ARINC

FLIGHT MANAGEMENT COMPUTER SYSTEM

ARINC CHARACTERISTIC 702-6

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1.0 INTRODUCTION AND DESCRIPTION

1.1 Purpose

This document sets forth the characteristics of a Flight Management Computer System specifically designed for installation in new generation commercial transport aircraft. The system is not designed for retrofit in any aircraft other than those utilizing ARINC 700 series equipment.

1.2 Summary of Operational Characteristics

The Flight Management Computer System (FMS) described herein is designed to provide performance data and fuel management display and control functions, and navigation and guidance to a desired flight plan based on energy efficient profiles.

NOTE: This Characteristic describes an FMS which is capable of providing performance management and navigation/guidance functions from take-off to final approach. It is recognized, however, that a need also exists for a simpler version of the system designed to provide performance management combined with limited navigation and guidance. The intent in developing the simpler system is to achieve a lower cost system with reduced operating logistics compared with the more sophisticated system described. It is anticipated that equipment cost may be reduced by:

a. Less complex software design

b. Minimum bulk data storage requirements

c. Simpler Control Display Unit (CDU)

Operating logistics impact may, in turn, be reduced by:

a. Minimized bulk data cost

b. Less frequent data update

c. Reduced crew training needs

It is not the intent herein to develop a "Characteristic within a Characteristic", nor is it intended to describe two separate systems. Manufacturers wishing to develop the simpler system should decide which functions are needed for such a system, and design the system in accordance with the relevant sections of this Characteristic. It should be emphasized, however, that all systems should conform to the interchangeability standards set forth in Section 2 of this Characteristic.

The energy management functions performed by the FMS includes the computation of target parameters, flight profiles and guidance commands to optimize performance during all phases of flight. The optimization should, by selection, be based on cost, time, fuel or range. Provisions should also be included to enable overall modification of these computations by a factor based on individual airline operating economics, local fuel costs, etc. To achieve this performance optimization within the constraints of the air traffic environment, the energy management functions are integrated with a three dimensional, earth oriented navigation system employing mixing of available navigation sensor system inputs. Primary data for this function are IRS/AHRS, GNSS, air data, and bearing and distance data derived from ground based VORTACS and VOR and/or DME facilities, with provisions for growth inputs from additional sensors.

The system provides for the automatic selection and tuning of VOR, DME and ILS systems. The FMS receives continuous inputs of altitude, airspeed, ground speed, fuel flow and fuel quantity, Engine Pressure Ratio (EPR) or revolution (N1), airplane configuration, etc. as required to support the energy management calculations.

A data base is stored in the Flight Management Computer (FMC) unit which may include performance and limit data for a variety of engine types and airplane configurations and navigation data to support the airline requirements.

Lateral guidance is computed with respect to great circle paths defined by the flight plan, and to transitional paths between the great circle paths, or to a preset heading or course. Vertical guidance is computed with respect to altitudes assigned to waypoints, or to paths defined by stored or computed profiles. Speed control along the desired path is provided during all phases of flight.

Lateral and vertical guidance and speed/thrust commands are computed for automatic control through the Flight Control Computer System (FCCS) and Thrust Control Computer System (TCCS). Deviation signals are computed for display on flight instruments.

Engagement of the FMS modes for automatic flight via the FCCS and TCCS is controlled through the FCCS Controller on the Mode Control Panel (MCP). Flight planning data entry and flight performance mode selection for FMC use is performed through the FMS Control/Display Unit (CDU).

The system should be designed with growth potential to add real-time constraints to the guidance modes to provide a four-dimensional (4D) guidance capability.

The system also has the optional capability to provide all the necessary signal processing the input/output functions to support a multi-function electronic display.

1.3 Brief Description of the System

The ARINC 702 Flight Management Computer System (FMS) comprises two units, one a rack-mounted computer unit and the other a cockpit-located control and display unit. The computer unit provides storage capability for all data needed for system operation.

1.0 INTRODUCTION AND DESCRIPTION (cont'd)

1.4 Unit Description

1.4.1 Flight Management Computer (FMC) Unit

The Flight Management Computer (FMC) unit should contain all of the components, electronic circuitry, memory, etc. incident to the functioning of the system. The unit should also contain, as a minimum, sufficient data storage for all required active engine and airplane performance data, all navigation data required to support the active flight plan, and any alternate flight plan which may have been entered into the system. The design goal should be that the FMC should be capable of storing all data required by the system. The computer should be designed such that normal and abnormal power switching transients and other primary power interruptions as defined in RTCA Document DO-160 do not cause essential memory contents to be lost.

COMMENTARY

> Provisions should be made in the design of the computer to allow for future growth of the system. Expanding the capabilities of the computer should be possible with a minimum of rework and at a minimum cost to the airline customer. Section 3.6 of this Characteristic describes some possible "growth features".

1.4.2 Control/Display Unit (CDU)

The CDU should provide means for manually inserting system control parameters and selecting modes of operation. In addition, it should display various computer outputs as well as for the verification of data entered into memory. Certain annunciations related to system operation may also be included.

When the FMC is used in conjunction with an IRS and/or GNSS Sensor, the CDU may also be used to control this equipment. Series control may be employed; i.e., the CDU interfaces only to the FMC and all communications with the IRS and/or GNSS are made via the FMC/IRS and/or FMC/GNSS interface.

NOTE: This method of series control may also be applied to other systems inputs, such as Omega, referred to in Section 3.6 of this Characteristic.

1.4.3 Flight Data Storage Unit (Optional)

Section deleted by Supplement 2.

1.5 Interchangeability

1.5.1 General

One of the primary functions of an ARINC Equipment Characteristic is to designate, in addition to certain performance parameters, the interchangeability desired for aircraft equipment produced by various manufacturers. The degree of interchangeability considered necessary is specified in the pertinent ARINC Equipment Characteristic.

1.5.2 Interchangeability Desired for the ARINC 702 Flight Management Computer System

System interchangeability of the FMC and the CDU with respect to the standard aircraft installation is desired, regardless of the manufacturing source. The standards necessary to ensure this level of interchangeability are set forth in Section 2 of this Characteristic.

1.5.3 "Generation Interchangeability" Considerations

The air transport industry desires that future evolutionary equipment improvements and the inclusion of additional functions in new equipments during the next few years do not violate the interwiring and form factor standards set forth in this document. Provisions to ensure forward-looking "generation interchangeability" (as best can be predicted) are included in this document to guide manufacturers in future developments.

1.6 Integrity and Availability

Since it is anticipated that this equipment may become the primary means of navigation on some aircraft, the utmost attention should be paid to the need for integrity and availability in all phases of system design, production, and installation.

1.7 Regulatory Approval

The equipment should meet all applicable regulatory requirements. This Characteristic does not and cannot set forth the specific requirements that an equipment must meet to be assured of approval. Such information must be obtained from the appropriate regulatory authority.

2.0 INTERCHANGEABILITY STANDARDS

2.1 Introduction

This section of this Characteristic sets forth the specific form factor, mounting provisions, interwiring, input and output interfaces and power supply characteristics desired for the complete Flight Management Computer System. These standards are necessary to ensure the continued independent design and development of both the equipment and the airframe installations.

Manufacturers should note that although this Characteristic does not preclude the use of different form factors and interwiring features, the practical problem of redesigning what will then be a standard aircraft installation to accommodate some special system could very well make the use of that other design prohibitively expensive for the customer. They should recognize, therefore, the practical advantages of developing equipment in accordance with the form factor, interwiring and signal standards of this document.

2.2 Form Factor, Connectors and Index Pin Coding

2.2.1 Flight Management Computer

The FMC should comply with the dimensional standards in ARINC Specification 600, "Air Transport Avionics Interfaces" for the 8 MCU form factor. The FMC should also comply with ARINC 600 with respect to weight, racking attachments, front and rear projections and cooling.

As an alternative, the 4 MCU form factor may be used. Equipment packaged in the 4 MCU form factor should be designated "ARINC 702S". The same functional guidelines and interwiring apply.

The FMC should be provided with a low insertion force, size 2 shell ARINC 600 service connector. This connector should be located on the center grid of the FMC rear panel, and index code 04 should be used. The top and center inserts of the connector (TP and MP) should each provide 150 socket-type contacts. The lower insert (BP) should provide 11 pin-type contacts and spaces for two small diameter coaxial contacts. Attachment 1A to this document shows the connector arrangement. Attachment 2 shows the pin assignments.

If functions not assigned pins on the service connector in Attachment 2 to this document are needed to be brought to the "outside world" to facilitate testing the FMC, they should be assigned pins on an auxiliary connector whose type and location is selected by the equipment manufacturer. The manufacturer should refer to ARINC Specification 600 when choosing the location for this connector and note that, other than to accommodate the needs for equipment identification by the ATE described in this document, he is free to make whatever pin assignments he wishes. The airlines do not want the unassigned ("future spare") pins of the service connector used for functions associated solely with ATE use.

2.2.2 Control/Display Unit (CDU)

The CDU should be packaged as a standard dzus-mounted control panel 9" high by 5.75" wide. The depth behind the panel should not exceed 10.5", excluding the connector. A connector type M83723/72R18-31N should be used having pin assignments as shown in Attachment 2. Outline drawings showing the connector location are included in Attachment 1B to this Characteristic. More details on CDU design may be found in Section 5.0.

NOTE: As stated in Section 1.2 of this Characteristic, a need exists to allow manufacturers the flexibility to develop FMC systems with differing levels of capability in an effort to reduce airline cost and logistic problems. Part of the system cost reduction may be achieved by developing a smaller, simpler CDU. Differing feelings exist in the industry concerning the relative merits of dedicated key versus shared function alphanumeric keyboards, and also on the trade-off between the amount of keyboard area versus display area. Thus, equipment manufacturers may be asked by their airline customers to supply CDUs of less than 9" panel height. Airframe manufacturers, however, should design cockpits to accommodate CDUs of the standard 9" height.

2.2.3 Optional Flight Data Storage Unit (FDSU)

Section deleted by Supplement 2.

2.3 Interwiring

The overall interwiring for the ARINC 702 Flight Management Computer System is set forth in Attachment 2. The interwiring for a given installation, however, need only ensure interconnection with the sub-systems chosen to support operation of the FMC system. Wiring associated with alternate sub-systems shown in Attachment 2 need not be installed. Equipment manufacturers are cautioned not to rely on special wires, cabling or shielding for their particular units because they will not exist in an ARINC 702 installation.

COMMENTARY

Why Standardize Interwiring?

The standardized interwiring is perhaps the heart of all ARINC Characteristics. It is this feature which allows the airline customer to complete his negotiations with the airframe manufacturer so that the latter can proceed with engineering and initial fabrication prior to airline commitment on

2.0 INTERCHANGEABILITY STANDARDS (cont'd)

2.3 Interwiring (cont'd)

a specific source of equipment. This provides the equipment manufacturer with many valuable months in which to put the final "polish" on his equipment in development.

The reader's attention is directed to the interwiring guidance in ARINC Report 414, Section 5.0. This material defines all of the basic standards utilized in airframe wiring installations and all equipment manufacturers should make themselves familiar with it.

The reader's attention is also directed to the guidance in Section 2.2.1 and Appendix 1 of ARINC Specification 429 concerning the basic standards for digital interfaces in airframe wiring installations.

2.4 Power Circuitry

2.4.1 Primary Power Input

The FMC and the CDU should be designed to use 115 volt 400Hz single phase power from a system designed for Category (A) utilization equipment per ARINC Specification 413A.

The primary power inputs to the FMC and the CDU will each be protected by a circuit breaker of the size shown in Attachment 2 to this Characteristic. Installation designers should note that the FMC circuit breaker should also be capable of handling the current drain of an ARINC 603 data loader. When such a device is used with the FMC, it derives its power from the FMC power source.

The equipment designer should be aware that severe switching and other transient interruptions to primary power occur during normal aircraft operations. He should ensure that such interruptions do not cause the computer to lose the contents of its memory or impose the need to provide an external battery to maintain operations. No pilot action should be needed to cause the system to return to normal operation following such normal power interruptions.

NOTE: Airframe installation designers should verify that the aircraft power systems satisfy the primary power interruption criteria of ARINC Specification 413A.

2.4.2 Power Control Circuitry

There should be no master on/off power switching within the FMC system. Any user desiring on/off control should provide, through the medium of an external switching function installed in the airframe, a means of interrupting the primary AC power to the system.

2.4.3 The Common Ground

The wire connected to the FMC connector pin labelled "Chassis Ground" should be employed as the DC ground return to aircraft structure. It is not intended as a common return for circuits carrying heavy AC currents, and equipment manufacturers should design their equipment accordingly.

2.4.4 The AC Common Cold

The wire connected to the FMC connector pin labelled "115 VAC Cold" will be grounded to the same structure that provides the DC chassis ground but at a separate ground stud. Airframe manufacturers are advised to keep AC ground wires as short as practicable in order to minimize noise pick-up and radiation.

2.5 Environmental Conditions

The FMC and CDU should meet the requirements of RTCA Document DO-160. Attachment 5 of this Characteristic tabulates the relevant environmental categories.

2.5.1 Thermal Interface and Design

2.5.1.1 FMC

The FMC should be designed to utilize, and the airframe installation should provide, cooling air in the manner described in Section 3.5 of ARINC Specification 600. The airflow rate provided to the FMC in the aircraft installation should be 44 Kg per hour and the pressure drop of the coolant airflow through the equipment should be 25 ± 5 mm of water at this rate. The unit should be designed to expend the pressure drop in a manner to maximize the cooling effect within the equipment. Adherence to the pressure drop standard is needed to allow interchangeability of equipment.

COMMENTARY

> The FMC should be designed such that loss of cooling air flow does not produce immediate failure. Having made this statement, the airlines wish to remind airframe manufacturers that they may not interpret it as a release from the need to provide cooling air for the FMC as specified above.

2.5.1.2 CDU

The internal power dissipation of the CDU should not exceed 92W. The CDU cooling and thermal design should be in accordance with ARINC Specification 408A, Sections 2.3, 3.6 and 3.10. These sections define case temperature limits, the equipment cooling method, the thermal appraisal procedure and expected high temperature exposure conditions which should be considered for the equipment design.

COMMENTARY

> ARINC 408A defines the standard interface between the aircraft and indicators; however, the thermal interface described should also be applied to the CDU.

2.6 Weights

System manufacturers should take note of the guidance information on weights contained in ARINC Specification 600.

2.7 System Functions and Signal Characteristics

A complete list of the system functions and signal characteristics required to ensure the desired level of interchangeability is set forth in Sections 3.0 and 4.0.

2.8 Grounding and Bonding

The attention of equipment and airframe manufacturers is drawn to the guidance material in Section 3.2.4 of ARINC Specification 600 and Appendix 2 of ARINC Specification 404A on the subject of equipment and radio rack grounding and bonding.

COMMENTARY

> A perennial problem for the airlines is the location and repair of airframe ground connections whose resistances have risen as the airframe aged. A high resistance ground usually manifests itself as a system problem that resists all usual approaches to rectification, and invariably consumes a wholly unreasonable amount of time and effort on the part of maintenance personnel to fix. Airframe manufacturers are urged, therefore, to pay close attention to assuring the longevity of ground connections.

3.0 SYSTEM DESIGN CONSIDERATIONS

3.1 System Configurations

Three different configurations of the ARINC 702 Flight Management Computer System illustrated in Attachment 3 to this Characteristic are described in this section. The FMC is expected to be capable of operating interchangeably in all three.

3.1.1 Single System Configuration

In this configuration, the FMC accepts inputs from one, two or three ARINC 704 IRS or ARINC 705 AHRS, one or two ARINC 743A GNSS Sensors, two each ARINC 706 Air Data System, ARINC 711 VOR, and ARINC 709 DME and one ARINC 710 ILS to compute the lateral and vertical navigation functions.

Inputs of fuel quantity, fuel flow and engine and airplane configuration parameters and inputs from the thrust control computer combined with the air data inputs are used to compute the performance data and fuel management display or control outputs. Initial condition inputs may be inserted manually via the CDU or automatically from airplane sensor systems.

3.1.2 Single System/Dual CDU Configuration

In this configuration, the interface is the same as for the single system, with the addition of a second CDU. Both CDUs will have the capability of requesting and displaying data independently, and simultaneously on a time shared basis.

NOTE: The question of which CDU is in command, particularly when changing data related to the engaged mode or active leg is one which requires study. Control authority may be delegated by means of a cockpit mounted switch or by software determination through keyboard action. Manufacturers are urged to review the thoughts of airlines and airframe manufacturers on this subject before a design decision is made. Most airlines will not want the switch, but for those that do, a discrete has been reserved for this function and is defined in Section 4.3.2.2 of this Characteristic.

3.1.3 Dual System Configuration

The basic interface for each FMC is the same in the dual configuration as in the single system configuration, except that there is two-way intersystem bus communication between the two FMCs. This bus permits intersystem comparison for self-test and reasonableness test purposes and also allows retrieval of second system data following loss of a single input sensor. It also provides the means for loading data into both FMCs from entries through one CDU.

This configuration should be considered basically as two separate systems, each relating its inputs and outputs to the No. 1 and No. 2 FMCs of the airplane, respectively.

Section 4.4 of this document provides guidance concerning the design of the FMC intersystem communications interface.

3.2 Basic System Functions

3.2.1 Performance Management

3.2.1.1 General

The Flight Management Computer should have the capability to calculate parameters for display or control purposes, compute the flight profiles and provide the guidance outputs for airplane performance in all phases of flight, including climb, cruise, holding, and descent. These computations may be optimized based on such criteria as: minimum trip fuel, minimum trip cost, minimum trip time, maximum rate of climb or descent, maximum angle of climb or descent and maximum holding endurance, either singly or in combination. The FMC may also provide data for turbulence penetration and engine-out conditions. These functions will be integrated with the flight planning function of the FMC (see Section 3.3.2 of this Characteristic). All performance data computations may be modified according to the Cost Index function defined in Section 3.4.1.2.6 of this document.

3.2.1.2 Performance Data Base

The FMC should store in its internal memory, a data base which includes aerodynamic and propulsion performance characteristics for one or more airframe/engine combinations. Provisions should also be included to enable modification of lift-drag characteristics, time and fuel flow, due to degradation during the lift of the airframe. If made, the changes should be annunciated to the crew members and other operational personnel. The pertinent data for a particular installation should be addressed by means of program pins reserved for this purpose as shown in Attachment 2 to this Characteristic.

3.2.1.3 Optimum Flight Path

The FMC should compute a flight path using as a baseline the planned lateral path and any established altitude requirements, together with the selected mode or modes of operation as referenced in Section 3.2.1.1 of this Characteristic. Guidance to this path will be implemented by means of a combination of lateral, vertical and speed/thrust commands.

COMMENTARY

> The vertical and speed/thrust guidance commands will be limited to prevent the airframe and engine limits from being exceeded. The speed limits VMO and MMO will be supplied to the FMC from the Air Data System and the VMin limit from the TCC. The airplane altitude limitations will be stored in the FMC performance data base. The engine limit data will be resident in the TCC and this will be the master reference source for this data. Limit data may also be stored in the FMC for its computation. It is expected that certain parameters relating to the airplane configuration will be received from another system, such as the TCC, rather than provide individual inputs to the FMC. These parameters are included in Attachment 4 to this Characteristic.

3.0 SYSTEM DESIGN CONSIDERATIONS (cont'd)

3.2.1.4 Performance Data Control and Display

The CDU should provide the means for selecting the particular submode of performance data operation required, i.e., maximum rate climb, economy cruise, etc. The CDU should also provide the means for manual entry of any data parameters which are required and are not available via the digital interfaces. Possible initial data entries are defined in Section 3.4.1.2 of this Characteristic. The CDU should provide the means for selecting the required mode of operation. Performance parameters to aid the flight crew in flight planning, aircraft operation, and optimum flight profile control, will be displayed on the CDU. These parameters may include, but are not limited to, any of the following:

Takeoff Data
Altitude Intercept Distance
Altitude Intercept Time
Top of Descent
Maximum Altitude
Optimum Altitude
Range Capability to Reserve Fuel Level
Range Capability to Empty Tanks
Endurance Time
Fuel Remaining Over Destination
Engine-Out performance
Turbulent Air Performance
Approach Speeds

3.2.2 Lateral Navigation and Guidance

3.2.2.1 Lateral Navigation

Position should be computed in terms of latitude and longitude for display on the CDU. Information will also be available in terms of bearing and distance to any designated fix for display on the CDU, and to the active waypoint for display on the CDU and flight instruments.

3.2.2.2 Lateral Guidance

Information related to aircraft position and velocity vector with respect to the desired lateral path should be developed for display on the CDU and cockpit instrumentation, as well as for use by the flight control computer system. Such information will include cross-track deviation, track angle error and a roll angle steering command. The desired path may be defined from a waypoint sequence or other procedure specified by the flight plan or by any lateral path computed from pilot entry at the CDU. Means may be provided for lateral path modification, such as a select heading or course input.

3.2.3 Vertical Navigation and Guidance

3.2.3.1 Vertical Navigation

The primary signals for vertical navigation computation should be baro-corrected altitude, CAS/Mach, vertical velocity, and along track distance to the bisector. Other data such as flight path angle and vertical acceleration, may also be available.

3.2.3.2 Vertical Guidance

Deviation and steering commands with respect to the desired vertical profile should be developed for guidance and display purposes. The system should also continuously compute the vertical profile (and, optionally, the vertical path angle) necessary to achieve the altitude required at the 'to' waypoint.

NOTE: The waypoint altitude requirement applies at the lateral track bisector.

The vertical track deviation signals should be suitable for display on flight instruments. A vertical steering command should be computed for use by the flight control computer system.

COMMENTARY

The vertical steering command parameter has not yet been selected, but is expected to be one of the following: vertical speed, vertical acceleration, pitch altitude.

NOTE: System designers must take into account the integration required between lateral, vertical and performance functions in all phases of operation. This is particularly applicable when any changes made to the lateral or vertical path have effect on the performance computation required to achieve the required flight profile.

3.2.4 Thrust Axis Control

The FMC should generate thrust axis limit data and commands consistent with the lateral and vertical navigation and performance specifications of this Characteristic. This information should include limit mode selection and N_1/EPR commands for the TCC and CAS/Mach commands for the FCC and the TCC.

COMMENTARY

Integration of the vertical and thrust axes is specified in order to prevent excessive throttle activity.

