI when the ILS receivers are tuned to the collocated DME and localizer facility.

Very High Frequency Omni Range (VOR)

Two VOR receivers are installed.

The flight crew must manually tune the VOR on the navigation control panel for display on the DUs and the standby radio magnetic indicator. VOR-DME radio updating is available if the crew manually tunes a valid in-range VOR station.

Instrument Landing System (ILS)

Two ILS receivers are installed.

The ILS receivers are tuned manually on the VHF navigation control panel. The flight crew must manually tune the ILS for display on the CDI. The ILS localizer and glideslope can also be displayed on the standby attitude indicator.

LOC updating of the FMC occurs only after the ILS is manually tuned. The tuned ILS frequency is displayed on the navigation display in the APP modes.

Marker Beacon

Marker beacon indications for outer, middle and inner marker are displayed on the upper right hand corner of the attitude display located on the Captain’s and First Officer’s Primary Flight Display (PFD) units.

Navaid Identifier Decoding

The Morse code identifier of a tuned VOR, ILS, or ADF can be converted to alpha characters. The decoded identifier is then shown on the PFD and ND. The crew should monitor this identifier for correct navigation radio reception. The identifier name is not compared with the FMC database.

Transponder

Two ATC transponders are installed and controlled by a single control panel. The ATC transponder system transmits a coded radio signal when interrogated by ATC ground radar. Altitude reporting capability is provided.

Transmissions are automatically enabled when the air/ground system indicates air mode.

Transponders may also transmit information, such as flight number, airspeed or groundspeed, magnetic heading, attitude, GPS position, etc., depending on the level of enhancement. Airport equipment monitors airplane position on the ground when the transponder is active (mode selector not in STANDBY or OFF). TCAS modes should not be used on the ground for ground tracking.

Weather Radar

The radar indicates a cloud’s rainfall intensity by displaying colors contrasted against a black background. Areas of heaviest rainfall appear in red, the next level of rainfall in yellow, and the least rainfall in green.

In map mode, the radar displays surfaces in red, yellow, and green (most reflective to least reflective). These displays enable identification of coastlines, hilly or mountainous regions, cities, or large structures. Ground mapping mode can be useful in areas where ground-based navigation aids are limited.

The radar system performs only the functions of weather detection and ground mapping. It should not be used or relied upon for proximity warning or anticollision protection.