3.2.5 4D Guidance (Growth Option)

All lateral, vertical, and speed/thrust guidance functions should be designed in such a manner that they can be integrated to provide growth to full 4D guidance and time control for all segments of the flight profile. The 4D guidance function should have the ability to compute and provide guidance to the optimum profile from enroute cruise to the runway, given a time requirement at a specified fix. The system should continuously assess its performance with respect to the various constraints of time, altitude or speed which may be imposed at points along the flight path, and compute and apply the required corrections to make good the 4D profile. A digital clock input to the FMC is reserved for use in computing 4D guidance.

3.0 SYSTEM DESIGN CONSIDERATIONS (cont'd)

3.2.5 4D Guidance (Growth Option) (cont'd)

NOTE: The mechanization of the computer should be such that the system clock is capable of providing an accurate time base for all phases of speed controlled operation along the flight path. However, interruption of the system clock during power interruptions is permitted.

3.2.6 Electronic Flight Instrument System Management

The system should have the capability to assemble and format data required to support Electronic Flight Instrument (EFI) system use.

NOTE: Interface standards for FMC/EFI operation may be found in Section 8 of this Characteristic.

3.2.7 Data Update Interface

The FMC data update port is expected to provide all data base updates to the FMC. These should include the use of the following methods of update, or a combination of them, according to the system configuration:

a. Transfer of airplane and engine performance and navigation data to the FMC for use in its computations. This may be implemented by bulk transfer of data for a flight or flight segment.

b. Transfer of flight plan oriented data contained in a carry-on storage medium, via a cockpit located data read unit, to the FMC.

Provisions should also be made for receipt of flight plans by data link.

c. Update of integral data storage in the FMC from a portable loader unit, telephone path, etc.

When external means are employed to update integral data storage in the FMC, it is essential that aircraft or engine performance data is protected from change during updating of the navigation data, and vice versa. See also Section 6.2 of this Characteristic.

3.2.8 IRS Initialization and Heading Set

The FMC should be capable of initializing up to three ARINC 704 Inertial Reference Systems when called upon to do so by flight crew action at the CDU. In response to this initialize command, the FMC should output on its general data buses a burst of not more than four or less than two initial position latitude/longitude pairs. This data should consist of BCD-encoded "set latitude" and "set longitude" words having the labels and data standards defined for these quantities in ARINC Specification 429.

The FMC should also be capable of setting the IRS magnetic heading output to the value entered by the crew at the CDU. The FMC should respond to the set heading command by transmitting a burst of not more than four or less than two BCD-encoded "set heading" words. ARINC Specification 429 defines the applicable label and data standards. Consult ARINC Specification 704, "Inertial Reference System", for further information on initialization and heading set.

3.2.9 GNSS Initialization

The FMC should be capable of initializing up to two ARINC 743A GNSS Sensors when called upon to do so by flight crew action at the CDU. In response to this initialize command, the FMC should output on its general data buses, current time and date and a burst of not more than four or less than two initial position of a latitude/longitude pair. This data should consist of BNR encoded current "time" in UTC, and BCD encoded current "date", "set latitude" and "set longitude" words.

COMMENTARY

> GNSS Sensors may be indirectly connected to the FMC through the IRS or ADIRS. The GNSS Sensor may also be directly connected to the CDU for initialization.

3.3 Operational Features and Technical Considerations

3.3.1 Performance Management Computation

3.3.1.1 General

A primary function of the FMC system is to provide performance management throughout any specified segment of the flight regime, within the constraints of the air traffic control environment and according to the operational requirements of the operator. This section, therefore, describes the functions regarded as basic to the system. However, this Characteristic neither recommends a specific implementation nor precludes variations on the basic concept. It is assumed that all performance-related calculations will take into account wind data, and will have the capability of being modified by a cost index factor determined by the operating economics of individual operators.

3.3.1.2 Take Off Function

This Characteristic does not specify any particular take off functions, nor does it preclude their incorporation into the FMC.

3.3.1.3 Altitude Intercept Distance and Time

The FMC should be able to compute an estimate of the ground distance and time to climb or descend to a selected altitude, according to the mode selected by the pilot. These parameters should also be computed on demand for any other altitude entered by the pilot.

3.3.1.4 Optimum Climb

The FMC should compute an optimum climb profile based on the climb mode selected by the pilot.

3.3.1.5 Optimum Cruise Altitude

The FMC should compute an optimum cruise altitude based on the cruise mode selected by the pilot.

3.3.1.6 Maximum Range

The FMC should compute the range capability of the aircraft to reserve fuel levels and also to empty tanks.

COMMENTARY

> No attempt is made in this Characteristic to define the meaning of "reserve fuel".

3.3.1.7 Maximum Endurance

The FMC should compute the endurance capability of the aircraft to reserve fuel levels and to empty tanks, based on the selected holding speed and altitude.

3.3.1.8 Fuel Remaining Over Destination

When distance to the destination is known, either along the flight plan path or as entered as an estimate via the CDU, the system should compute the fuel remaining over the destination, taking into account the modes selected for each segment of the planned flight.

3.3.1.9 Top of Descent

The system should compute the distance and time to go to a computed top of descent point, based on the selected mode of descent to reach an altitude at a specified waypoint in the flight plan.

3.3.1.10 Engine-Out Performance

The FMC should be able to compute aircraft performance for engine-out situations.

3.3.1.11 Turbulent Air Performance

This Characteristic does not specify any particular turbulent air performance functions nor does it preclude their incorporation into the FMC. FMC designers planning such functions should first familiarize themselves with the modes of operation of the FCC gust alleviation feature specified in ARINC Characteristic 701.

3.3.2 Flight Planning

The system should allow the pilot to enter the flight plan by various means depending on current conditions and available stored data. The means should range from entry of individual definitive parameters via the keyboard to selection from storage of these parameters, of flight plan segments or of a complete flight plan.

NOTE: Program design and data organization should ensure that pilot action is kept to a minimum in preparing the system for a normal air carrier operation.

If the FMC does not store all data internally, then it should, as a minimum, contain sufficient integral data storage capacity to store all data required for the active flight plan (including performance profiles) and one complete alternate flight plan. It should be possible, via the CDU, to manually enter or change data in this store.

NOTE: Discretion must be exercised during system design in determining the philosophy involved in enabling any manually entered changes to the active leg or more of operation.

Provision should also be made to allow the pilot to assemble and verify an alternate or diversionary flight plan without affecting the active flight plan. This flight plan would then be ready for activation upon receipt of the required clearance.

3.3.3 Data Retrieval and Verification

The pilot should be able to call up any data from the flight plan or from bulk data storage at all times for inspection or verification, without interrupting or in any way affecting the guidance or display outputs of the system.

3.3.4 Supplemental Navigation Information

The FMC should be capable of providing position, distance, time and altitude information relative to a pilot-specified navigation situation. Typical requests for information are as follows:

> Time, distance and altitude abeam a selected navaid or waypoint.
>
> Bearing and distance to a specified navaid or waypoint.
>
> Latitude (longitude) of a flight plan intersection with a specified longitude (latitude).

System designers should take note that pilots will desire rapid access to this data in specific operational situations.

3.3.5 Slant Range Correction

DME slant range data should be automatically corrected for aircraft altitude and station elevation during enroute and terminal area operation.

COMMENTARY

> The provision of redundant air data inputs to the FMC should ensure adequate integrity for the slant range correction function reference data. Complete loss of air data, however, should not cause loss of FMC capability not dependent upon it.

3.3.6 Automatic Station Selection and Tuning

The FMC system should provide the capability of automatically selecting VOR, DME and ILS channels in accordance with a stored program procedure, and of tuning the respective receivers. It should be capable of selecting one or more navaids according to available facilities in order to provide the optimum navigational accuracy. The FMC should also be capable of enabling the frequency scanning and frequency diversity modes of an appropriately equipped ARINC 709 DME, and utilizing the range data thus obtained. The pilot should be able to override the autoselection process by manual entry or selection of a navaid identifier at the CDU, or by external switching to manual control by the navaid tuner. One use of manual override is to be able to receive ATIS information broadcast via VOR ground stations.

3.0 SYSTEM DESIGN CONSIDERATIONS (cont'd)

3.3.6 Automatic Station Selection and Tuning (cont'd)

A discrete has been reserved for autotune master/slave control for a dual FMC installation and is defined in Section 4.3.2.3.

NOTE: The airlines have advised DME manufacturers that they are generally dissatisfied with the DME ident provided within the framework of present DME System Standards. They would like to see more frequent ident transmissions, distance replies provided during ident characters and more information (such as station latitude, longitude and elevation) included in the ident signal. They have even suggested investigating the feasibility and economic sense of translating the Morse code ident received from the ground stations into ISO alphabet #5 characters for output on the DME's digital data output buses. FMC manufacturers are advised to keep themselves informed on development in the DME ident field so that they can take advantage of them in their computer designs.

3.3.7 "Direct To" Function

The pilot should be able, at any time, to command a direct leg to any waypoint either in the flight plan or manually selected or entered at the CDU. The specified waypoint will thus replace the active waypoint for the current leg and the flight plan will be modified accordingly. However, it should also be possible to return to guidance with respect to the original flight plan by simple action at the CDU.

COMMENTARY

System designers should take precautions to avoid sudden, large deviations in the vertical path guidance arising from the use of this function. Also, the function should be implemented with turn anticipation to avoid "S" turns during course transitions.

3.3.8 Detection of a Power Interrupt

The program should be designed such that, on detection of a power interrupt, the system should automatically store all flight plan data and all current navigation and performance data.

3.3.9 Self Test

The FMC should be designed to perform automatic self tests of its internal operation, and reasonableness tests on input data during normal operation. The FMC will generate digital output buses which will include malfunction codes to indicate the FMC's assessment of its health, and the status of its interfaces.

Means should be provided for initiating a maintenance test through an externally supplied discrete (see Section 4.3.2.5 of this Characteristic). This maintenance test will provide test values on the digital outputs with the appropriate status matrix code for the test condition as defined in ARINC Specification 429. This test can also exercise internal monitoring and diagnostic routines and provide test formats on the CDU and on a multifunction display. The FMC may also have the capability, via a switch on the front of the FMC, for initiating a maintenance test for ground use only. If this switch is provided, an indicator lamp should also be mounted on the FMC front panel to show the result of the test.

The CDU may include a pilot confidence test, initiated by a control on the CDU, which will provide a visual indication that the display and any status annunciators are operating correctly. This test should in no way affect the online performance, navigation and guidance computations or the FMC interfaces.

3.3.10 Immunity from Flight Path Perturbation

The navigation and guidance output signals from the FMC system should be derived in such a way that bearing noise, scallops, etc., as well as any perturbations generated within the FMC system itself, or within any of its sensors, are eliminated or reduced to negligibly small proportions.

The integrated vertical and speed/thrust command outputs should also be derived in a manner to minimize flight path excursions due to speed control consistent with minimizing throttle activity.

3.3.11 Manual Override Inputs

When it is necessary to depart from instructions contained in the stored flight plan, the pilot should be able to enter override inputs at the AFS glare shield controller or the CDU. Section 3.4.1.8 of this document refers.

3.4 System Inputs

3.4.1 Management and Control (Pilot and Program Inputs)

The following sections describe the various system initialization, flight plan defining parameters, etc., that are required by the system prior to its utilization in various modes. Such entries may be made manually via the CDU, or automatically from an internal or external source under program control.

NOTE: Standards applicable to source data will be found in ARINC Specification 424.

3.4.1.1 System Initialization

Following application of power to the FMC system, it should automatically perform an initialization, internal monitoring and test cycle, if appropriate. Failure to complete the cycle successfully should cause appropriate annunciation on the CDU.

3.0 SYSTEM DESIGN CONSIDERATIONS (cont'd)

3.4.1.2 Initial Data Inputs

3.4.1.2.1 Present Position

Present position will normally be entered into the system through the CDU in terms of latitude and longitude, with a resolution of 0.1 minute of arc. It may also be read in from bulk data storage referenced to the known physical location of the airplane such as at a gate.

3.4.1.2.2 Gross Weight

Airplane gross weight should be computed at all times for performance data functions. Initial gross weight may be entered manually through the CDU or obtained from the aircraft weight and balance system. The required resolution of the computation is 100 pounds.

3.4.1.2.3 Zero Fuel Weight

Zero fuel weight may be entered through the CDU, with a resolution of 100 pounds. This parameter may be used, in conjunction with fuel weight calculated from fuel quantity, in calculating gross weight.

3.4.1.2.4 Outside Air Temperature

Outside air temperature prior to takeoff may be entered manually via the CDU or may be obtained from the air data system if aspirated TAT probes are available. Required resolution is 1°C.

3.4.1.2.5 Airport Elevation

This may be entered manually at the CDU or read from bulk data storage, or the air data system. A resolution of 10 feet should be provided.

3.4.1.2.6 Cost Index

Cost index as determined by the operator may be entered manually through the CDU. This should not require an entry prior to each flight. The cost index may also be pre-stored.

3.4.1.2.7 Greenwich Mean Time

If required, this may be entered manually at the CDU, or may be obtained from a digital clock or data link input.

3.4.1.3 Waypoint Definition

The parameters required to define a waypoint may be entered into the system manually through the CDU or may be recalled from bulk data storage by entry or selection of the waypoint identifier. The definitive parameters shown in the following sections may be available for display or entry on the CDU on request by the pilot. Waypoints should be defined by latitude/longitude or by reference fix/bearing/distance.

3.4.1.3.1 Waypoint Identifier

The waypoint identifier should be a unique alphanumeric designator. The waypoint identifier should not exceed seven characters. A waypoint identifier may or may not be assigned to an impromptu waypoint.

3.4.1.3.2 Waypoint Latitude and Longitude

Waypoint latitude and longitude are the earth coordinates of the waypoint. The minimum resolution is 0.1 minute of arc over the ranges 0 to 90° North and South for latitude, and 0 to 180° East and West for longitude.

3.4.1.3.3 Waypoint Reference Fix

The reference fix used in bearing and distance definition of a waypoint should be the identifier of a navaid or another waypoint.

3.4.1.3.4 Waypoint Bearing from Station (Theta)

The bearing of the waypoint from the referenced navaid (Theta) will have a minimum resolution of 0.1° over the range 0 to 359.9°.

3.4.1.3.5 Waypoint Distance from Station (Rho)

Waypoint-to-referenced navaid horizontal distance will have a resolution of 0.1 nautical miles over the range 0 to 200 nautical miles.

3.4.1.4 Navaid Definition

The parameters required to define a navaid may be entered into the system manually via the CDU but will normally be recalled from bulk data storage by entry of the navaid identifier. The parameters listed below should be available for display or entry on the CDU.

3.4.1.4.1 Station Identifier

The four alpha/numeric character (max) identifier of the tuned navaid (or navaids).

3.4.1.4.2 Station Frequency

The five numeric characters of the active station frequency.

3.4.1.4.3 Station Elevation

Station elevation has a minimum resolution of 100 feet and a range of 0 to 15,000 feet. To denote a station elevation below MSL, a minus sign should be provided for in this parameter.

3.4.1.4.4 Station Declination

The resolution for station declination should be 1.0° minimum over a range from 180° East to 180° West.

COMMENTARY

> Station declination is the angular difference between true north and the zero degree radial of the navaid at the time the navaid was last site-checked. For ILS localizers, station declination is the angular difference between true north and magnetic north at the localizer antenna site at the time the magnetic bearing of the localizer course was established.

3.0 SYSTEM DESIGN CONSIDERATIONS (cont'd)

3.4.1.4.5 Station Latitude and Longitude

Station earth coordinates in latitude and longitude should have a minimum resolution of 0.1 minute of arc over a range of 0 to 90° North and South for latitude and 0 to 180° East and West for longitude.

3.4.1.5 Cross Track Offset Distance

Cross track offset distance is a distance, entered at the CDU which defines the position of an impromptu track parallel to the original track. A selected offset should apply to all segments until the pilot either selects another value or cancels the use of the offset capability by any means, including selection of a direct leg to a fix. Initiation of an offset should be restricted to the currently active leg.

One nautical mile increments of offset distance to a minimum of 20 nautical miles left and right of the original track should be provided.

COMMENTARY

> The equipment manufacturer is advised to carefully evaluate the conditions under which crosstrack offset is permitted.

3.4.1.6 Along Track Offset Distance

Along track offset distance is a distance, entered at the CDU, at which the pilot wishes to reach or depart the reference altitude either prior to or beyond the selected waypoint. The resolution desired is one nautical mile and the range ± 99 nautical miles relative to the waypoint (where "+" is beyond and "-" is prior to the waypoint).

COMMENTARY

> Equipment manufacturers are advised carefully to evaluate the conditions under which along track offset is permitted and also the method of displaying the offset.

3.4.1.7 Assigned Time at a Fix

This parameter may be manually entered at the CDU and defines a pilot or ATC assigned time at a specified fix along the flight path. It should be specified in hours, minutes, and optionally in tenths of minutes.

3.4.1.8 Manual Override Inputs

The following is a list of parameters which may be manually entered at the AFS glare shield controller or the CDU. This list shows typical inputs which may be expected for normal operation but is not intended to preclude others.

a. Selected Heading

b. Selected Indicated Airspeed

c. Selected Mach Number

d. Selected Course (No. 1 and No. 2)

e. Selected Altitude

f. Selected Vertical Speed

g. Selected Bank Angle Limit

Inputs made at the glare shield controller should override the data with which the FMC is working when they are made, but should not result in the stored flight plan being amended. Inputs made at the CDU should similarly override in-use data but may also cause stored flight plan revisions if appropriate.

3.4.2 Sensor Inputs

Sensor inputs to the FMC system are set forth in Section 4.2.1 of this Characteristic and listed in Attachment 4.

3.4.3 Sensor Warning Inputs

Sensor warning inputs will be implemented as specified in ARINC Specification 429, Section 2.1, in that validity status is contained within the digital word format.

3.5 System Outputs

FMC system outputs are set forth in Section 4.2.2 of this Characteristic and listed in Attachment 4.

3.5.1 System Integrity Monitoring and Failure Warning Outputs

Discrete outputs in this category are described in Section 4.3.2 of this Characteristic. All other such alerts and warnings are included in the transmitted digital word as specified in ARINC Specification 429, Section 2.1.

3.5.2 System Control Signals

FMC control inputs and outputs are described in Sections 4.3.1, 4.3.2 and 4.3.3 of this Characteristic.

3.6 Growth Features

The following list of "growth features" has been prepared to assist manufacturers in planning for the possible inclusion of additional features that airlines might desire at some time in the future. Note that the list does not set out to be all-inclusive or to preclude other features. Also, it is possible that one or more of these features may find immediate application in special circumstances. Later, industry standardization of their use may prove desirable.

3.0 SYSTEM DESIGN CONSIDERATIONS (cont'd)

In order to make this information as useful as possible at this time, pins have been reserved on the FMC service connectors for these features.

a. Omega Interface

b. MLS Interface

c. Spares (2)

3.7 Sensor Failures

In all cases of sensor input failure, suitable sensor failure warning and degraded status annunciation should be provided.

3.8 FMC Equipment Accuracy

The airlines desire that the airborne FMC equipment contribute as little error as possible to the overall FMC system error.

FAA Advisory Circular No. 90-45A is one source of accuracy information. Equipment designers should be aware, however, that the airlines' accuracy needs may be more demanding than this.

3.9 System Status Alert

Any change of status that results in reduced system operational capability or availability should be annunciated to the pilot on, or adjacent to, primary flight instruments. Additional data of use in diagnosing the reason for the change will be of value if it can be displayed on the CDU. Means should be provided to cancel the alert.

COMMENTARY

> The system status alert is designed only to attract the attention of the pilot to the fact that something has happened either within the system or to one of the sensors that has degraded or will degrade the operational viability of the system. It will be necessary for the pilot to look for further signs to determine the actual problem and whether or not he can correct it.

4.0 STANDARD SIGNAL CHARACTERISTICS

4.1 General Accuracy and Operating Ranges

The purpose of this section is to set forth the detailed characteristics of the electrical signal standards and interfaces of the Flight Management Computer System. Although the actual applications of these standard signal characteristics were set forth in other sections of this Characteristic, this section tabulates the detailed signal characteristics in order to facilitate their use by the reader.

The accuracies specified herein should apply under all combinations of the environmental conditions referenced in Section 2.5 of this Characteristic. Accuracy measurements should be made on the assumption that the inputs to the FMC are perfect. Accuracies are specified on the basis of 95% of observations and do not include typical reading inaccuracies of the pilot’s instruments.

4.1.1 Resolution

For the purposes of this Characteristic, the resolution or the function threshold sensitivity, is considered to be the maximum cyclic input change (double amplitude) that can occur without detectable change in the output. The specific figures set forth for threshold sensitivity of each function should be made without vibration of any kind being applied and it should be checked approaching the reading with signals from either direction.

4.1.2 Standardized Signals

As explained in Section 2, all of the electrical inputs and outputs from the system will be in the form of a standard digital format or a standard switch contact. Standards must be established exactly to assure interchangeability of interwiring, and therefore, the necessary interchangeability of equipment.

Certain basic standards will be established herein, applicable to all outputs. Unless otherwise specified in the detailed material of Section 4.2 and 4.3, signals should conform to the standards set forth in the subparagraphs herein.

4.1.2.1 Digital Data Standards

All digital data is to be transmitted and received using the standard digital data format as defined in Attachment 2, "Data Standards", of ARINC Specification 429.

4.1.2.2 Standard "Applied Voltage"

The standard "applied voltage" is a nominal +27.5 VDC signal. This voltage is considered "to be applied" when the actual voltage under the specified load conditions exceeds 18.5 VDC (+36 VDC maximum) and is considered to "not be applied" when the potential on this lead drops to 3.5 VDC or less, when loaded with 50,000 ohms or more.

4.1.2.3 "Standard Ground" Signal

The "Standard Ground" signal may be generated by either a solid state or mechanical type switch. In either case, a "contact potential" or residual voltage of 3.5 volts or less represents the "grounded" condition.

4.1.2.4 "Standard Open" Signal

The "standard open" signal may be generated by a solid state switch or an open circuit. In either case, the circuitry should be designed such that the impedance is greater than 100,000 ohms when measured at 31 volts DC.

4.2 Data Signals

Data signaling for inputs and outputs to the FMC should be in the low speed ARINC 429 formats, except where otherwise specified in the following sections. The data signals are called out in Attachment 4 to this Characteristic.

4.2.1 FMC Digital Data Inputs

The following sections describe the FMC’s digital data input ports. It is unlikely that all of these inputs will be employed in a given installation and those not needed in a particular aircraft type need not be implemented in the computer. However, hardware, software and computer cycle time capacity should be available to allow all of them to be brought into use if needed.

COMMENTARY

> Providing for FMC interchangeability across different aircraft types in a users fleet may generate the need for the computer to offer more input capacity than needed on any one of those types.

4.2.1.1 VOR Input Ports

Two input ports are provided to receive data from dual ARINC 711 VOR Receivers.

4.2.1.2 DME Input Ports

Two input ports are provided to receive data from dual ARINC 709 DME Interrogators.

4.2.1.3 ILS Input Port

One input port will receive data from an ARINC 710 ILS Receiver.

4.2.1.4 Air Data Input Ports

Two input ports will receive data from dual ARINC 706 Air Data Systems.

4.2.1.5 IRS/AHRS Input Ports

Three input ports will receive data from ARINC 704 IRS or ARINC 705 AHRS. These are high speed ARINC 429 inputs.

4.0 STANDARD SIGNAL CHARACTERISTICS (cont'd)

4.2.1.6 Flight Control System Input Ports

One input port will receive data from an ARINC 701 Flight Control System glare shield controller.

4.2.1.7 Control Display Unit Input Ports

Two input ports are provided to receive data from one or two CDUs. One of these ports is designated the "on-side" port and the other is designated the "off-side" port (see Attachment 2 to this document).

4.2.1.8 Data Update Input Ports

Two input ports are dedicated to receive data to update bulk storage integral to the FMC. One of these ports is intended for an interface with a loading device of the type described in ARINC Report 603. The characteristics of the digital data transmission on this bus are defined to the extent necessary in that document. With certain minor exceptions, this definition follows the rules for file data transfer set forth in ARINC Specification 429.

The second input port is dedicated to an input from ACARS air-ground-air data link avionics. The electrical characteristics of this interface should conform to ARINC Specification 429. The data rate, word format and coding standards are defined in ARINC Characteristic 724 (ACARS). Excerpts from that document are reproduced in Attachment 8 for reference.

4.2.1.9 Intersystem Data Input Port

One input port provides the intersystem comparison data received from a second FMC.

COMMENTARY

> As an alternative to ARINC 429, a faster intersystem data bus may be necessary. Also refer to sections 4.2.2.1 and 4.4.

4.2.1.10 Propulsion/Configuration Data Input Ports

Six input ports are provided for engine and fuel flow and quantity parameters and data received from the Thrust Control Computer (TCC).

NOTE: It is intended that four of these ports should be assigned for receiving individual engine and fuel flow data from up to four engines or fuel systems. The remaining two ports would normally receive other data such as thrust limit, fuel quantity and TCC data.

4.2.1.11 Electronic Flight Instrument System Input Ports

One input port is provided for data from an Electronic Flight Instrument system. Connector pins are reserved for an input port for data from a second EFI system.

4.2.1.12 Digital Clock Input

One input port is provided for data from a digital clock. The clock input may be provided from a GNSS source.

4.2.1.13 Reserved Ports for Growth Inputs

Four input ports are reserved for inputs from the following systems: (i) Omega, (ii) MLS, and (iii) Spares (2).

4.2.1.14 GNSS Input Ports

Two input ports should receive data from an ARINC 743A GNSS Sensor. These may be high or low speed ARINC 429 inputs. The ARINC 743A GNSS Sensor is capable of providing ARINC 429 data in high or low speed format.

COMMENTARY

> Some aircraft manufacturers have assigned the GNSS input ports to pins different to those specified in Attachment 2.

4.2.2 FMC Digital Data Outputs

Nine separate, buffered digital data output ports are provided to drive the CDUs and other subsystems requiring FMC system data. These are: (1) Intersystem, (ii) General Data Output (2), (iii) EFI (2), (iv) CDU Output (2), (v) Data Loader, and (vi) ACARS. The characteristics of the digital data bus(es) carrying data to the CDU(s) are not constrained by this specification, although it is recommended that choices be made which permit the use of ARINC 429, and do not result in a need to make special EMI provisions in the aircraft.

4.2.2.1 FMC Intersystem Output

The FMC should provide a output bus which can be used for intersystem communication from one FMC to another. The characteristics of this bus are constrained by this Characteristic only to the extent that its electrical, logic and timing elements conform to ARINC Specification 429. This is intended to minimize the need for special EMI provisions on the aircraft. Section 4.4 of this document provides guidance on intersystem communications.

COMMENTARY

> It may be necessary to exchange data at higher data rates than possible on an ARINC 429 data bus. In these cases, an alternative data bus may be used. Any alternative data bus should meet the same EMI requirements of ARINC 429.

4.2.2.2 General Data Output #1

This port provides output data from the FMC to Flight Instruments, to radio receivers or frequency management unit for tuning, to the Thrust Control Computer System, Flight Control Computer System and other users. It may also provide initialization data to the IRS. This bus should be output at the low speed rate defined in ARINC Specification 429.

NOTE: The amount of data to be carried on this bus may necessitate the use of high speed operation or a reduction of parameter refresh rates.

4.2.2.3 General Data Output #2

This port provides a second independent, buffered output of the data appearing on General Data Output #1 defined in Section 4.2.2.2 above. In a single FMC installation, it provides data for a second set of flight instruments,

4.0 STANDARD SIGNAL CHARACTERISTICS (cont'd)

4.2.2.3 General Data Output #2 (cont'd)

FCCS and tuning outputs. This bus should operate at the low speed rate defined in ARINC Specification 429.

4.2.2.4 Instrumentation Data Output

Two ports are dedicated to supplying data for the Electronic Flight Instrument systems. These buses should operate at the high data rate defined in ARINC Specification 429.

COMMENTARY

> The specialized design of the FMC/EFI interface (see Chapter 8 of this document for details) makes these outputs unsuitable for supplying other displays such as digital electromechanical instruments. The general data outputs should be used for these purposes.

4.2.2.5 CDU Output Port "A"

This port provides the means for the FMC to supply data for display, etc. to the primary CDU for the system.

4.2.2.6 CDU Output Port "B"

This port provides the means for the FMC to supply data to a second CDU, if installed.

4.2.2.7 Data Loader Output

This port provides output data to the data loader, if installed.

4.2.2.8 Data Link Output

One low speed output port is provided for an interface with the downlink portion of the ACARS air-ground-air data link.

4.2.3 CDU Digital Data Inputs

The CDU should provide two digital data input ports. These input ports should be connected to the associated FMC output buses defined in Section 4.2.2.5 of this Characteristic. One of these ports should be designated the "A" port and the other designated the "B" port (see Attachment 2 to this document).

4.2.4 CDU Digital Data Outputs

The CDU should provide an output bus similar to that described in Section 4.2.2 of this Characteristic, which will communicate with the FMC.

4.2.5 FDSU Digital Data Input (Option)

Section deleted by Supplement 2.

4.2.6 FDSU Digital Data Output (Option)

Section deleted by Supplement 2.

4.3 Control Signals

FMC control signal inputs and outputs will be as specified in ARINC Specification 429, except where otherwise specified in the following section.

4.3.1 Digital Control Inputs

Control inputs to the FMC system should be implemented through the digital input ports specified in Section 4.2.1 of this Characteristic and will be in the format specified in ARINC 429, Attachment 2, Table 4.

NOTE: Such inputs may include FMC Mode Control Inputs from the AFS glare shield controller.

4.3.2 Discrete Inputs and Outputs

4.3.2.1 Specifically Assigned FMC Discrete Inputs

4.3.2.1.1 Off-side CDU Enable

This input discrete is provided for use if necessary to enable data entry to the FMC from the off-side CDU (the non-"prime" CDU) in a dual CDU configuration. An open circuit condition indicates the off-side CDU input to the FMC is enabled.

4.3.2.1.2 Autotune Master/Slave Discrete

This input discrete is provided for use, where necessary, in determining which FMC in a dual system configuration has control of navaid autoselection. An open circuit condition indicates that the FMC to which it is applied is in control.

4.3.2.1.3 Oleo Strut Switch

A "standard ground" input will be supplied to the FMC when the airplane oleo strut switch indicates an "on ground" condition.

4.3.2.1.4 Maintenance Test Discrete

The FMC should accept an input discrete for initiating a maintenance test. A "standard ground" condition of this discrete constitutes a test command.

4.3.2.1.5 Manual/Auto Discretes

Two input discretes are provided to determine the states of the captain and first officer Manual/Auto tuning switches. A "standard ground" indicates the selection of manual tune.

4.3.2.1.6 MAG/True Input Discrete No. 1

This input discrete is provided to the FMC to indicate whether the navigation outputs should be referenced to magnetic or true north. A "standard ground" condition indicates the selection of the true north reference.

4.0 STANDARD SIGNAL CHARACTERISTICS (cont'd)

4.3.2.1.7 Source/Destination Identifier

Two input discretes are provided to enable the FMC to recognize/encode the SDI code specified in ARINC Specification 429 (see Attachment 2 to this document).

4.3.2.1.8 Navigation Data Base Update Enable

This discrete input is supplied by an external data loader when updated information for the FMC's navigation data base is being delivered. A "standard ground" indicates this condition.

4.3.2.1.9 Operating Program Update Enable

This discrete input is supplied by an external data loader when an updated FMC operating program is being delivered. A "standard ground" indicates this condition.

4.3.2.1.10 Performance Data Base Update Enable

This discrete input is supplied by an external data loader when updated information for the FMC's performance data base is being delivered. A "standard ground" indicates this condition.

4.3.2.2 Reserved FMC Discrete Inputs for Future Specific Assignments

Three inputs should be reserved for future assignment to specific discrete functions.

4.3.2.3 Reserved FMC Discrete Inputs for Application-Unique Functions

Twenty-three inputs should be reserved for discretes to control unique functions defined by the FMC software. These functions may be standardized among certain aircraft types (e.g., derivatives) of one manufacturer. Their standardization across different manufacturers' aircraft types, however, is unlikely.

4.3.2.4 FMC Discrete Outputs

4.3.2.4.1 CDU Message Alert Discrete

The FMC should provide a "standard ground" output discrete for activating a "CDU message alert" annunciator when it is necessary to draw the flight crew's attention to a message displayed on the CDU.

4.3.2.5 CDU Discretes

4.3.2.5.1 CDU Active Input Identification Discrete

A discrete input to the CDU should be provided to enable it to determine which FMC data input port to activate. A "standard open" should indicate that it should activate the port connected to the FMC for which it is the primary CDU.

4.3.2.5.2 CDU Primary/Secondary Status Input Discrete

An input discrete to the CDU should be provided to define the CDU as primary or secondary. An open circuit condition signifies primary status.

4.3.3 Digital Control Outputs

Control outputs to the CDU and other systems are to be implemented in the digital format specified in ARINC 429, Attachment 2, Table 4.

4.3.4 FMC "Data Loader Connected" Function

Connection of an external data loader to the FMC will result in a short circuit appearing between pins MP9J and MP9K of the computer's service connector. This information may be employed in the FMC in any way the designer deems appropriate.

4.4 FMC/FMC Intersystem Communications

As noted in Section 4.2.2.1 describing FMC Intersystem Output, FMC/FMC intersystem communications are not defined in this document. The formats and data content should be optimized by the system implementer to support system synchronization, including, but not limited to, the following:

Navigation Cross Check - used to monitor independent navigation calculation and improve the integrity of the navigation solution.

Data Entry Transfer - used to ensure that data entries and selections are reflected in all FMCs.

Radio Tuning Coordination - used to ensure that each FMC tunes a different set of radio sensors (if possible) to ensure navigation independence.

Status Information - used to synchronize mode of operation such as phase of flight, active flight plan leg, navigation status and other events.

Sensor Data - used to transfer data from some inputs, cross check discretes, confirm sensor faults, etc.

4.5 FMC/ACARS Interface

The FMC interface with ACARS data link equipment should function as described in ARINC Specification 619, "ACARS Protocols for Avionic End Systems" and Attachment 8A of this Characteristic.

5.0 CONTROL DISPLAY UNIT (CDU) DESIGN

5.1 General

The CDU should contain all the electronic circuitry, etc., required to display all specified input/output parameters, and should provide all necessary controls for complete operation of the FMC System, other than those referred to in Section 4.3.1 of this Characteristic.

COMMENTARY

> The CDU display should provide sufficient data display space to provide efficient, yet uncluttered, display of all data required for the mode or function selected. This should take into account such things as required performance parameters for a multi-engine transport, flight progress data pages, etc. An object of the design should be to reduce to a minimum the pilot workload in searching through various pages for the required data, while striking a balance with the readability of the data on each page. System designers should provide some form of annunciation on the CDU to indicate when the data page selected for display does not relate to the active leg or engaged mode.

5.2 Form Factor

The CDU should be configured as a Dzus-mounted panel as shown in the outline control drawing in Attachment 1B to this document.

5.3 Cooling

The thermal design of the CDU should be in accordance with Sections 2.3.3.6 and 3.10 of ARINC Specification 408A. Unwanted heat generated in the equipment should be conducted to the outer surface of the case, from where it may be removed by convection and radiation (see Section 2.5.1.2 of this document).

5.4 Panel Illumination

The Control Display Unit should be of the integrally lighted type designed to operate from the 5 volt panel light dimmer bus. In addition, the CDU should accept a lamp test discrete input from the master bright/dim/test system on the aircraft.

COMMENTARY

> A long-term goal of the airlines is to have all push-button, display and panel lighting intensities controlled from a central dimmer.

5.5 Keyboard

The CDU keyboard should have alpha-numeric capability.

COMMENTARY

> During overall system design, manufacturers should investigate methods of reducing crew workload to the minimum consistent with operational needs.

5.6 Mode and Function Controls

The type of mode or function control employed (rotary knobs, push-buttons, reconfigurable keyboards, etc.) is not specified by this Characteristic.

NOTE: The FMC system described by this Characteristic is expected to be part of an avionics system which is considerably more integrated than on current airplanes. Hence, in choosing a mode control medium, designers should take into account the active and passive roles of the CDU during system cross-fill or cross-control operation, bulk data update, and mode control from other systems, such as the FCCS controller.

5.7 CDU Interface

The CDU is interfaced with the FMC via the inputs and the outputs defined in Sections 4.2.3 and 4.2.4 of this Characteristic, respectively. There are two optional interface configurations for the CDU:

a. One CDU dedicated to one FMC.

b. Two CDUs controlled by one FMC.

The FMC may have a discrete input as defined in Section 4.3.2.2 to allow for external selection of a master CDU.

5.8 CDU Confidence Test

The CDU may have a test push-button or other means of control which will initiate a pilot confidence test of the CDU display, push-button lights, and status indicators.

6.0 DATA BASE STORAGE CONSIDERATIONS

6.1 Performance Data

The airplane performance and engine data should be stored such that it is protected from any change during updating of the navigation data. Certain of the performance data parameters, as determined by the particular airframe manufacturer and system manufacturer and primarily used for initialization purposes should be accessible for modification at the CDU. The remainder of the stored performance data should be inaccessible for update from the CDU, unless specific precautions are included to ensure that modification to the data can only be performed during ground or bench maintenance action. It should be possible to store some parameters with variations for different airplane or engine types. These should be differentiated by program pin combinations. The pins reserved for this function are shown in Attachment 2 to this Characteristic.

NOTE: Should the system designer elect to include, in a single software package, performance data and computation for several aircraft and engine types, even involving different airframe manufacturers, he should take into account the logistic and workload burden which may be imposed when testing the system during maintenance at airline or airframe manufacturer level. He should also be aware of the possible proprietary nature of the performance data which may be included.

6.1.1 Performance Data Update

It is not expected that, once installed, performance data will need updating very frequently. In addition to that data accessible for change via the CDU, means must be provided via ground support equipment for update of all performance data. However, it is not necessary for all stored performance data to be accessible for verification on the CDU.

6.2 Navigation Data

The navigation data base storage capacity should be sufficient to store all navigation data required to support the needs of an air carrier operator. It should be accessible for update without removing any LRUs from the airplane.

COMMENTARY

It is imperative that delays in display of data following recall, etc. are reduced to a minimum. Efficient data stacking and consequent reduction in track searching time will help this. The use of integral data base storage will further assist this and may also reduce the cost of the installed system. In view of the fact that several different technologies now exist to permit design of rapid access storage of sufficient capacity to handle all FMC system data base storage requirements integral with the computer, system manufacturers are urged to investigate such a design.

In order to reduce the airline maintenance costs for update of the navigation data, consideration should be given during system design to provide a separate section of data storage for "tailored" airline data, such as company routes, etc. These are not expected to change as frequently as the normal update cycle and thus may be suitable for maintenance by the airline. It is anticipated that, by this method, all data subject to cyclical update will be "standard" published navigation data, thus providing means to further reduce the airline maintenance cost.

NOTE: If this feature is implemented, system designers must provide means for verification of the correct effect of changes made to the tailored data. As an example, if a change is made to a company route, it must be verified that entering the route identifier will result in the assembly of data which is valid and which defines a continuous flight path.

7.0 PROVISIONS FOR AUTOMATIC TEST EQUIPMENT

7.1 General

To enable Automatic Test Equipment (ATE) to be used in the bench maintenance of the ARINC 702 Flight Management Computer, those internal circuit functions not available at the FMC service connector and considered by equipment manufacturers to be needed for automatic test purposes should be brought to pins on an auxiliary connector of a type selected by the equipment manufacturer for this purpose. This connector may be fitted with only that number of contacts as there are functions to be brought to it, and should be provided with a protective cover suitable to protect these pins from damage, contamination, etc., while the unit is installed in the aircraft. The manufacturer should observe ARINC Specification 600 standards for unit projections, etc., when choosing the location for this auxiliary connector.

7.2 Unit Identification

Six pins on the ATE connector insert should be reserved for the implementation of a "resistance coding" scheme for unit identification by the ATE, in which a 1% tolerance resistor is connected from each pin to a common ground in a "star" formation. Values selected should correspond to the standard 10% increments in resistance in order to prevent ambiguities resulting from tolerance build-up and aging. The power handling capability of each resistor need not exceed 0.1 watt.

7.2.1 Pin Allocation

Two pins should be allocated to each of the following functions and one pin to the "star formation common" (i.e., DC chassis ground).

a. Manufacturer Identification (resistor values to be registered with the AEEC staff when selected)

b. Part No. or Type No. of the Equipment

c. Modification Status of the Equipment

IMPORTANT NOTE: Resistor codes for manufacturer identification will be recorded by the AEEC staff in order to prevent duplication. Such registration, however, should not be confused with assignment. It is the responsibility of each manufacturer to select a code and inform the AEEC staff of his choice. Code assignments for equipment part number and modification status are entirely the province of the manufacturer and do not require registration with the AEEC staff.

7.2.2 Use of ATLAS Language

Equipment manufacturers should note that the airlines desire to have FMC test procedures intended for execution by automatic test equipment written in the ATLAS language described in ARINC Specification 616, "Avionics Subset of ATLAS Language".

8.0 ELECTRONIC FLIGHT INSTRUMENT INTERFACE

8.1 Introduction

The navigation data base stored in the ARINC 702 Flight Management Computer may, together with computed guidance data, be used to support the operation of a map display on an electronic horizontal situation indicator or other electronic display in the cockpit. This section of this Characteristic describes interface standards which will enable any manufacturer's FMC to be used with any manufacturer's electronic display. The term Electronic Flight Instrument (EFI) will be used to describe such displays generically.

8.2 FMC Outputs to EFI

Two high speed ARINC 429 data output ports are provided on the FMC for instrumentation supply. All of the map background and position updating (dynamic) data for two EFIs will be supplied from both of these ports. In an installation comprising one FMC and two EFIs, the FMC's #1 Instrumentation Output should be connected to the Captain's EFI, and its #2 Instrumentation output to the First Officer's EFI. A possible interconnection scheme in an installation comprising two FMCs and two EFIs is to connect the #1 output of FMC #1 and the #2 output of FMC #2 to the Captain's EFI and the #1 output of the FMC #2 to the #2 output of FMC #1 to the First Officer's EFI.

COMMENTARY

> The foregoing data output arrangements permit one FMC to supply independently organized data to each of two EFIs. While the word formats of the individual data elements crossing the interface are not map scale dependent, the total number of data words needed to construct the map does vary with the map scale selected. The FMC can thus accommodate the generation of maps on both sides of the cockpit even when the Captain and the First Officer have selected different scales.

8.3 FMC Inputs From EFI

The FMC provides two low speed ARINC 429 data input ports through which map mode, scale and symbol option selections are transferred from the EFIs to the FMC.

8.4 EFI Design Features

The following EFI design features impact the design of the FMC/EFI interface.

8.4.1 Map

The EFI will generate a dynamic map positioned relative to the aircraft. The map may be oriented with respect to aircraft track or heading.

8.4.2 Plan

The EFI may also generate a north-oriented static map positioned relative to reference points selected at the FMC Control Display Unit (CDU). This may be used by the flight crew to verify the correct insertion of flight plan waypoints and other data.

8.4.3 Map Scales

EFI map scales will be a compatible subset of the ARINC 708 Weather Radar, which has selectable ranges, in five-mile increments, from 10 to 320 nautical miles of look-ahead.

8.4.4 Map Projection

The EFI will transform earth coordinate data received from the FMC into flat plane coordinates for the map display. The accuracy of this transformation will be such that the EFI can be used as a primary instrument for guiding the aircraft along great circle and circular transition flight paths, and provide accurate registration of planar weather radar data on the map display. The map projection method chosen is expected to permit worldwide EFI usage without latitude restrictions.

The EFI will also ensure that vector lines and conics which cross display editing boundaries are correctly terminated to ensure a continuous and accurate presentation on the display. The EFI will translate the map background to account for aircraft motion between map background data block transmissions based on aircraft position and angular data received from the FMC and other systems.

8.4.5 Option Selection

The EFI will provide for symbology option selections, including weather radar data overlay on the map. These will allow the flight crew to declutter the map by selectively removing different categories of data, e.g., Navaids, Airfields, Geographic Reference Points, Waypoint Definition Data, etc..

8.4.6 Symbol Repertoire

Each category of data shipped from the FMC for display on the EFI will call for a distinctive symbol on the display. A list of potential data categories includes, but is not necessarily limited to, the following:

Primary Flight Plan Path
Secondary Flight Plan Path
Altitude Intercepts
Time Schedules
Waypoints
Waypoint Data (altitude, speed, time)
Origin and Destination Airports
Special Reference Points
Runway Data
Marker Beacons
Tuned Navaids
Navaids, including VORTAC, VOR, DME/TACAN (high altitude and low altitude)
VOR Radials
Airports
Geographic Reference Points
ILS Data
MLS Data
Non-Directional Beacons (NDB)
Navigation Data

8.0 ELECTRONIC FLIGHT INSTRUMENT INTERFACE (cont'd)

8.4.6 Symbol Repertoire (cont'd)

The data available for display in a particular installation will depend on the navigation data base content of the FMC. The above data categories fall into the following general symbology types, each of which requires different data parameters for definition via the FMC/EFI interface.

Vectors (straight lines)
Conics (circular arc lines)
Upright Symbols
Rotated Symbols
Dynamic Symbols
Alpha/Numeric Data Readouts

8.4.7 EFI Data Conditioning

The EFI will perform any input data filtering needed to produce a smoothly changing map display, and will condition data used to update readouts on the display.

8.5 FMC Design Features

The following FMC design features impact the design of the FMC/EFI interface.

8.5.1 Navigation Data Base

The navigation data base stored in the FMC will be derived from ARINC 424 data, but will be customized by each FMC manufacturer to be compatible with his computer and memory architectures. However, the data base will include standard navigation data types, including VORTAC, VOR, DME/TACAN, airfields, runways, and geographic reference points (GRPs) such as intersections, named waypoints, etc., which can be presented on a map display. The data base may also contain standard, government-published sequences of waypoints such as airways, SIDS, STARS, etc., as well as tailored waypoint sequences (company routes).

8.5.2 Flight Plans

As part of its guidance function, the FMC will have flight plans assembled in its guidance buffers by pilot data entry and selection through the CDU. Such flight plans will define paths in the sky in two, three and ultimately four dimensions. Accurate representation of aircraft position with respect to the flight plan path is essential when the EFI is used as the primary instrument by which the flight crew controls the aircraft laterally and vertically with respect to a three-dimensional path, and along that path to make good assigned times at waypoints.

Flight plan paths can be presented on the EFI as sequences of lines and conics representing great circle paths between waypoints and curved transitions between path legs. Path legs consisting of DME arcs can also be displayed. The FMC generates the necessary data to define four-dimensional flight plans in its guidance buffers. The guidance algorithms in the FMC calculate the position, speed and time differences between the aircraft state vector and the flight plan, and hence generate the guidance commands to the automatic flight control system (including the auto-throttle) to make good the flight plan.

The guidance data can be used to define the vector lines and conics needed to represent the flight plan path and other guidance symbology on the EFI.

8.5.3 Map Display Edit Areas

The FMC should, to the extent of the limitations imposed by the size of the data block (see Section 8.6.2), supply map background data for an area large enough to preclude the appearance of blank screen between transmissions. The EFI will limit the data displayed to that needed for the viewing window. This limit operation will include vector clipping to ensure the correct display of vector data and associated text.

8.6 Interface Design

The design of the FMC/EFI interface is described in the following paragraphs.

8.6.1 General

Map background data and position updating and other dynamic data should be interleaved on the FMC instrumentation output buses. The FMC should specify the data type to be displayed and the associated positioning and rotation data. The EFI will control symbology color, size, brightness, blinking and related parameters, and transform map position data received from the FMC into screen coordinates.

The FMC should extract the information necessary for the map background from its navigation data base and flight plan buffers. Position data transmitted to the EFI should be in latitude and longitude coordinates. The types of data transmitted should respond to mode symbology options and display range selected by the flight crew on the EFI control panel. The order of the data on the bus should be in general accordance with the priority in which it is to be displayed.

The FMC/EFI dynamic data interface should be designed to permit updating of the map background data positions between background data block transmissions without the need for a hand-shaking relationship between the FMC and the EFI symbol generator.

The FMC/EFI interface design and map background and dynamic data bus implementation should be such that the EFI can provide a valid map display if map background data transmissions are lost or invalid for periods of up to 10 seconds duration.

The display mechanization should accommodate a worldwide map projection. This may result in the need to provide additional and/or special software to project map data in the vicinity of the earth's poles.

8.6.2 Map Data Updating

The FMC should supply map data to the EFI in alternating 64-word blocks of background and dynamic data until a complete map background data block (512 words maximum) has been transmitted (see Attachment 6, Figure 2). After completion of the map background data transmission, the dynamic data should continue to be

8.0 ELECTRONIC FLIGHT INSTRUMENT INTERFACE (cont'd)

updated at a rate of 20 times per second (nominal) until a new map background data block is to be transmitted. Map background data should be updated and transmitted once every three seconds (nominal), except that when a mode, scale or option change is made on the EFI, the FMC should update and transmit new map background data within one second (maximum).

COMMENTARY

> Dynamic data update at a rate greater than 16 times per second is needed to avoid undesirable visual effects on the display.

8.6.3 Background Data Prioritizing

To ensure that writing time or other internal data processing limitations in the EFI do not result in most wanted map background data not appearing on the display, the FMC should prioritize the information as follows. The EFI should truncate the data, if necessary, in the reverse order of this prioritization.

1. Flight Plan Data
   a. Primary Flight Plan
   b. Secondary Flight Plan
   c. Flight Plan Changes
   d. Waypoints
   e. Waypoint Data
   f. Offsets
   g. Altitude Intercepts
   h. Flight Plan Events
2. Selected Reference Points
3. Runway Data (may be edited out in some flight phases but should not disappear because of truncation of the data stream)
4. Origin and Destination Airports
5. Tuned Navaids
6. Navigation Data (may be dynamic rather than background)
7. Non Flight Plan Navaids
8. General Reference Points (position ordered)
9. Procedures
10. Terrain Data

8.6.4 Background Data Editing

An example of the background data editing process is shown in Attachment 6, Figure 1. The FMC should, as a minimum, transmit data for the displayed area plus the area which could appear on the display as a result of aircraft translation and rotation between map background data updates. There is a 1000 to 1 increase in these areas between the expected minimum and maximum map scales of 10 to 320 nautical miles.

Because the density of data needed for terminal operations could saturate the display at the higher map scales and the volume of data within the edit area overload the EFI symbol generator buffers, the FMC should determine the amount of data it supplies to the EFI from an analysis of the map scale and mode selection information it receives from the EFI. Typically, the high map scales are used in cruise and the low map scales are used for terminal area operations. Therefore, only high altitude chart data need be transferred across the interface for the larger map scales.

8.6.5 Mode Change Response

The FMC should respond to a mode, scale or symbology option selection change received from the EFI such that the desired data transmission occurs within one second maximum.

COMMENTARY

> Airlines desire the overall (FMC and EFI) response time of a practical system to be less than two seconds.

8.6.6 Map Translation and Rotation Data

The FMC should provide the following data to the EFI to support map projection and rotation functions:

Map Projection

Map Background Data

1. Map reference latitude (plan mode only)
2. Map reference longitude (plan mode only)
3. Map mode/scale

Map Position Data

1. Aircraft present latitude
2. Aircraft present longitude

Map Rotation

Map Position Data

1. Track (true)
2. Track (magnetic)

8.6.7 Resolution

The resolution of data used to position symbology on the display should be such that a change of binary state of the least significant bit of a position data word produces no visible step movement on the display.

8.6.8 Interface Data Errors

The mechanization of the FMC/EFI interface should minimize the visual effects on the map display of occasional data errors.

8.6.9 FMC-to-EFI Data Transfer Protocol

Because the FMC/EFI interface is dedicated to the transfer of data between the FMC and the EFI symbol generator(s), not all of the formatting and protocol standards of ARINC Specification 429, "Mark 33 Digital Information Transfer System (DITS)", have been adopted

8.0 ELECTRONIC FLIGHT INSTRUMENT INTERFACE (cont'd)

8.6.9 FMC-to-EFI Data Transfer Protocol (cont'd)

for it. The following Sections indicate where these departures from ARINC Specification 429 have been made. Although not mentioned hereafter, the electrical and timing standards set forth in Specification 429 for high speed (100 k bits/second) operation and the standard "broadcast" protocol do apply.

8.6.9.1 Data Block Format

The first word of each 64-word data block should be a "Start of Transmission" word containing octal code 301 in its label field (bits 1 through 8) if the block contains map background data and octal code 303 in this field if the block contains dynamic data. Bits 9 through 13 of each map background data block "Start of Transmission" word should contain a binary number indicating the position of the block in the sequence of such blocks into which the transmission is divided. In addition, the first such "Start of Transmission" word of a transmission should contain in bits 20 through 29 a binary count of the total number of usable background data words to be contained in the transmission. (This count should not include "Start of Transmission", "End of Transmission", or fill-in words.) This field should contain binary zeros in all subsequent background data block "Start of Transmission" words of the transmission. All background data block "Start of Transmission" words should contain binary zeros in bits 14 through 19, while bits 30 and 31 should contain the "control word" code defined in Section 8.6.9.2 and bit 32 should be set to render word parity odd.

The "Start of Transmission" word of each dynamic data block should contain binary zeros in bits 9 through 29 and the "control word" code defined in Section 8.6.9.2 in bits 30 and 31. Bit 32 should be set to render word parity odd.

The last word of each 66-word map background data block should be an "End of Transmission" word containing octal code 302 in its label field. Bits 9 through 29 of this word should contain binary zeros. Bits 30 and 31 should contain the "control word" code defined in Section 8.6.9.2 and bit 32 should be set to render word parity odd.

The 62 usable data words of each map background data block should contain the positional, character and control information used by the EFI to construct the map background. The label codes and word formats defined in Attachment 6 to this document should be used. Bits 30 and 31 should be encoded to indicate word type per Section 8.6.9.2 and bit 32 should be set to render word parity odd. If the final block of the transmission contains less than 62 useful words, it should be padded to this length with fill-in words (binary zeros in bit positions 1 through 32) and terminated with the "End of Transmission" word at position 64.

Dynamic data blocks should be interleaved with map background data blocks as described in Section 8.6.2. Dynamic data blocks should contain data words labelled and formatted per ARINC Specification 429.

COMMENTARY

> The interleaving on the same bus of blocks of data labelled per ARINC 429 standards and blocks of data labelled per other standards requires the EFI to be capable of changing from one set of standards to the other at appropriate instants during the data transmissions. The EFI is expected to make use of the two "Start of Transmission" words and the background data block "End of Transmission" word in deciding when to make these changes.

8.6.9.2 Data Type Word Formats

The general word format defined in ARINC Specification 429 should be employed. Words transmitted by the FMC for which standards are defined in ARINC Specification 429 should employ those standards and their ARINC 429 labels. Formats of symbol word groups, vector word groups, map reference word groups and dynamic symbol words should differ from ARINC 429 standards in that the label field should be used to encode data type and the sign/status matrix to designate multiple word records within a data type group as follows:

BIT		WORD DESCRIPTION
31	30	
0	1	First word of data type group
0	0	Intermediate positional, character words
1	1	Control words (symbol rotation and vector conics)
1	0	Last word of data type group

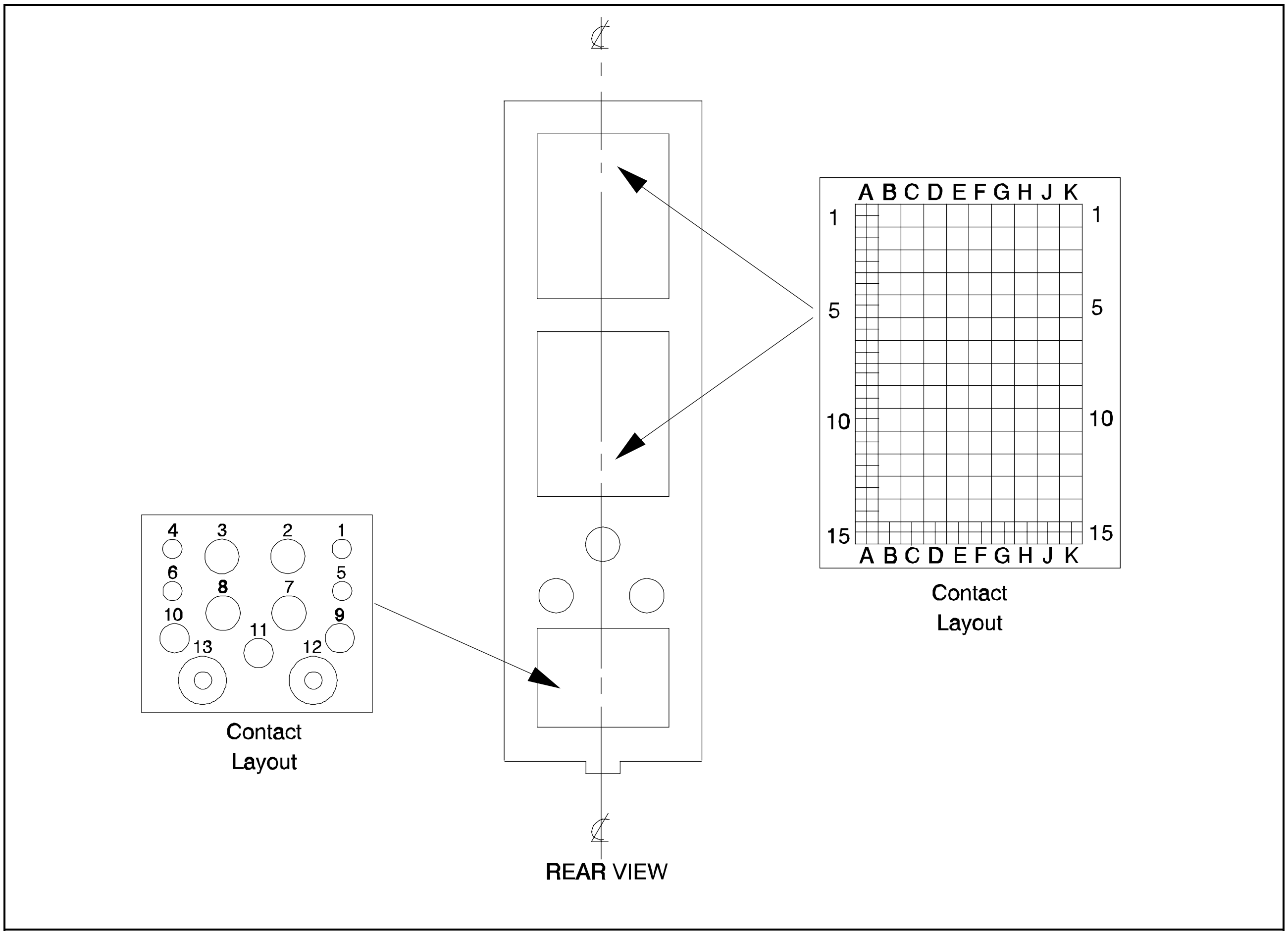
Attachment 6 to this document sets forth the formats of these non-ARINC 429 words.

8.6.10 EFI-to-FMC Data Transfer

The data sent from the EFI to the FMC will consist of the map mode, scale and symbol option selections made by the flight crew at the EFI control panel. These selections will be encoded into one or more ARINC 429 discrete words, as defined in that specification and in ARINC Characteristic 725, "Electronic Instrument System".

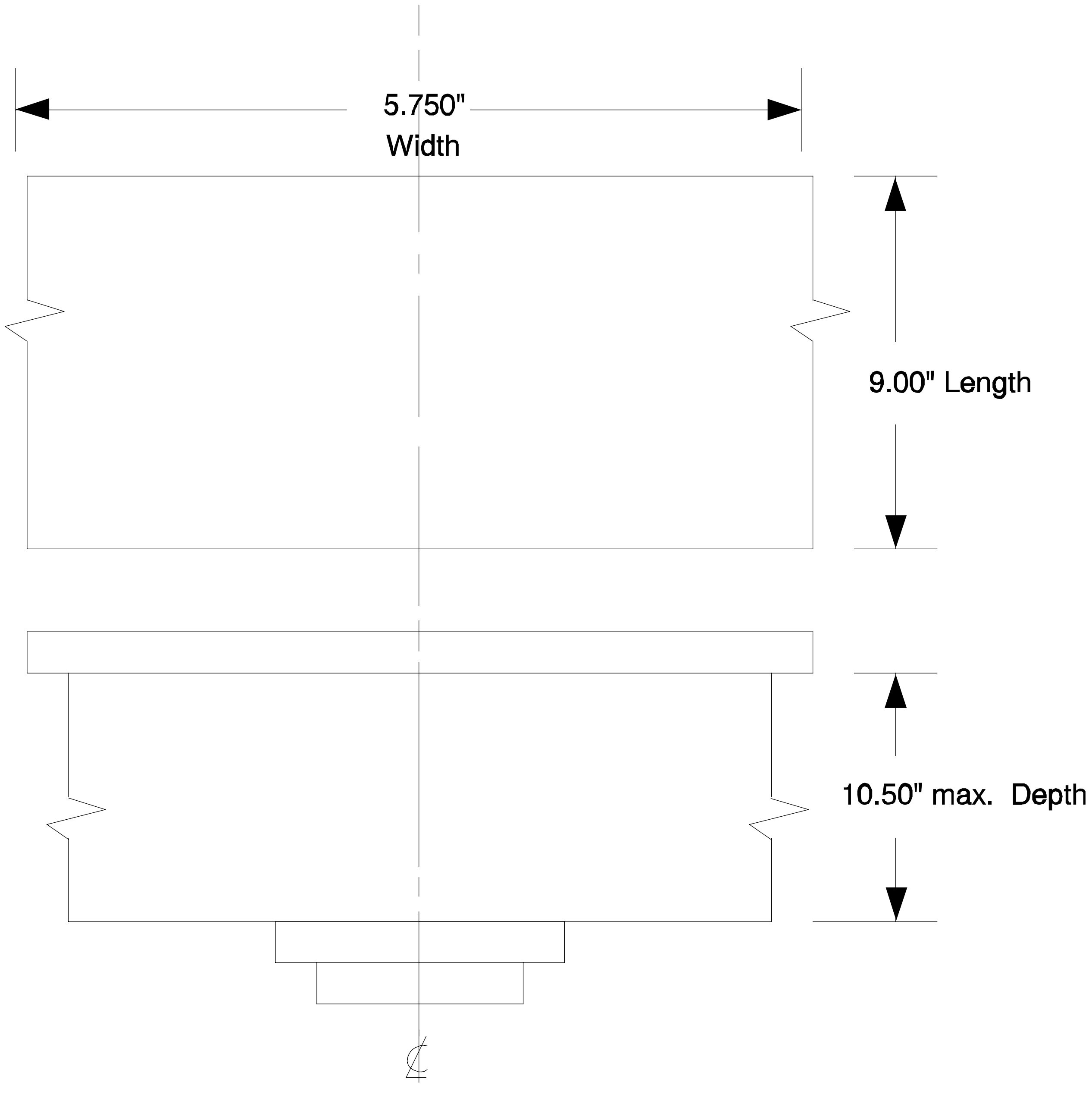
ATTACHMENT 1A

FMC CONNECTOR POSITIONING



ATTACHMENT 1B

CONTROL/DISPLAY UNIT (CDU)



ATTACHMENT 1C

FDSU CONNECTOR POSITIONING

Deleted by Supplement 2

ATTACHMENT 2
STANDARD INTERWIRING ⟨1⟩ ⟨2⟩

Function		Wire I/R ⟨6⟩ *	FMC	CDU**	Other
VOR Omni-Bearing	A	D-5	TP1A		MP4A ARINC 711
Input #1	B	D-5	TP1B		MP4B VOR #1
Future Spare			TP1C		
DME Distance	A	D-5	TP1D		MP3G ARINC 709
Input #1	B	D-5	TP1E		MP3H DME #1
Future Spare			TP1F		
ILS	A	D-5	TP1G		MP11B ARINC 710
Input	B	D-5	TP1H		MP11C ILS
Future Spare			TP1J		
Oleo Struct.Discrete Input		D-5	TP1K		To Oleo Struct Switch
Future Spares			TP2A		
			TP2B		
			TP2C		
			TP2D		
			TP2E		
			TP2F		
			TP2G		
			TP2H		
			TP2J		
			TP2K		
IRS/AHRS	A	0.1-2	TP3A		To ARINC 704 IRS or
Input #1	B	0.1-2	TP3B		ARINC 705 AHRS #1
Future Spare			TP3C		
GNSS Sensor	A	0.1-2	TP3D		To ARINC 743A
Input #1	B	0.1-2	TP3E		GNSS #1
Future Spare			TP3F		
Propulsion Data	A	0.1-2	TP3G		To Propulsion Data
Input #1	B	0.1-2	TP3H		Data Source #1
Future Spare			TP3J		
Functional Test Discrete I/P		D-10	TP3K		To Self Test Switch
Future Spares			TP4A		
			TP4B		
			TP4C		
			TP4D		
			TP4E		
			TP4F		
			TP4G		
			TP4H		
			TP4J		
Mag/True I/P Discrete #1		D-10	TP4K		Mag/True I/P #1
EFI	A	0.01-10	TP5A		To EFI Data
Input #1	B	0.01-10	TP5B		Source #1
Future Spare			TP5C		
Fuel Quantity	A	D-5	TP5D		To Fuel Quantity
Input	B	D-5	TP5E		Data Source
Future Spare			TP5F		
Thrust Control	A	0.1-2	TP5G		To ARINC 703
Computer Input	B	0.1-2	TP5H		TCC
Future Spare			TP5J		
Off-Side CDU Enable Disc.		D-10	TP5K		To CDU Select Switch ⟨3⟩
Future Spares			TP6A		
			TP6B		
			TP6C		
			TP6D		
			TP6E		
			TP6F		
			TP6G		
			TP6H		
			TP6J		
RESERVED (Future Discrete)			TP6K		

* Wire I/R values added by Supplement 1

** All CDU connector pin assignments reflect connector type change made in Supplement 1

ATTACHMENT 2 (cont'd)
STANDARD INTERWIRING ⟨1⟩ ⟨2⟩

Function		Wire I/R ⟨6⟩ *	FMC	CDU**	Other
Propulsion Data	A	0.1-2	TP7A		To Propulsion Data
Input #3	B	0.1-2	TP7B		Source #3
Future Spare			TP7C		
Air Data	A	D-5	TP7D		To ARINC 706
Input #1	B	D-5	TP7E		ADS #1
Future Spare			TP7F		
Glare Shield	A	D-5	TP7G		To ARINC 701 Glare
Controller I/P	B	D-5	TP7H		Shield Controller
Future Spare			TP7J		
FMC Master/Slave Disc I/P		D-10	TP7K		⟨4⟩
Future Spares			TP8A		
			TP8B		
			TP8C		
			TP8D		
			TP8E		
			TP8F		
			TP8G		
			TP8H		
			TP8J		
			TP8K		
CDU	A	D-5	TP9A	8	
Data Input	B	D-5	TP9B	9	
Future Spare			TP9C		
Data Update	A	D-5	TP9D		1 Data Loader
Input	B	D-5	TP9E		2 Interface Connector ⟨7⟩
Nav Data Base Update Enable Disc		D-10	TP9F		5
FMC General	A	D-5	TP9G		To Data Utilization
Data Output #1	B	D-5	TP9H		Devices
Future Spare			TP9J		
Man/Auto Tune Disc #1 I/P		D-10	TP9K		To DFS ⟨4⟩
Future Spares			TP10A		
			TP10B		
			TP10C		
			TP10D		
			TP10E		
			TP10F		
			TP10G		
			TP10H		
			TP10J		
			TP10K		
Instrumentation	A	0.01-10	TP11A		To EFI/Instruments
Data Output #1	B	0.01-10	TP11B		
Future Spare			TP11C		
Other CDL	A	D-5	TP11D		8 Other ARINC
Data Input	B	D-5	TP11E		9 702 CDU
Future Spare			TP11F		
Data Output	A	D-5	TP11G		3 Data Loader
to Data Loader	B	D-5	TP11H		4 Interface Connector ⟨7⟩
Future Spare			TP11J		
Man/Auto Tune Disc #2		D-10	TP11K		To DFS ⟨4⟩
Future Spares			TP12A		
			TP12B		
			TP12C		
			TP12D		
			TP12E		
			TP12F		
			TP12G		
			TP12H		
			TP12J		
			TP12K		

* Wire I/R values added by Supplement 1

** All CDU connector pin assignments reflect connector type change made in Supplement 1

ATTACHMENT 2 (cont'd)
STANDARD INTERWIRING ⟨1⟩ ⟨2⟩

Function		Wire I/R ⟨6⟩ *	FMC	CDU**	Other
Data Output	A	D-5	TP13A		MP13G Other ARINC
to Other FMC	B	D-5	TP13B		MP13H 702 FMC
Future Spare			TP13C		
Data Output to	A	D-5	TP13D	2	
CDU (Port "A")	B	D-5	TP13E	3	
Future Spare			TP13F		
Data Output to	A	D-5	TP13G		5 Other ARINC
Other CDU	B	D-5	TP13H		6 702 CDU
(Port "B")					
Future Spare			TP13J		
CDU Message Alert Discrete		D-10	TP13K		To Alert Annunciator
Future Spares			TP14A		
			TP14B		
			TP14C		
			TP14D		
			TP14E		
			TP14F		
			TP14G		
			TP14H		
			TP14J		
			TP14K		
RESERVED for MLS	A		TP15A		
Data Input	B		TP15B		
Future Spare			TP15C		
IRS/AHRS	A		TP15D		To ARINC 704 IRS or
Input #3	B		TP15E		ARINC 705 AHRS #3
Future Spare			TP15F		
RESERVED for	A		TP15G		
OMEGA Data Input	B		TP15H		
Future Spare			TP15J		
RESERVED (CDU Message Origin Disc. O/P)			TP15K		
Propulsion Data	A	0.1-2	MP1A		To Propulsion Data
Input #4	B	0.1-2	MP1B		Source #4
Future Spare			MP1C		
VOR Omni-Bearing	A	D-5	MP1D		MP4A ARINC 711
Input #2	B	D-5	MP1E		MP4B VOR #2
Future Spare			MP1F		
Data Input From	A	D-5	MP1G		TP13A Other ARINC
Other FMC	B	D-5	MP1H		TP13B 702 FMC
Future Spare			MP1J		
SDI Code Input		0.1-1	MP1K		See Note ⟨5⟩
Future Spares			MP2A		
			MP2B		
			MP2C		
			MP2D		
			MP2E		
			MP2F		
			MP2G		
			MP2H		
			MP2J		
			MP2K		
IRS/AHRS	A	0.1-2	MP3A		To ARINC 704 IRS or
Input #2	B	0.1-2	MP3B		ARINC 705 AHRS #2
Future Spare			MP3C		
Digital Clock	A	D-5	MP3D		To Digital
Input	B	D-5	MP3E		Clock
Future Spare			MP3F		
ACARS Data	A	D-5	MP3G		From ACARS
Link I/P	B	D-5	MP3H		Data Link
Future Spare			MP3J		
SDI Code Input		0.1-1	MP3K		See Note ⟨5⟩

* Wire I/R values added by Supplement 1

** All CDU connector pin assignments reflect connector type change made in Supplement 1

ATTACHMENT 2 (cont'd)
STANDARD INTERWIRING ⟨1⟩ ⟨2⟩

Function		Wire I/R ⟨6⟩ *	FMC	CDU**	Other
Future Spares			MP4A		
			MP4B		
			MP4C		
			MP4D		
			MP4E		
			MP4F		
			MP4G		
			MP4H		
			MP4J		
			MP4K		
Propulsion Data	A	0.1-2	MP5A		To Propulsion Data
Input #2	B	0.1-2	MP5B		Source #2
Future Spare			MP5C		
Air Data	A	D-5	MP5D		To ARINC 706
Input #2	B	D-5	MP5E		ADS #2
Future Spare			MP5F		
RESERVED			MP5G		
RESERVED			MP5H		
Future Spare			MP5J		
SDI Code Input		0.1-1	MP5K		See Note ⟨5⟩
Future Spares			MP6A		
			MP6B		
			MP6C		
			MP6D		
			MP6E		
			MP6F		
			MP6G		
			MP6H		
			MP6J		
			MP6K		
RESERVED (Spare	A		MP7A		
Data I/P Port #2)	B		MP7B		
Future Spare			MP7C		
FMC General	A	D-5	MP7D		To Data Utilization
Data Output #2	B	D-5	MP7E		Devices
Future Spare			MP7F		
DME Distance	A	D-5	MP7G		MP3G ARINC 709
Input #2	B	D-5	MP7H		MP3H DME #2
GNSS Sensor	A		MP7J		To ARINC 743A
Input #2	B		MP7K		GNSS #2
Future Spares			MP8A		
			MP8B		
			MP8C		
			MP8D		
			MP8E		
			MP8F		
			MP8G		
			MP8H		
			MP8J		
			MP8K		
Output to	A	D-5	MP9A		To ACARS
ACARS Data Link	B	D-5	MP9B		Data Link
Future Spare			MP9C		
RESERVED (EFI	A		MP9D		
Input #2)	B		MP9E		
Future Spare			MP9F		
Instrumentation	A	0.01-10	MP9G		To EFI/Instrumentation
Output #2	B	0.01-10	MP9H		
"Data Loader		0.1-10	MP9J		11 Data Loader
Connected" I/P		0.1-10	MP9K		12 Interface Connector ⟨7⟩

* Wire I/R values added by Supplement 1
** All CDU connector pin assignments reflect connector type change made in Supplement 1

ATTACHMENT 2 (cont'd)
STANDARD INTERWIRING ⟨1⟩ ⟨2⟩

Function	Wire I/R ⟨6⟩ *	FMC	CDU**	Other
Future Spares		MP10A o		
		MP10B o		
		MP10C o		
		MP10D o		
		MP10E o		
		MP10F o		
		MP10G o		
		MP10H o		
		MP10J o		
		MP10K o		
Operating Pgm. Update Enable Disc.	D-10	MP11A o		o 6 Data Loader Interface Connector ⟨7⟩
Perf. Data Base Update Enable Disc.	D-10	MP11B o		o 7
RESERVED (Application-Unique Discrete Inputs)		MP11C o		
		MP11D o		
		MP11E o		
		MP11F o		
		MP11G o		
		MP11H o		
		MP11J o		
RESERVED (Target Speed Disc O/P)		MP11K o		
Future Spares		MP12A o		
		MP12B o		
		MP12C o		
		MP12D o		
		MP12E o		
		MP12F o		
		MP12G o		
		MP12H o		
		MP12J o		
		MP12K o		
RESERVED (Application-Unique Discrete Inputs)		MP13A o		
		MP13B o		
		MP13C o		
		MP13D o		
		MP13E o		
		MP13F o		
		MP13G o		
		MP13H o		
		MP13J o		
RESERVED (Target N1/EPR Disc. O/P)		MP13K o		
Future Spares		MP14A o		
		MP14B o		
		MP14C o		
		MP14D o		
		MP14E o		
		MP14F o		
		MP14G o		
		MP14H o		
		MP14J o		
		MP14K o		
RESERVED (Application-Unique Discrete Inputs)		MP15A o		
		MP15B o		
		MP15C o		
		MP15D o		
		MP15E o		
		MP15F o		
		MP15G o		
RESERVED (Future Discretes)		MP15H o		
		MP15J o		
		MP15K o		

* Wire I/R values added by Supplement 1

** All CDU connector pin assignments reflect connector type change made in Supplement 1

ATTACHMENT 2 (cont'd)
STANDARD INTERWIRING 1 2

Function	Wire I/R 6 *	FMC	CDU**	Other
115 VAC Primary Power Hot	2-1	BP1		115 VAC 5 AC/B
Future Spares		BP2		
		BP3		
		BP4		
		BP5		
		BP6		
115 VAC Primary Power Cold	2-0.1	BP7		AC Ground
Chassis Ground	2-0.1	BP8		DC Ground
Future Spares		BP9		
		BP10		
		BP11		
		BP12		
		BP13		
		BP14		
5 VAC Panel Light Supply Hot	2-1		28	5 VAC Panel Lamp Supply
Cold			29	
115 VAC Primary Power Hot	1-1		30	115 VAC 2 AC/B
115 VAC Primary Power Cold	1-0.1		31	AC Ground
Chassis Ground	1-0.1		25	DC Ground
Active Port Program	D-0.1		10	
Primary/Secondary Program	D-0.1		11	
RESERVED (FMC Fail Warn Disc I/P)			12	
RESERVED (CDU Fail Warn Disc O/P)			13	
RESERVED (CDU Message Origin Disc I/P (#1 FMC))			14	
RESERVED (CDU Message Origin Disc I/P (#2 FMC))			15	
Lamp Test Discrete I/P	D-10		23	
28 VDC Bright/Dim Lo	D-1		26	
28 VDC Bright/Dim Hi	D-1		27	
Future Spares			1	
			4	
			16	
			17	
			18	
			19	
			20	
			21	
			22	
			24	
Data Input from other FMC	D-5		5	MP7G Other ARINC 702 FMC
	D-5		6	MP7H

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* Wire I/R values added by Supplement 1

** All CDU connector pin assignments reflect connector type change made in Supplement 1

ATTACHMENT 2 (cont'd)
NOTES APPLICABLE TO THE STANDARD INTERWIRING

〈1〉 Standard Interwiring

The standard interwiring shown in this Attachment is for a single FMC installation comprised of one FMC and one CDU. For the sake of completeness, however, wiring is also shown to enable the FMC to operate with a second CDU (see Section 5.7 of this document), and for a cross-talk bus between this FMC and another one.

〈2〉 Shield Grounds

Digital data bus shield grounds should be grounded to aircraft structure at both ends and on both sides of each production break.

〈3〉 Off-Side CDU Enable Discrete

Per Section 4.3.2.2 of this document, this discrete tells the FMC which CDU has control of data entry in dual CDU installations in which either may perform this function. When an open circuit is sensed by the FMC, its "prime" CDU has control. When the wire is connected to ground by means of a cockpit-located switch, or equivalent, the "other" CDU has control.

〈4〉 FMC Master/Slave and Manual Auto Tune Discrete

This discrete is used in dual FMC installations to tell one of them that it has control of the navaid autotune function and that the other does not. The use of the function is controlled by the Manual/Auto discretes, as described in Section 4.3.2.6.

〈5〉 Source/Destination Identifier (SDI) Encoding

Pins MP1K, MP3K and MP5K are assigned for encoding the location of the FMC in the aircraft (i.e., "system number") per Section 2.1.4 of ARINC Specification 429. If the SDI function is used, the following encoding scheme should be employed, the pins designated being either left open circuit or connected, on the aircraft-mounted half of the connector, to pin MP5K. The wiring of these pins should cause bit numbers 9 and 10 of each digital word transmitted by the FMC to take on the binary states defined in ARINC Specification 429. When the SDI function is not used, both pins MP1K and MP3K should be left open circuit such that bit numbers 9 and 10 are always binary "zeros".

FMC No.	Connector Pin	
	MP1K	MP3K
Not Applicable	Open	Open
1	Open	To MP5K
2	To MP5K	Open
3	To MP5K	To MP5K

The foregoing describes the SDI function performed by a data source. ARINC Specification 429 also discusses the data identification function to be performed by sinks whose "system numbers" are encoded in this way. In summary, the FMC should recognize and accept data words in which bit numbers 9 and 10 are either both "zeros" or form the code defined by pins MP1K and MP3K. All other data may be discarded.

〈6〉 Wire Sizes

The "I-R" values define the maximum current (I) in amperes and effective resistance (R) in ohms for which the installation and equipment should be designed. It is anticipated that installation designers will use these figures, together with the lengths of the cable runs in a given airframe, to calculate the gauge of each wire in the installation. Where their calculations reveal the possibility of using higher gauge numbers than #22 AWG, they are asked to stop and consider whether the mechanical strength of this wire is adequate for the installation before deciding to use it. The airlines report recent sad experiences with such wire, and although they are, of course, interested in the weight saving its use affords, they will quickly point out that these savings are rapidly nullified by maintenance costs if frequent breakages occur.

NOTE: Wire for which a "D" symbol is shown in place of a current rating may be used for any function ranging from "Dry Circuits" (hence "D") to 5 ampere applications.

Both installation and equipment designers should give due regard to special cases wherein parallel or series-parallel connected circuits may result in higher currents or voltage drop (effective resistance) than in simple circuits. Unless otherwise noted, the current limit set forth applies to all elements of parallel or series-parallel circuits.

ATTACHMENT 2 (cont'd)
NOTES APPLICABLE TO THE STANDARD INTERWIRING

〈7〉 Data Loader Interface

It is expected that the airframe manufacturers will provide, at some convenient location on the aircraft, a connection point for an external data loader of the type described in ARINC Report 603. This Attachment shows wiring from the FMC to a connector type MS24264-18B-31S or MS24265-18B-31S for this purpose, with which the MS24266R-18B-31P connector at the aircraft end of the data loader's pendant cable will mate. Note that the Attachment does not show the 115 VAC and aircraft ground wires to this connector needed in a practical installation. The reader is referred to ARINC Report 603 for information on these needs.

Note also that the three FMC data load enable discrete functions are connected to the data loader's discrete outputs as follows:

1. Navigation Data Base Update Enable to Data Loader Discrete Output #1.
2. Operating Program Update Enable to Data Loader Discrete Output #2.
3. Performance Data Base Update Enable to Data Loader Discrete Output #4 is not used.

For successful "automatic mode" data loader operation with the FMC, therefore, users must ensure that navigation data base update information appears on track #1 of the data tape, operating program update information on track #2 of the tape and performance data base update information on track #3. Track #4 should not be used. In the "control mode" of data loader operation, in which the FMC assumes management of the loading process, these restrictions on tape track use do not apply but other considerations do. See ARINC Report 603 for full details.

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ATTACHMENT 2 (cont'd)
CONNECTOR INSERT PIN LAYOUTS*
A. FMC

Top Insert (TP)

	A	B	C	D	E	F	G	H	J	K
1	VOR Input #1 A	B		DME Input #1 A	B		ILS Input A	B		Oleo Strut Disc. I/P
2										
3	IRS/AHRS I/P #1 A	B		GNSS Input #1 A	B		Propulsion Data I/P A #1	B		Funct. Test Disc. I/P
4										
5	EFI I/P #1 A	B		Fuel Quantity I/P A	B		TCC Input A	B		Off-Side CDU Enable
6										RESERVED Fut.Disc.
7	Propulsion Data I/P A #3	B		Air Data I/P #1 A	B		Glare Shield Cont. A I/P	B		FMC Master /Slave Disc.
8										
9	CDU Data I/P A	B		Data Update I/P A	B	Nav DB Enable	FMC Gen. O/P #1 A	B		Man./Auto Tune Disc#1
10										
11	Inst. Data O/P #1 A	B		Other CDU Data I/P A	B		Data O/P to Data A Loader	B		Man./Auto Tune Disc#2
12										
13	Data to Other FMC A	B		Data to CDU Pert A A	B		Data to Other CDU A	B		CDU Msg. Alert Disc.
14										
15	RES(MLS Data In) A	B		IRS/AHRS I/P #3 A	B		RES (OMEGA I/P) A	B		RES (CDU Msg. Disc.)

*Connector insert pin layouts added by Supplement 1

ATTACHMENT 2 (cont'd)
CONNECTOR INSERT PIN LAYOUTS*
A. FMC (cont'd)

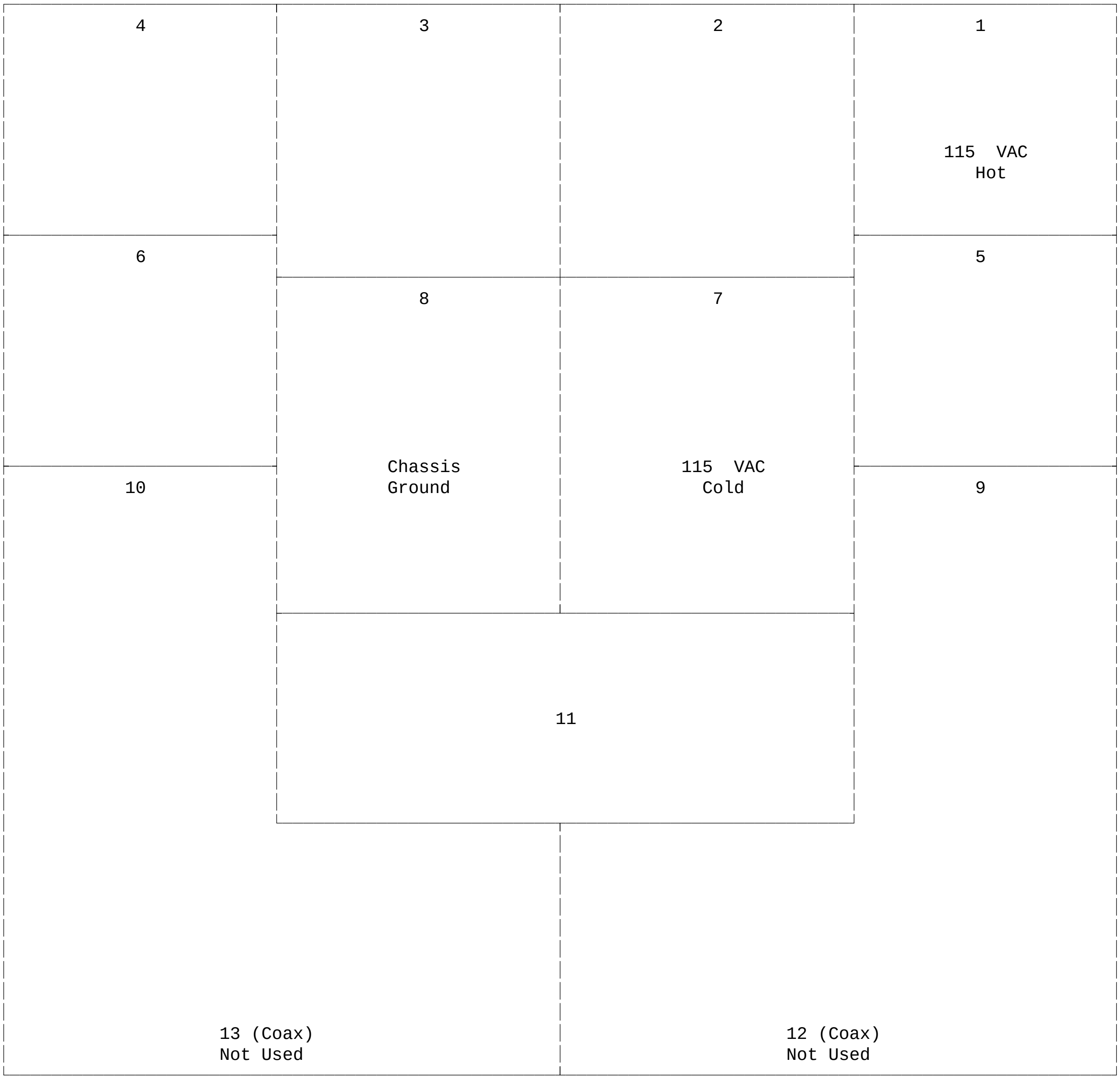
Middle Insert (MP)

	A	B	C	D	E	F	G	H	J	K
1	Propulsion Data I/P A #4 B			VOR I/P #2 A B			Data from Oth.CDU A B			SDI Code I/P
2										
3	IRS/AHRS I/P #2			CLOCK INPUT A B			ACARS DLK I/P A B			SDI Code I/P
4										
5	Propulsion Data I/P A #2 B			Air Data I/P #2 A B			RES (Spare I/P #1) A B			SDI Code I/P
6										
7	RES (Spare I/P #2) A B			FMC Gen. O/P #2 A B			DME I/P #2 A B		GNSS Input #2 A B	
8										
9	O/P to ACARS DLK A B			RES (EFI I/P #2) A B			Inst. Data O/P #2 A B		"Data Loader Connected" I/P	
10										
11	Op.Pgm. Enable D	Perf. Data Dsc	<-------- RESERVED (Application-Unique Discrete Inputs) -------->							RES(Target Speed Disc)
12										
13	<-------- RESERVED (Application-Unique Discrete Inputs) -------->									RES(Target Speed Disc)
14										
15	<-------- RESERVED (Application-Unique Discrete Inputs) -------->								RESERVED (Future Disc.)	

* Connector insert pin layouts added by Supplement 1

ATTACHMENT 2 (cont'd)
CONNECTOR INSERT PIN LAYOUTS*
A. FMC (cont'd)

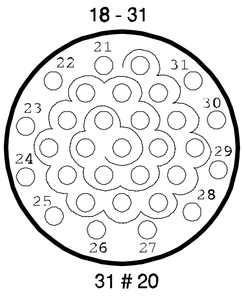
Bottom Insert (BP)



*Connector insert pin layouts added by Supplement 1

ATTACHMENT 2 (cont'd)
CONNECTOR INSERT PIN LAYOUTS (cont'd)
B. CDU

Connector Type MS83723/72R18-31N



Pin	Assignment
1	Future Spare
2	Data Input A
3	Port "A" B
4	Future Spare
5	Data Input A
6	Port "B" B
7	Future Spare
8	Data Output A
9	to FMC B
10	Active Port Program
11	Primary/Secondary Program
12	RESERVED (FMC Failure Warning Discrete I/P)
13	RESERVED (CMU Failure Warning Discrete O/P)
14	RESERVED (CDU Message Origin Disc. I/P (#1 FMC))
15	RESERVED (CDU Message Origin Disc. I/P (#1 FMC))
16	
17	
18	
19	Future Spares
20	
21	
22	
23	Lamp Test Discrete I/P
24	Future Spare
25	Chassis Ground
26	28 VDC Bright/Dim Lo
27	28 VDC Bright/Dim Hi
28	5 VAC Panel Light Supply Hi
29	5 VAC Panel Light Supply Lo
30	115 VAC Primary Power Hot
31	115 VAC Primary Power Cold

* Connector insert pin layouts added by Supplement 1

ATTACHMENT 2 (cont'd)
CONNECTOR INSERT PIN LAYOUTS
C. Optional FDSU

Top Insert (TP)

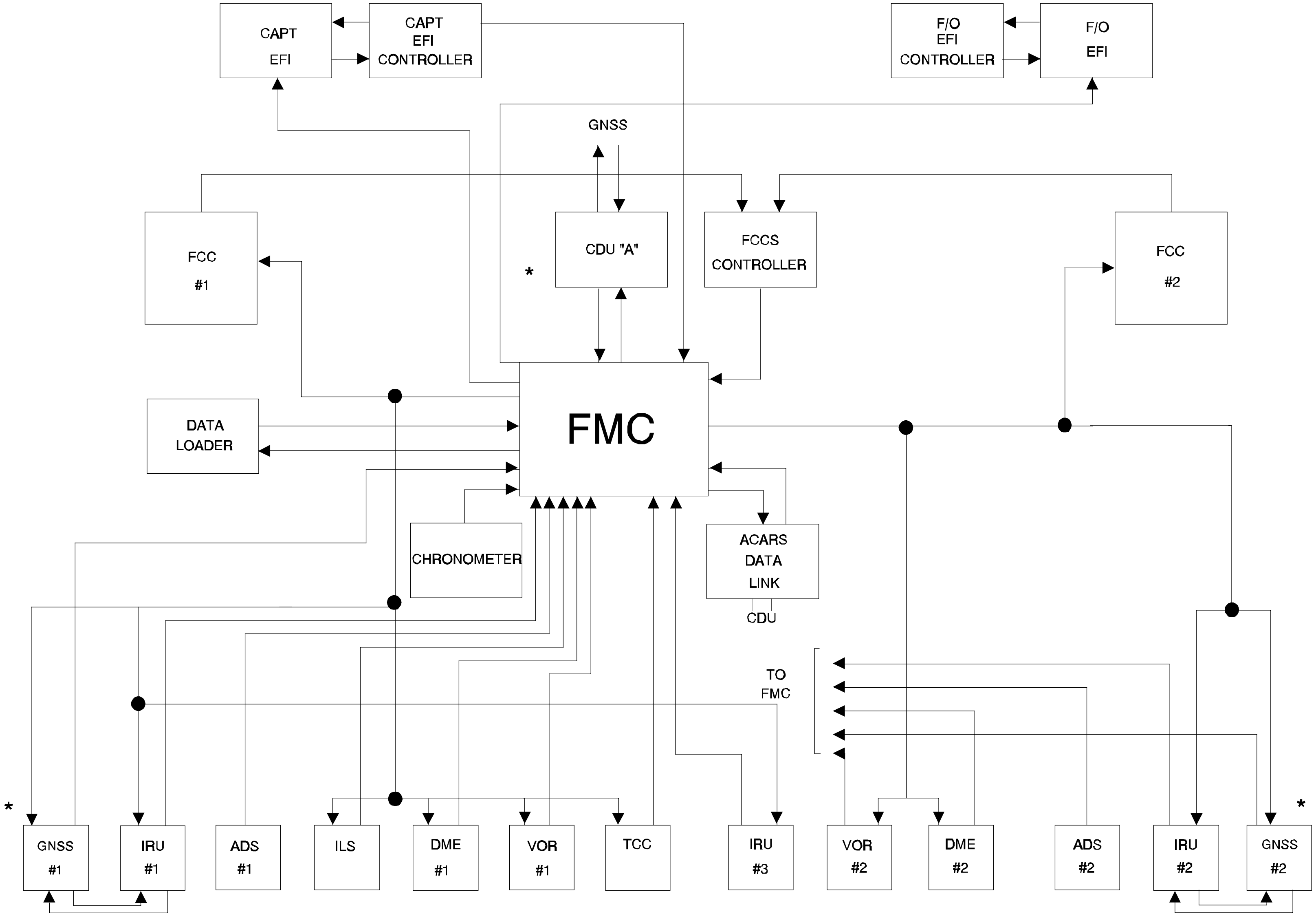
Deleted by Supplement 2

ATTACHMENT 2 (cont'd)
CONNECTOR INSERT PIN LAYOUTS
C. Optional FDSU (cont'd)

Bottom Insert (BP)

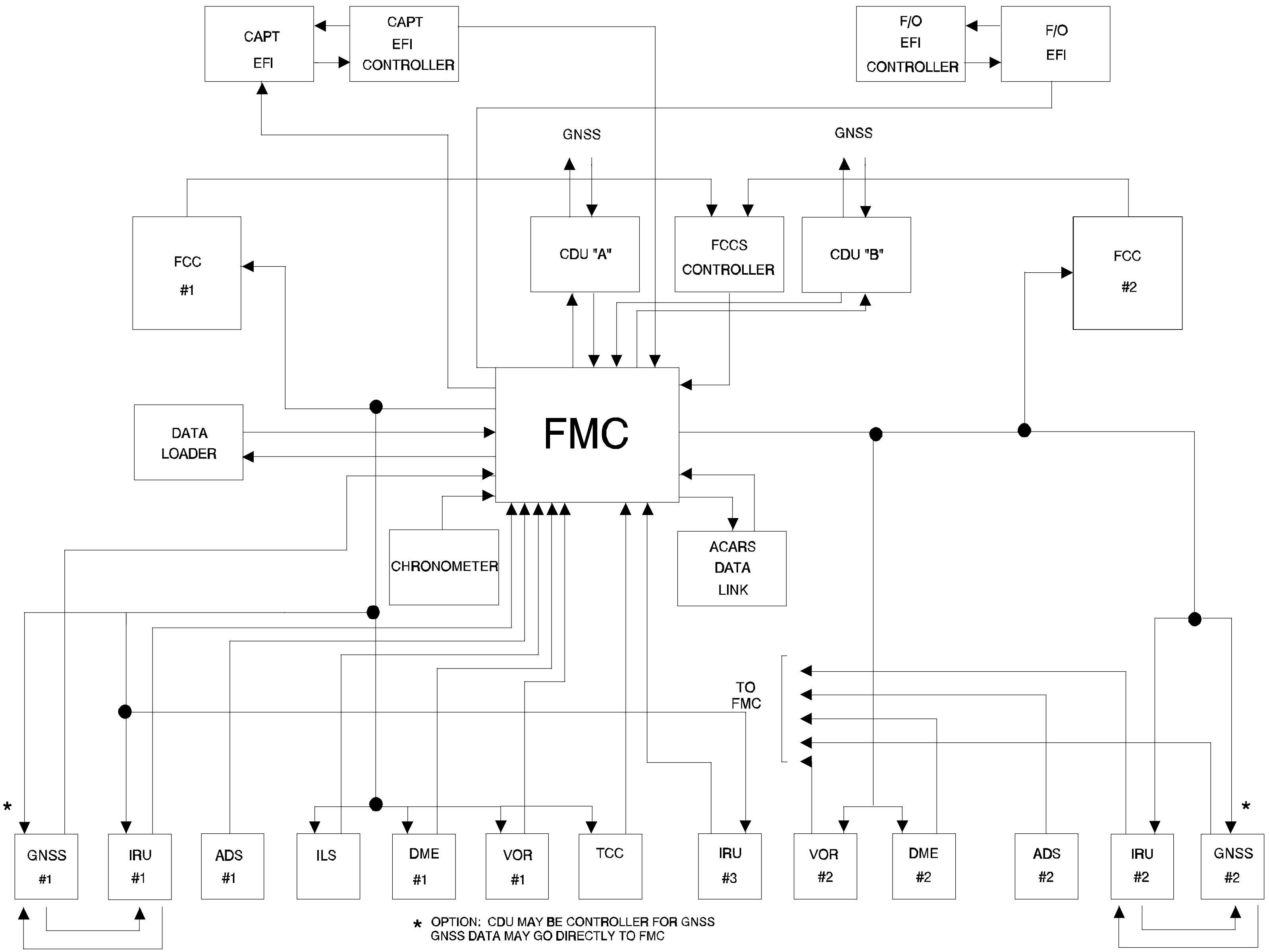
Deleted by Supplement 2

ATTACHMENT 3
FLIGHT MANAGEMENT SYSTEM
CONFIGURATION 1 - SINGLE FMC INSTALLATION



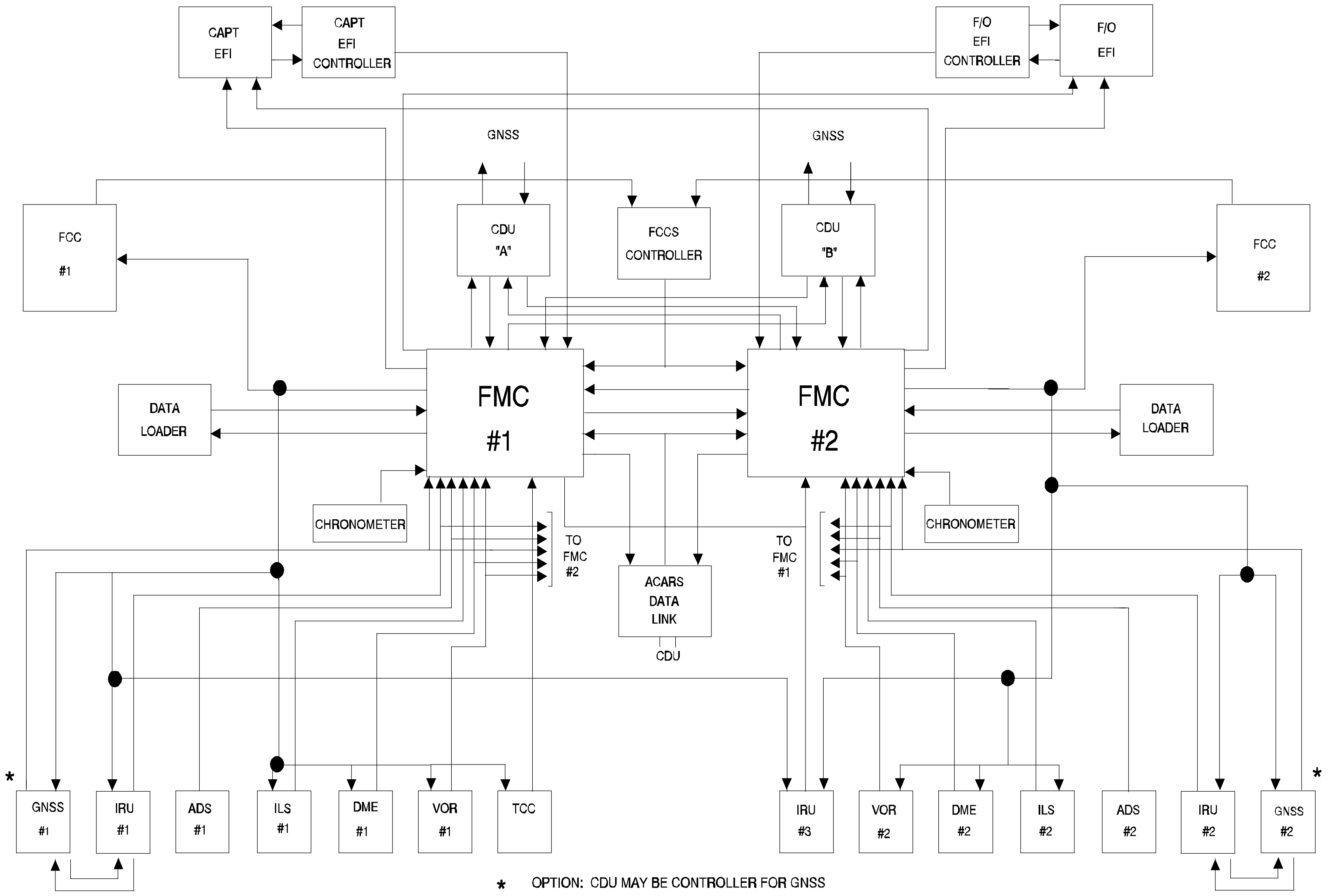
* OPTION: CDU MAY BE CONTROLLER FOR GNSS
GNSS DATA MAY GO DIRECTLY TO FMC

ATTACHMENT 3 (cont'd)
FLIGHT MANAGEMENT SYSTEM
CONFIGURATION 2 - SINGLE FMC/DUAL CDU INSTALLATION



* OPTION: CDU MAY BE CONTROLLER FOR GNSS
GNSS DATA MAY GO DIRECTLY TO FMC

ATTACHMENT 3 (cont'd)
FLIGHT MANAGEMENT SYSTEM
CONFIGURATION 3 - DUAL FMC INSTALLATION



* OPTION: CDU MAY BE CONTROLLER FOR GNSS
GNSS DATA MAY GO DIRECTLY TO FMC

ATTACHMENT 4
DATA INPUT/OUPUT
FMC INPUTS

	BUS INPUT											
FUNCTION	GNSS	VOR	DME	ILS	AIR DATA	IRS	AHRS	FCC GSC	FCCU	TCCU	CDU	OTHER
ALIGN STATUS/INERTIAL DISCRETES						X						
SELECTED COURSE								X				
SELECTED HEADING								X				
SELECTED ALTITUDE								X				
SELECTED AIRSPEED								X				
SELECTED VERTICAL SPEED								X				
SELECTED MACH								X				
AFS DISCRETES									X			
GREENWICH MEAN TIME												0
MLS AZIMUTH												0
MLS ELEVATION 1												0
MLS ELEVATION 2												0
MLS RANGE												0
LOCALIZER DEVIATION				X								
GLIDE SLOPE DEVIATION				X								
DME DISTANCE			X									
ALTITUDE (BARO)					X							
MACH					X							
COMPUTED AIRSPEED					X							
TRUE AIRSPEED					X							
TOTAL AIR TEMPERATURE					X							
ALTITUDE RATE						X	X					
STATIC AIR TEMPERATURE					X							
AIR DATA COMPUTER DISCRETES					X							
ALTITUDE (29.92)					X							
MAXIMUM ALLOWABLE AIRSPEED					0							
VOR OMNIBEARING		X										
UNIVERSAL COORDINATED TIME (UTC)	X											X

ATTACHMENT 4 (cont'd)
DATA INPUT/OUTPUT
FMC INPUTS

	BUS INPUT											
FUNCTION	GNSS	VOR	DME	ILS	AIR DATA	IRS	AHRS	FCC GSC	FCCU	TCCU	CDU	OTHER
PRESENT POSITION - LATITUDE	X					X						
PRESENT POSITION - LONGITUDE	X					X						
GROUND SPEED	X					X						
TRACK ANGLE - TRUE	X					0						
TRUE HEADING						0						
TRACK ANGLE - MAGNETIC						X						
MAGNETIC HEADING						X	X					
DRIFT ANGLE						0						
FLIGHT PATH ANGLE						0						
FLIGHT PATH ANGLE ACCELERATION						0						
PITCH ANGLE						X	X					
ROLL ANGLE						X	X					
TRACK ANGLE RATE						0	0					
ALONG TRACK ACCELERATION						0						
CROSS TRACK ACCELERATION						0						
VERTICAL ACCELERATION						X	X					
LATERIAL ACCELERATION						X	X					
LONGITUDINAL ACCELERATION						X	X					
N-S VELOCITY	X					X						
E-W VELOCITY	X					X						
N1 OR EPR ACTUAL										X		
N1 OR EPR COMMAND										X		
N1 OR EPR LIMIT										X		
N1 OR EPR DERATE										X		
FUEL FLOW/QUANTITY												X
CONTROL PANEL DISCRETES											X	
*ENGINE BLEED										X		
*ANTI-ICE										X		
TCC DISCRETES										X		

ATTACHMENT 4 (cont'd)
DATA INPUT/OUTPUT
FMC INPUTS

	BUS INPUT											
FUNCTION	GNSS	VOR	DME	ILS	AIR DATA	IRS	AHRS	FCC GSC	FCCC	TCCU	CDU	OTHER
*OMEGA P. POS - LATITUDE												0
*OMEGA P. POS - LONGITUDE												0
*OMEGA DISCRETES												0
*DATA LINK DISCRETES												0
*DATA LINK FLIGHT PLANS												0
*DATA LINK GMT												0
*ACS DISCRETES												0
*INTERSYSTEM COMPUTED DATA												X
ILS FREQUENCY				X								
VOR/ILS FREQUENCY #1		X										
DME FREQUENCY #1			X									
MLS FREQUENCY												0
*VOR/ILS FREQUENCY #2		X										
*DME FREQUENCY #2			X									
*EXTERNAL DATA LOAD												0
*GROSS WEIGHT										X		
*AIRPLANE CONFIGURATION DISCRETES										X		
GNSS STATUS	X											
DATE	X											X

ATTACHMENT 4 (cont'd)
DATA INPUT/OUTPUT
FMC OUTPUTS

FUNCTION	BUS OUTPUT						
	CDU #1 & #2 BUS ⟨1⟩	GENERAL #1 & #2 BUSES		DATA LDR BUS ⟨1⟩		EFI	OTHER
		BNR	BCD				
DISTANCE TO GO			X				
TIME TO GO			X				
ILS FREQUENCY			X				
VOR/ILS FREQUENCY #1			X				
DME FREQUENCY #1			X				
MLS FREQUENCY/CHANNEL			O				
DESIRED TRACK		X					
BEARING TO WAYPOINT		X					
CROSS TRACK DEVIATION		X					
VERTICAL DEVIATION		X					
HORIZONTAL COMMAND SIGNAL		X					
VERTICAL COMMAND SIGNAL		X					
THROTTLE COMMAND SIGNAL		X					
FMC DISCRETES		X					
N1 OR EPR COMMAND		X					
*VOR/ILS FREQUENCY #2			X				
*DME FREQUENCY #2			X				
TRACK ANGLE		X					
GROUND SPEED			X				
DRIFT ANGLE		X					
WIND SPEED			X				
WIND ANGLE			X				
*NAVAID #1 IDENTIFIER			O				
*NAVAID #2 IDENTIFIER			O				

* Not presently included in ARINC Specification 429

ATTACHMENT 4 (cont'd)
DATA INPUT/OUTPUT
FMC OUTPUTS

FUNCTION	BUS OUTPUT						
	CDU #1 & #2 BUS ①	GENERAL #1 & #2 BUSES		DATA LDR BUS ①		EFI ②	OTHER
		BNR	BCD				
*CDU DATA	X						
*INTERSYSTEM COMPUTED DATA							X
PRESENT POSITION-LATITUDE		0	0				
PRESENT POSITION-LONGITUDE		0	0				
TRACK ANGLE-TRUE			0				
SELECTED VERTICAL SPEED		0					
SELECTED MACH		0					
SELECTED HEADING		0					
SELECTED COURSE		0					
SELECTED ALTITUDE		0					
SELECTED AIRSPEED		0					
SELECTED RUNWAY HEADING		0					
FAST/SLOW		0					
*ACS DATA						0	
*EXTERNAL DATA LOAD COMMAND DISCRETES				0			
*DATA LINK DISCRETES							0
*DATA LINK DATA							0
UNIVERSAL COORDINATED TIME (UTC)		0					
DATE			0				

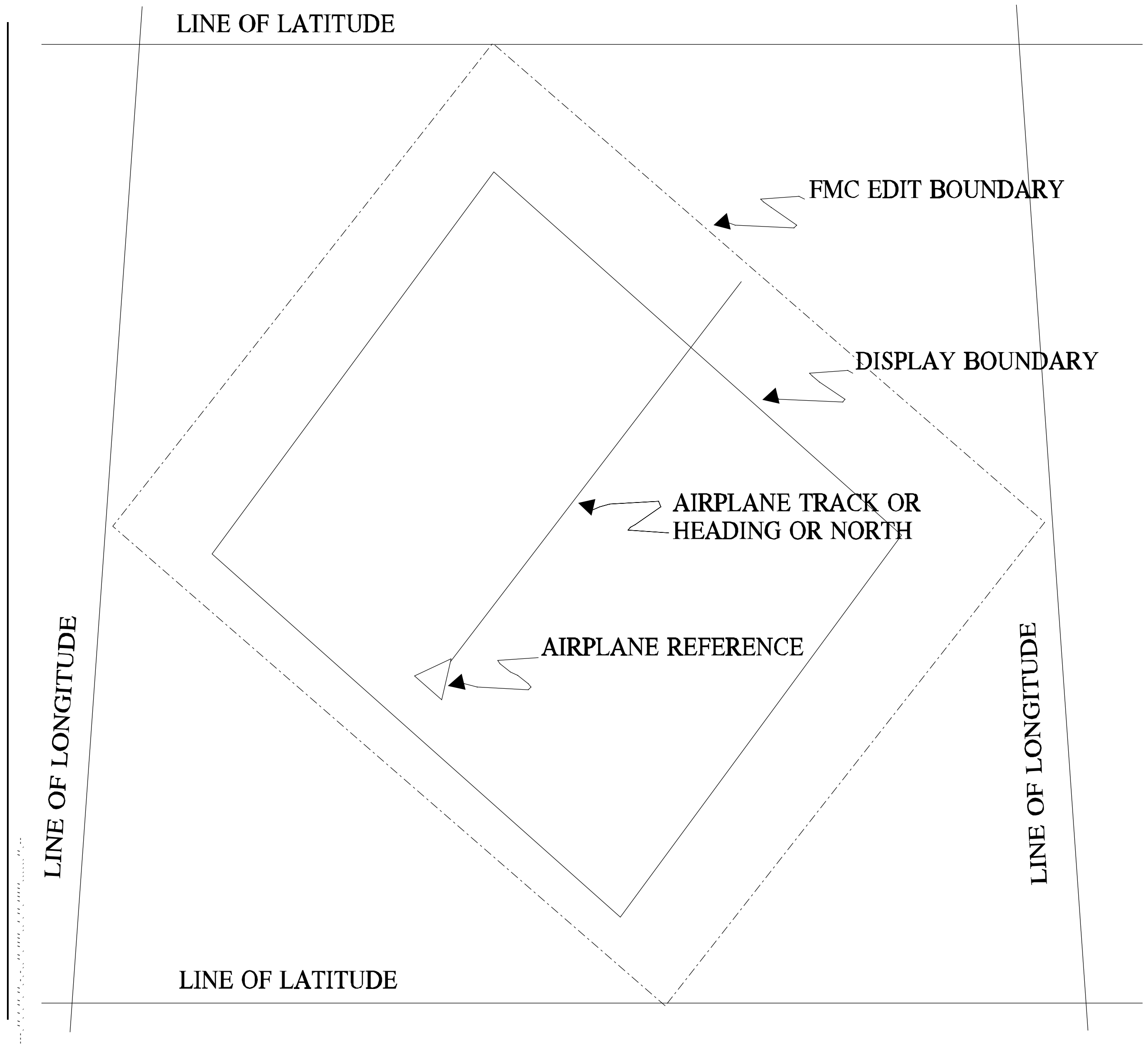
① The data content of the FMC private buses is left to the discretion of the system manufacturer to meet system or customer requirements, and hence is not completely specified herein.

② See Section 3 of this Characteristic.

ATTACHMENT 5
ENVIRONMENTAL TEST CATEGORIES

ENVIRONMENT	DO-160 SECTION	UNIT LOCATION	
		ELECTRONICS RACK	COCKPIT
Temperature and Altitude	4	Category A1	Category A2
Temperature Variation	5	Category C	Category C
Humidity	6	Category A	Category A
Shock	7		
Vibration	8	Category O/B	Category K/A
Explosion	9	Category X	Category X
Waterproofness	10	Category X	Category X
Hydraulic Fluid	11	Category X	Category X
Sand and Dust	12	Category X	Category X
- Fungus	13	Category X	Category X
- Salt Spray	14	Category X	Category X
Magnetic Effects	15	TBD	TBD
Power Input	16	Category A	Category A
Voltage Spikes	17	Category B	Category B
Audio Frequency			
- Conducted Susceptibility	18	Category A	Category A
Electromagnetic Compatibility		Category A	Category A
- Induced Signal Susceptibility	19		
- Radio Frequency Susceptibility	20		
- Emission of Radio Frequency Energy	21		

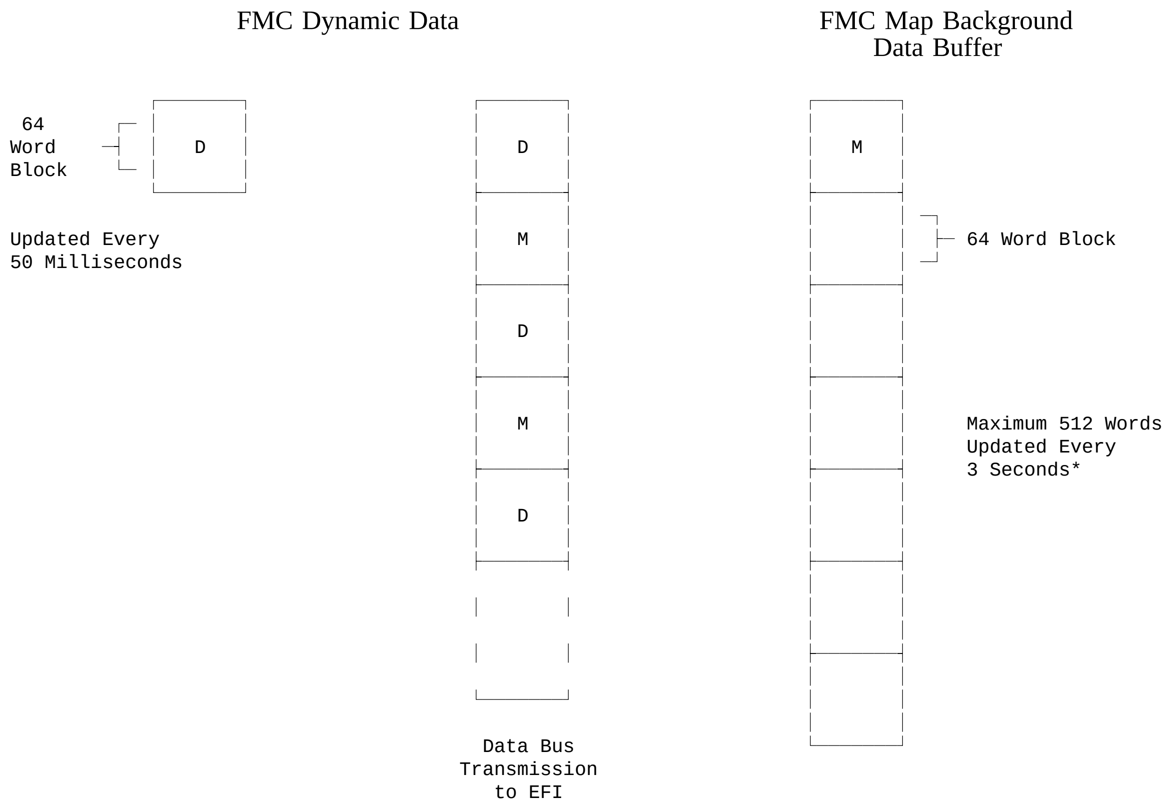
ATTACHMENT 6
FMC/EFI INTERFACE



NORTH-UP ORIENTATION USED IN PLAN MODE

FIGURE 1: MAP EDIT AREA

ATTACHMENT 6 (cont'd)
FMC/EFI INTERFACE



*Updated and transmitted within 1 second after either a mode, scale or option change.

FMC/EFI DATA TRANSMISSION FORMAT

FIGURE 2

ATTACHMENT 6 (cont'd)
FMC/EFI INTERFACE

TABLE 1 - FMC/EFI Data Type Identification Codes

OCTAL	BIT POSITION								PARAMETER
LABEL	1	2	3	4	5	6	7	8	
301	1	1	0	0	0	0	0	1	START OF TRANSMISSION (SOT) (BACKGROUND)
303	1	1	0	0	0	0	1	1	START OF TRANSMISSION (SOT) (DYNAMIC)
100	0	1	0	0	0	0	0	0	VECTOR - Active Flight Plan
300	1	1	0	0	0	0	0	0	- Active Flight Plan Changes
040	0	0	1	0	0	0	0	0	- Inactive Flight Plan
240	1	0	1	0	0	0	0	0	- Inactive Flight Plan Changes
140	0	1	1	0	0	0	0	0	- Radial
340	1	1	1	0	0	0	0	0	- Runway Center Line
020	0	0	0	1	0	0	0	0	- Offset Path
220	1	0	0	1	0	0	0	0	
120	0	1	0	1	0	0	0	0	
320	1	1	0	1	0	0	0	0	
060	0	0	1	1	0	0	0	0	
260	1	0	1	1	0	0	0	0	
160	0	1	1	1	0	0	0	0	VECTOR IDENTIFIERS
360	1	1	1	1	0	0	0	0	
010	0	0	0	0	1	0	0	0	
210	1	0	0	0	1	0	0	0	
110	0	1	0	0	1	0	0	0	
310	1	1	0	0	1	0	0	0	
050	0	0	1	0	1	0	0	0	

ATTACHMENT 6 (cont'd)
FMC/EFI INTERFACE

TABLE 1 - FMC/EFI Data Type Identification Codes (cont'd)

OCTAL	BIT POSITION								PARAMETER
LABEL	1	2	3	4	5	6	7	8	
250	1	0	1	0	1	0	0	0	SYMBOLS - VORTAC + Identifier
150	0	1	1	0	1	0	0	0	- Tuned VORTAC + Identifier
350	1	1	1	0	1	0	0	0	- VOR + Identifier
030	0	0	0	1	1	0	0	0	- Tuned VOR + Identifier
230	1	0	0	1	1	0	0	0	- DME/TACAN + Identifier
130	0	1	0	1	1	0	0	0	- Tuned DME/TACAN + Identifier
330	1	1	0	1	1	0	0	0	- Waypoint + Identifier
070	0	0	1	1	1	0	0	0	- Active Waypoint + Identifier
270	1	0	1	1	1	0	0	0	- Airfield + Identifier
170	0	1	1	1	1	0	0	0	- Origin/Destination Airfield Ident
370	1	1	1	1	1	0	0	0	- GRP + Identifier
004	0	0	0	0	0	1	0	0	- Altitude Profile Point +Identifier
204	1	0	0	0	0	1	0	0	- Selected Reference Point
104	0	1	0	0	0	1	0	0	
304	1	1	0	0	0	1	0	0	
044	0	0	1	0	0	1	0	0	
244	1	0	1	0	0	1	0	0	
144	0	1	1	0	0	1	0	0	
344	1	1	1	0	0	1	0	0	
024	0	0	0	1	0	1	0	0	

ATTACHMENT 6 (cont'd)
FMC/EFI INTERFACE

TABLE 1 - FMC/EFI Data Type Identification Codes (cont'd)

OCTAL	BIT	POSITION							PARAMETER
LABEL	1	2	3	4	5	6	7	8	
224	1	0	0	1	0	1	0	0	TEXT - Type 1: Navigation Advisory
124	0	1	0	1	0	1	0	0	- Type 2: Maintenance Test
324	1	1	0	1	0	1	0	0	- Type 3
064	0	0	1	1	0	1	0	0	- Type 4
264	1	0	1	1	0	1	0	0	MAP REFERENCE GROUP - Latitude
164	0	1	1	1	0	1	0	0	- Longitude
364	1	1	1	1	0	1	0	0	DISCRETE WORD - Map Mode
014	0	0	0	0	1	1	0	0	- Range
214	1	0	0	0	1	1	0	0	
114	0	1	0	0	1	1	0	0	
314	1	1	0	0	1	1	0	0	
054	0	0	1	0	1	1	0	0	ROTATED SYMBOLS - Runway + Identifier
254	1	0	1	0	1	1	0	0	- Airport + Runway + Ident
154	0	1	1	0	1	1	0	0	- Marker Beacon
354	1	1	1	0	1	1	0	0	- Holding Pattern - R
034	0	0	0	1	1	1	0	0	- Holding Pattern - L
234	1	0	0	1	1	1	0	0	- Procedure Turn - R
134	0	1	0	1	1	1	0	0	- Procedure Turn - L
334	1	1	0	1	1	1	0	0	
074	0	0	1	1	1	1	0	0	

ATTACHMENT 6 (cont'd)
FMC/EFI INTERFACE

TABLE 1 - FMC/EFI Data Type Identification Codes (cont'd)

OCTAL	BIT POSITION								PARAMETER
LABEL	1	2	3	4	5	6	7	8	
274	1	0	1	1	1	1	0	0	
174	0	1	1	1	1	1	0	0	
374	1	1	1	1	1	1	0	0	
302	1	1	0	0	0	0	1	0	END OF TRANSMISSION (EOT)
000	0	0	0	0	0	0	0	0	FILL-IN WORDS

ATTACHMENT 6 (cont'd)
FMC/EFI INTERFACE

TABLE 2 Symbol Word Groups

Symbol Latitude Word

32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
P	X	X	NS	45	22.5	11.25	5.625	2.812	1.406	.7031	.3515	.1757	.0878	.0439	.0219	.0109	.0054	.0027	.0013	.0006	.0003	.00017	.00008	SYMBOL TYPE							

Symbol Longitude Word

32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
P	X	X	EW	90	45	22.5	11.25	5.625	2.812	1.406	.7031	.3515	.1757	.0878	.0439	.0219	.0109	.0054	.0027	.0013	.0006	.0003	.00017	SYMBOL TYPE							

Symbol Azimuth Word (Rotated Symbols Only)

32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
P	X	X	±	90	45	22.5	11.25	5.625	2.812	1.406	.7031	.3515	.1757	.0878	.0439	.0219	.0109	.0054	.0027	.0013	.0006	.0003	.00017	SYMBOL TYPE							

Symbol Identifier Word(s)

32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
P	X	X	CHARACTER #3							CHARACTER #2							CHARACTER #1							SYMBOL TYPE							

Length (Runway Symbol Only) FT

32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
P	X	X	±	16384	8192	4096	2048	1024	512	256	128	64	32	16	8	4	2	1	0	0	0	0	0	SYMBOL TYPE							

P = Parity
See Section 8.6.9.2 for encoding of bits 30 and 31

ATTACHMENT 6 (cont'd)
FMC/EFI INTERFACE

TABLE 3 Vector Word Groups

Vector Latitude Word

32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
P	X	X	NS	45	22.5	11.25	5.625	2.812	1.406	.7031	.3515	.1757	.0878	.0439	.0219	.0109	.0054	.0027	.0013	.0006	.0003	.00017	.00008	VECTOR TYPE							

Vector Longitude Word

32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
P	X	X	EW	90	45	22.5	11.25	5.625	2.812	1.406	.7031	.3515	.1757	.0878	.0439	.0219	.0109	.0054	.0027	.0013	.0006	.0003	.00017	VECTOR TYPE							

Conic Definition Word (Subtended Angle)

32	3	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
P	X	X	±	90	45	22.5	11.25	5.625	2.812	1.406	.7031	.3515	.1758	.0879	.0439	0	0	0	0	0	0	0	0	VECTOR TYPE							

Conic Definition Word (Radius) NM

32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
P	X	X	±	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	2^{-1}	2^{-2}	2^{-3}	2^{-4}	2^{-5}	2^{-6}	2^{-7}	0	0	0	0	0	VECTOR TYPE							

Conic Definition Word (Initial Angle)

32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
P	X	X	±	90	45	22.5	11.25	5.625	2.812	1.406	.7031	.3515	.1758	.0879	.0439	0	0	0	0	0	0	0	0	VECTOR TYPE							

P = Parity
See Section 8.6.9.2 for encoding of bits 30 and 31

ATTACHMENT 6 (cont'd)
FMC/EFI INTERFACE

TABLE 4 Map Reference Word Groups

Map Reference Position Group - Latitude (Plan Mode) Word

32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
P	X	X	NS	45	22.5	11.25	5.625	2.812	1.406	.7031	.3515	.1757	.0878	.0439	.0219	.0109	.0054	.0027	.0013	.0006	.0003	.00017	.00008	0	0	1	0	1	1	0	1

Map Reference Position Group - Longitude Word

32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
P	X	X	EW	90	45	22.5	11.25	5.625	2.812	1.406	.7031	.3515	.1757	.0878	.0439	.0219	.0109	.0054	.0027	.0013	.0006	.0003	.00017	0	0	1	0	1	1	1	0

Map Mode Discrete Word

32	3	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
P	X	X	0	0	0	RA ALERT RESET	VOR/ILS ORIENT	MAP ORIENT	AIRPORTS	WAYPOINT DATA	GRP	NAV AIDS	0	0	EFIS S/T	SPARE	SPARE	PLAN	ILS	VOR	MAP	0	0	0	0	1	0	1	1	1	1

*

Map Range Discrete Word

32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
P	X	X	160	80	40	20	10	5	WXR DATA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0

Miles**

P = Parity
See Section 8.6.9.2 for encoding of bits 30 and 31

* Only one bit set at any given time
** All bits set to zero represents 320 mile range

ATTACHMENT 6 (cont'd)
FMC/EFI INTERFACE

TABLE 5 Bus #2 Dynamic Symbol

Altitude Range Arc Word (NM)

32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
P	X	X	±	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	2^{-1}	2^{-2}	2^{-3}	2^{-4}	2^{-5}	2^{-6}	0	0	0	0	0	1	1	1	1	0	1	1	0

P = Parity
See Section 8.6.9.2 for encoding of bits 30 and 31

ATTACHMENT 6 (cont'd)
FMC/EFI INTERFACE

TABLE 6 Bus Control Words

SOT (Start of Transmission) Word (Background Data)

BLOCK NUMBER (bits 13–9)

32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
P	1	1	512	256	128	64	32	16	8	4	2	1	0	0	0	0	0	0	16	8	4	2	1	1	0	0	0	0	0	1	1

SOT (Start of Transmission) Word (Dynamic Data)

32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
P	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1	1

EOT (End of Transmission) Word

32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
P	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1

P = Parity
See Section 8.6.9.2 for encoding of bits 30 and 31

ATTACHMENT 7
FMC/FMC INTERSYSTEM COMMUNICATIONS

Deleted by Supplement 6

ATTACHMENT 8A
FMC/ACARS INFORMATION EXCHANGE

SECTION 1
TEXT-IMBEDDED ERROR CHECK FOR GROUND COMPUTER/AIRBORNE COMPUTER MESSAGES

End-to-End Error Check

The FMC should provide the facility to perform an "end-to-end" error check on messages received and transmitted via ACARS. This is accomplished by designating the four characters preceding the suffix character (ETX) of the final block of the message as the "text-imbedded" error control field. This field will be used to verify successful transfer of each message to which the end-to-end error check applies.

The allowable character set on which the end-to-end check is performed is defined in Attachment 10 to this Characteristic, entitled "ISO Alphabet No. 5 Subset for Ground Computer/Airborne Computer Message Exchange Via ACARS". In addition, bit patterns of the characters appended to the message by the error checking procedure must be encoded per this ISO subset.

The pad bit for each 7-bit character in the message is set to a binary zero prior to encoding or decoding of the error check.

The error check to be used in the verification of end-to-end message integrity is a cyclic redundancy check (CRC), described in Section 3 of this attachment, "Character-oriented CRC Calculation". The CRC generator polynomial is the same CCITT polynomial introduced into ARINC Specification 429 by Supplement 12.

COMMENTARY

> The end-to-end error check provides an assurance that a message composed on the ground has been correctly reconstructed by the FMC (and vice versa for messages originated by the FMC). It supplements the message integrity assurance provisions which are employed at various levels during the transfer of data from originator (e.g., the host airline computer) to the FMC. The normal message integrity checks which, on-board the aircraft, include BCS, word count check, parity check, etc. should continue to be exercised in accordance with the appropriate ACARS Characteristic (ARINC 597, 724, or 724B) and this Characteristic.

Encoding the CRC at the Message Source

The procedure specifying the application of the CRC by the source on the message text is as follows. (See Section 3 of this attachment, "Character-oriented CRC Calculation", for a detailed description and example of this procedure.)

a. The CRC is to be applied to the message text beginning with the first character of the IMI, and ending with the last text character of the message.

b. When ordering bits in the message to be CRC'd, the most significant bit (MSB) of the message is the least significant bit of the first character of the IMI. The least significant bit (LSB) of the message is the most significant bit of the last text character of the message (excluding the ETX character).

c. After the source has been determined the CRC code from the 16-bit "remainder", four hexadecimal characters representing these 4-bit bytes will be encoded as ISO #5 characters for the CRC field. The hexadecimal characters are determined by assigning 4 bits at a time in the order specified by the table in Section 2 of this attachment. The resulting four characters are placed at the end of the original message text to be transmitted, in the same transmission order as message text characters; i.e., the least significant bit of each character is transmitted first.

d. For character-oriented file transfer protocols, an ETX character follows the last character of the CRC code.

Decoding the CRC at the Message Sink

a. Upon the receipt of a message which is error-free in accordance with the link level protocol, the sink will begin verification of the received message.

b. In order to verify the value of the CRC, the sink should first ensure each 7-bit ISO #5 character of the message text has the associated pad bit set to a binary zero, such that each character can be assumed to be 8 bits in length. The sink should also ensure any intermediate "end-of-block" characters have been deleted from the message text.

ATTACHMENT 8A (cont'd)
FMC/ACARS INFORMATION EXCHANGE

SECTION 1 (cont'd)
TEXT-IMBEDDED ERROR CHECK FOR GROUND COMPUTER/AIRBORNE COMPUTER MESSAGES

The sink then operates on the four characters representing the CRC code to translate them back to the original 16-bit binary value calculated by the source; i.e., the reverse of the procedure specified in section (iii) above is performed. Finally, the sink verifies the integrity of the message text by applying either of the verification procedures specified for the receiving system in the following section on "Character-Oriented CRC Calculation".

c. If the CRC confirms message integrity, the sink should accept the message. If message integrity is not confirmed (the CRC fails), the sink should discard the message. Further action will be defined by the user and will depend on the application of the message.

COMMENTARY

> This CRC scheme is only compatible with uncorrupted messages from the host airline computer to the FMC and vice versa. No intermediate systems may be allowed to modify the message text portion of the transmission by character substitution or insertion (such as line feeds, carriage returns, etc.).

ATTACHMENT 8A (cont'd)
FMC/ACARS INFORMATION EXCHANGE

SECTION 2
ISO #5 REPRESENTATION OF HEXADECIMAL CHARACTERS FOR BINARY DATA TRANSMISSION

This document states that ISO #5 representation of hexadecimal characters should be used for the interchange of binary information between ground-based and airborne computers via ACARS. The following example illustrates the binary-to-ISO character conversion process.

LSB \ MSB /

1. BINARY DATA STREAM	1 0 1 1		0 1 0 0		0 0 0 0		0 0 1 1	
2. 4 BIT BYTES STREAM	1 0 1 1		0 1 0 0		0 0 0 0		0 0 1 1	
3. HEX CHARACTER VALUE	B		4		0		3	
4. ISO CHARACTER (COLUMN, ROW)	4,2		3,4		3,0		3,3	
5. ISO BIT VALUES (P = PAD BIT)	P	1000010	P	0110100	P	0110000	P	0110011
6. ISO BITS TRANSMITTED (PAD BITS set to 0)	0	1000010	0	0110100	0	0110000	0	0110011
7. CHARACTER TX ORDER	CHAR 4		CHAR 3		CHAR 2		CHAR 1	

TRANSMISSION ORDER ==>

ATTACHMENT 8A (cont'd)
FMC/ACARS INFORMATION EXCHANGE

SECTION 3
CHARACTER-ORIENTED CRC CALCULATION

Generation of the CRC Code

This CRC calculation method is based on the premise that a message may be represented as the coefficients of a polynomial, G(x), having k terms, where k is the number of bits in the message.

COMMENTARY

> The notation used to describe the CRC is based on the property of cyclic codes that a code vector such as 1000000100001 can be represented by a polynomial $G(x) = x^{12} + x^5 + 1$. The elements of a k element code vector are thus the coefficients of a polynomial of order k - 1. In this application, these coefficients can have the value 0 or 1, and all polynomial operations are performed modulo 2.

To create the polynomial G(x) representing the message, the terms are ordered as follows: The coefficient of the most significant bit of G(x), (x^{k-1}, is the least significant bit of the first character of the message. The coefficient of the least significant bit of G(x), (x^0), is the most significant bit of the last character of the message.

For example, if the message, G(x), is 'FPR', the first character is 'F' which is represented by the code 46 hex or 01000110 binary. The rightmost bit of 'F', 0 in this example, is therefore the most significant bit of G(x). Similarly, the last character, 'R', is represented by the code 52 hex or 01010010 and the least significant bit of G(x) is the leftmost bit of 'R', which is 0. The message FPR has 24 bits so k has a value of 24.

The actual transmission order for the message is most significant bit (MSB) to least significant bit (LSB) as follows: (Note: Slashes (/) are used for octet separation only.)

```
   Transmission Order  ==>

 LSB                          MSB
   01010010/01010000/01000110
       'R'          'P'         'F'
```

In order to illustrate the mathematical procedure, the entire message is transposed for representation as a bit stream with the most significant bit (MSB) at the left and the least significant bit (LSB) at the right to yield:

```
 MSB                          LSB
   01100010/00001010/01001010
```

Expressing the bit stream for this example as a polynomial, G(x), yields:

$$G(x) = x^{22} + x^{21} + x^{17} + x^{11} + x^9 + x^6 + x^3 + x^1$$

To generate the CRC code the generator polynomial is defined as:

$$P(x) = x^{16} + x^{12} + x^5 + 1$$

The CRC code is the one's complement of the remainder obtained from the modulo 2 division of:

$$\frac{x^{16}G(x) + x^k(x^{15} + x^{14} + x^{13} + \ldots + x^2 + x + 1)}{P(x)} = Q(x) + \frac{R(x)}{P(x)}$$

where Q(x) is the quotient and R(x) is the remainder.

ATTACHMENT 8A (cont'd)
FMC/ACARS INFORMATION EXCHANGE

SECTION 3 (cont'd)
CHARACTER-ORIENTED CRC CALCULATION

Note:

The addition of $X^{16}G(x)$ and $xk(x^{15} + x^{14} + x^{13} + \ldots x^2 + x + 1)$ is modulo 2 and is equivalent to inverting the 16 most significant bits of G(x) and appending a bit string of 16 zeroes to the lower order end of G(x).

If the 16-bit binary CRC code were appended to the original G(x) the resulting message, M(x), would be of length n, where n = k + 16. This is equivalent to the following operation:

$$M(x) = x^{16}G(x) + (16\text{-}bit)\ CRC\ (Modulo\ 2).$$

When the 16-bit binary CRC is transformed into four ISO #5 characters (8 bits each), the final message to be transmitted, M*(x) is now of length N* = k + 32, and so

$$M*(x) = x^{32}G(x) + (32\text{-}bit)\ CRC\ (Modulo\ 2).$$

Using the above example with 'FPR' as G(x), the CRC calculation gives a remainder of 00111111/11010010, where the left-hand 0 is the most significant bit and the right-hand 0 is the least significant bit. (See Appendix 7 of ARINC Specification 429, "Mathematical Example of CRC Encoding/Decoding" for a detailed example of the mathematical operations involved to arrive at this remainder.)

The CRC code is the one's complement of the remainder, or 11000000/00101100. This CRC code is converted to a four character (ISO #5) code and appended to the end of the message over which the CRC code was calculated by applying steps 1 through 7 in Section 2 as follows:

1. Because the message was transposed in this illustration to generate the CRC code, the resultant CRC code must also be transposed from left to right. Transposing 11000000/00101101 yields 10110100/00000011. This operation returns the CRC code to the same transmission order as the original message, with the most significant bit to the right and the least significant bit to the left.

2-3. Separating the 16-bit transposed value into 4-bit segments and expressing it in hex yields B403.

4-7. The four characters representing this value are coded as ISO #5 characters and appended to the message in the order: MS to LS character. For this example the order is 3, 0 4, B.

The complete message plus CRC code for this example (read left to right) is:

FPR304B

The transmission order of this message is right to left, as:

B403RPF ==>

Verification (Decoding) of the CRC Code

At the receiving system, the four characters representing the CRC code are converted back into the original binary CRC code; i.e., the steps in Section 2 are performed in reverse order. At this point, verification (decoding) of the CRC is accomplished by either of the following methods:

(1) After conversion back to the binary CRC code, the 16-bit binary CRC is appended to the message G(x) (in the same transmission order as the message) resulting in the message M(x), of length n, where n = k + 16 and

$$M(x) = x^{16}G(x) + (16\text{-}bit)\ CRC\ (Modulo\ 2).$$

ATTACHMENT 8A (cont'd)
FMC/ACARS INFORMATION EXCHANGE

SECTION 3 (cont'd)
CHARACTER-ORIENTED CRC CALCULATION

M(x) is multiplied by X^{16}, added to the product $x^n(x^{15} + x^{14} + x^{13} + ... + x^2 + x + 1)$, and divided by P(x) as follows (where n = k + 16):

$$\frac{x^{16}M(x) + x^n(x^{15}+x^{14}+x^{13}+...+x+1)}{P(x)} = Qr(x) + \frac{Rr(x)}{P(x)}$$

This CRC procedure is designed to create a constant remainder for error free messages. If the transmission of the serial incoming bits plus CRC code (i.e., M(x)) is error free, then the remainder, Rr(x) is always:

MSB LSB
00011101/00001111

(coefficients of x^{15} through x^0, respectively).

(2) An alternate procedure for the receiving system, which will ensure the same data integrity, is to recompute the CRC code on the received message less the four CRC characters (using the same generator polynomial). The generated CRC code is then compared with the one received. The following steps are performed:

The received message, M*(x), is stripped of the four CRC characters, leaving only G(x). The four characters representing the CRC code are converted back into the original binary 16-bit CRC code; that is, the steps in Section 2 are performed in reverse order.

A binary CRC code is generated for G(x) using the same encoding method described for the message source.

The generated binary CRC code is compared with the 16-bit binary CRC code stripped from the message and if they are identical, the message is assumed to be free of errors and exactly represents the message transmitted by the source.

ATTACHMENT 8B
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 1

DEFINITION OF TERMS USED IN DATA LINK MESSAGES

All uplink and downlink messages are formatted using a consistent set of syntax rules. The following definitions are used to describe parts of a message:

IMI (Imbedded Message Identifier)

The IMI is a three alphanumeric character identifier. An IMI is placed at the beginning of the text to identify the relative message content. Only one IMI is used per message. The same IMI can be used for both uplinks and downlinks.

Examples of IMIs are: FPN, PER, LDI, POS, REJ, etc.

IEI (Imbedded Element Identifier)

The IEI is a two alpha character identifier that is used to group one or more elements.

Examples of IEIs are: FN, RP, RM, CG, RW, etc.

ELEMENT

An element is the smallest omissible part of an uplink or downlink message. It can be a single parameter, or a number of parameters. A single parameter element is defined as either fixed length or variable length with a defined maximum number of characters. Directional elements are single parameter elements that must contain either a single alpha character preceding one or more numeric characters, or one or more numeric characters followed by an alpha character. The alpha character indicates the direction (or qualifier) that is associated with the numeric value. Directional elements can be fixed or variable length.

A multi-parameter element is used to group similar or related information. Multi-parameter elements can be fixed length, variable length or a combination of fixed and variable length. However, only one field within a multi-parameter element can be of variable length. There is no delimiter between single data elements within a multi-parameter element.

Example: OAT: P23 The single parameter element, OAT is plus 23 degrees.

V1VRV2: 131139147 The multi-parameter element is composed of
V1 = 131 knots
VR = 139 knots
V2 = 147 knots

PARAMETER

A parameter is an element or part of an element that has the following attributes:

1. Type - Variable or Fixed
2. Element Type - Alpha (A - Z)
   Alphanumeric (A - Z, 0 - 9, dash)
   Numeric (0 - 9)
3. Character Length - Number of Characters
4. Scaling Factor - Identifies the multiplication factor
5. Units - Identifies the parameter units

LIST

A list is a repeatable group of elements within a data link message. Each list contains one or more elements.

MESSAGE FORMAT EXAMPLE

The following is an example of a Predicted Wind Information uplink message (the IMI for this message is PWI and the IEI is DD, for Descent Wind Data).
Example: PWI/DD350270060.310270045.140260040:060,,,M04,1013

ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 1 (cont'd)

Altitude/Wind List (up to ten allowed):

Altitude	Wind
FL350	270/060 kts
FL310	270/045 kts
14000	260/040 kts

Remaining elements:

TAI On Altitude	6000 ft
TAI On/Off Altitude	(Missing Data)
Des Transition Altitude	(Missing Data)
Descent ISA Deviation	-4 Degrees C
QNH	1013 Hectopascals

FLIGHT PLAN DEFINITION

Each independent part of a flight plan is called a flight plan element (FPE). Each FPE is preceded by a Flight Plan Element Identifier (FPEI) which identifies the group of data that follows. These FPEs are used in combination to fully define the FMC flight plan in both the uplinks and downlinks. The flight plan definition is used to create a flight plan (either active or inactive) or modify an existing flight plan.

FPEI (Flight Plan Element Identifier)

FPEIs are used to identify special elements, which are used in the (Flight Plan) Route IEIs of RP, RI, RM, and RA. Examples of Flight Plan Element Identifiers are :H:, :V:, ".", "..", "DA", etc.

FPE (Flight Plan Element)

A Flight Plan Element (FPE) is a special type of variable or fixed length element (or group of elements) used in RP, RI, RM, or RA IEIs.

Examples of FPEs (and their corresponding FPEIs) are shown below:

FPE	FPEI	Example
Departure Airport	:DA:	KJFX
Arrival Airport	:AA:	KLAX
Company Route	:CR:	JFKLAX07
Waypoint Spd/Alt	:V:	N47W125,250,AT1250
Direct to Waypoint	..	BLAKO
Departure Runway	:R:	04O
Airway VIA	.	J36
Arrival Procedure	:A:	DOWNE
Arrival Transition	.	HECTR
Arrival Runway	(XXX)	(04O)

The last four items in the table illustrate the dual role of the special character "." which is context dependent. It can be used as a "VIA" indicator for an airway, or as a transition indicator if it is preceded by an ":A:" (or an ":AP:" or a :D:), as in DOWNE.HECTR(04O).

Example: FPN/RM..NIA.J48.BENNY,N33240W116250:AT:NIA-
M0400,280,AT1400:A:BENE3.NIA:AP:ILS32R.EDD

- IMI (FPN) followed by
- IEI (RM) followed by
- Direct to waypoint NIA
- followed by a via airway J48
- to waypoint BENNY with optional lat/lon definition
- then an along track offset definition of NIA -40.0 with an associated speed restriction of 280 at 14,000 feet
- followed by a standard arrival BENE3 with a NIA transition
- and the standard approach of ILS32R with an EDD transition.

ATTACHMENT 8B (cont’d)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 1 (cont’d)

UPLINK AND DOWNLINK DELIMITERS

When constructing an uplink or a downlink message, delimiters are used to consistently identify the information in the message. The delimiters supersede each other in the order given (i.e., ’/’ has the highest priority).

IEI DELIMITER ’/’ solidus, Character 2/15

This character precedes each Imbedded Element Identifier which identifies the beginning of predefined group of elements. This delimiter is always followed by two alpha characters.

LIST TERMINATOR ’:’ colon, Character 3/10

The colon is an end of list control character. This character is used to terminate a repetitive list structure.

LIST ENTRY TERMINATOR ’.’ period, Character 3/11

The period is a list entry terminator. This character is used to terminate each list entry (group of elements). List entries are groups of parameters or elements that are repeated one or more times.

ELEMENT TERMINATOR ’,’ comma, Character 2/12

Commas are used to separate elements (unless they have been separated by or terminated with another control character; i.e., ’/’, ’:’, ’.’ or another FPEI in the case of RI, RM, RP, or RAs). Missing elements are denoted by consecutive commas.

REQUEST MESSAGES

To allow the receiving system to recognize the difference between a message that is transmitting data and a message that is requesting data, a special IMI has been reserved for requests. This IMI (’REQ’ is the default) precedes anyrequest message. The data that follows this IMI depends on whether the message is an uplink or a downlink.

UPLINK REQUEST A DOWNLINK

The request IMI is followed by an element which contains the IMI of the "reply". This is optionally followed by a comma (element terminator), which is optionally followed by a list of elements that define the IEIs to be included in the downlink (all separated by a list entry terminator). An IMI, or IEIs following the REQ are considered elements in the uplink.

Example: REQPRG,DT.FN

This example is a request from the ground for the current destination and current flight number which results in a downlink of:

PRG/DTKSEA/FNSFOSEA001

DOWNLINK REQUESTING AN UPLINK

In a downlink request, the request IMI is followed by the requested information.

Example: REQFPN/COKSEAKSFO02

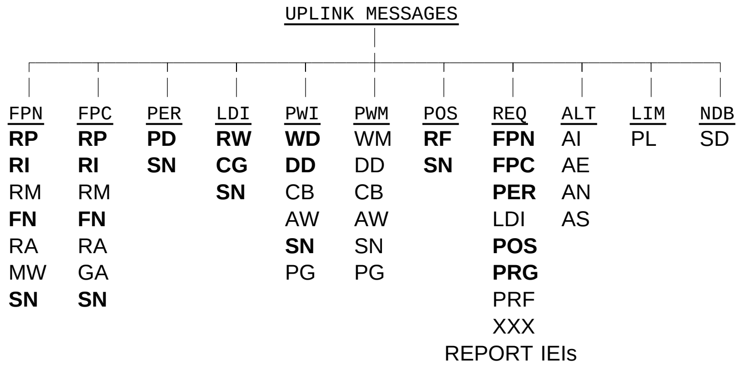
This example is a request from the FMC for a flight plan, the request includes the entered company route as a data element.

ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

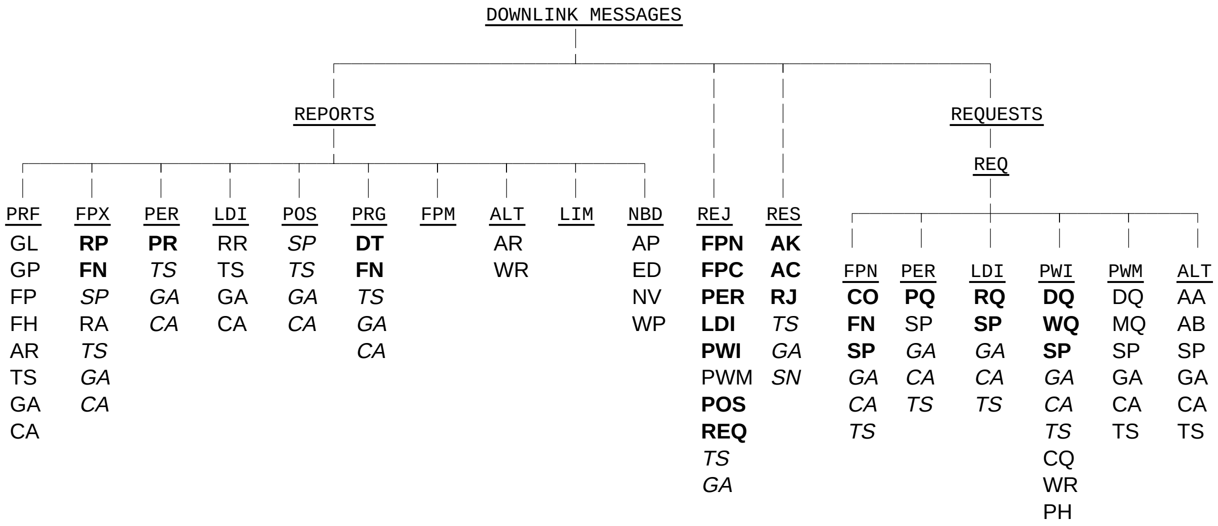
SECTION 2
IMI/IEI RELATIONSHIPS

COMMENTARY

This section identifies the IEIs normally associated with IMIs that have been defined. This section will be updated as the need for new IMIs and IEIs is identified. Users are requested to advise the AEEC staff when such a need arises. The basic IEIs are listed in bold text, the dependent IEIs are listed in italics and the extended IEIs are listed as normal text.



XXX may be an unrecognizable IMI that is followed by recognizable IEIs.



FPX represents FPN and FPC.

ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 3
UPLINK IMI DEFINITIONS

COMMENTARY

This section lists the currently defined uplink IMIs and provides a brief description of the associated message content. This section will be updated as the need for new IMIs is identified. Users are requested to advise the AEEC staff when such a need arises.

IMI	DESCRIPTION	DEFINITION
ALT	ALTERNATE DATA	Contains alternate airport information generated by the airline.
FPC	FLIGHT PLAN	Flight plan information supplied by ATC.
FPN	FLIGHT PLAN	Flight plan information generated by the airline.
LDI	LOAD INFORMATION	Contains load information for takeoff generated by the airline.
LIM	PERFORMANCE LIMITS DATA	Contains performance limits data that is provided by the airline.
NDB	AIRLINE DATABASE	Contains supplemental Navigation Data Base, Effectivity Date, Supplemental Navigation Airport, Navaid, and Waypoint definitions generated by the airline.
PER	PERFORMANCE INITIALIZATION	Contains performance initialization data generated by the airline.
POS	POSITION	Contains specified triggers for automatic position report information generated by the airline.
PWI	PREDICTED WIND DATA	Contains climb, alternate, en route and/or descent wind information that is to be applied to the flight plan. Generated by the airline.
PWM	PREDICTED WIND MODIFICATION	Contains alternate, en route, and/or descent wind information that is to be applied to the modified active flight plan. Descent wind data may be applied regardless of the route status. Generated by the airline ground station.
REQ	REQUEST	Contains a type of request (FPN/FPC, PER, LDI, POS, PRG, PRF, XXX) for information generated by the airline.
TAC	RESERVED	
TAR	RESERVED	

ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 4
DOWNLINK IMI DEFINITIONS

COMMENTARY

This section lists the currently defined downlink IMIs and provides a brief description of the associated message content. This section will be updated as the need for new IMIs is identified. Users are requested to advise the AEEC staff when such a need arises.

IMI	DESCRIPTION	DEFINITION
ALT	ALTERNATE DATA	Provides the airline with alternate airport information.
FPC	FLIGHT PLAN	Provides flight plan report to ATC.
FPM	FLIGHT PLAN	Provides flight plan modification information to the airline.
FPN	FLIGHT PLAN	Provides flight plan information to the airline.
LDI	LOAD INFORMATION	Provides the airline with a load information data report for a single runway.
LIM	PERFORMANCE LIMITS DATA	Provides the airline with the current FMC performance limits.
NDB	AIRLINE DATABASE	Provides the contents of the supplemental data base to the airline.
PER	PERFORMANCE INITIALIZATION	Provides performance initialization data report to the airline.
POS	POSITION	Provides the airline with current position report information.
PRF	PREFLIGHT	Provides preflight report to the airline.
PRG	PROGRESS (ETA) REPORT	Provides the airline with progress report data in response to a trigger.
PWI	PREDICTED WIND DATA	Provides the airline with climb, en route and/or descent wind information that is to be applied to the flight plan.
PWM	PREDICTED WIND MODIFICATION	Provides the airline with en route, and/or descent wind information that is to be applied to the modified active flight plan. Descent wind data may be applied regardless of the route status.
REJ	DOWNLINK REJECTION	Provides ATC or the airline with information referencing a rejected uplink message.
REQ	REQUEST	Requests (FPN/FPC, PER, LDI, PWI/PWM) information from the airline or ATC.
RES	DOWNLINK RESPONSE	Provides a response to an uplink message.
TAC	RESERVED	
TAR	RESERVED	

ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 5
UPLINK IEIs

COMMENTARY

This section lists the currently defined uplink IEIs. This section will be updated as the need for new IEIs is identified. Users are requested to advise the AEEC staff when such a need arises.

IEI	DESCRIPTION
AE	COMPANY PREFERRED ALTERNATES DATA
AI	ALTERNATE INFORMATION DATA
AN	ALTERNATES INHIBIT DATA
AW	ALTERNATE WIND DATA
AS	ALTERNATES FLIGHT LIST DATA
CA	COMPANY DISTRIBUTION
CB	CLIMB WIND DATA
CG	TAKEOFF CENTER OF GRAVITY
DD	DESCENT FORECASTS
FN	FLIGHT NUMBERS
GA	GROUND ADDRESS
MW	MEAN WIND DATA
PD	PERFORMANCE INITIALIZATION DATA
PG	PAGE INFO
PL	PERFORMANCE LIMITS
RA	ALTERNATE ACTIVE/INACTIVE ROUTE
RF	POSITION REPORT FIX
RI	INACTIVE ROUTE
RM	ROUTE MODIFICATION
RP	ACTIVE ROUTE
RW	RUNWAY DATA
SD	SUPPLEMENTAL NAVIGATION DATABASE
SN	MESSAGE SEQUENCE NUMBER
TS	TIME STAMP
WD	ENROUTE WIND DATA
WE	WIND VECTOR MAGNITUDE DIFFERENCE
WM	ENROUTE WIND MODIFICATION

ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 6
DOWNLINK IEIs

COMMENTARY

This section lists the currently defined downlink IEIs. This section will be updated as the need for new IEIs is identified. Users are requested to advise the AEEC staff when such a need arises.

IEI	DESCRIPTION
AA	COMPANY PREFERRED ALTERNATES REQUEST
AB	ALTERNATES FLIGHT LIST REQUEST
AC	ACCEPT
AK	ACKNOWLEDGE
AP	SUPPLEMENTAL NAV DATA BASE AIRPORTS
AR	ALTERNATE INFORMATION REPORT
CA	COMPANY DISTRIBUTION
CO	COMPANY ROUTE REQUEST
CQ	CLIMB FORECAST REQUEST
DI	DOWNLINK TIME INFORMATION
DQ	DESCENT FORECAST REQUEST
DT	DESTINATION REPORT
ED	SUPPLEMENTAL EFFECTIVITY DATE
FH	FLIGHT PLAN HISTORY
FN	FLIGHT NUMBER
FP	FUEL PLANNING
GA	GROUND ADDRESS
GL	GENERAL DATA
GP	GENERAL DIRECTIONS
MQ	MOD WIND REQUEST
NV	SUPPLEMENTAL NAV DATA BASE NAVAIDS
PH	FLIGHT PHASE
PL	PERFORMANCE LIMITS
PQ	PERFORMANCE INITIALIZATION REQUEST
PR	PERFORMANCE INITIALIZATION REPORT
RA	ALTERNATE ACTIVE/INACTIVE ROUTE
RJ	REJECT
RP	ACTIVE ROUTE
RQ	RUNWAY DATA REQUEST
RR	RUNWAY DATA REPORT
SN	MESSAGE SEQUENCE NUMBER
SP	SCRATCHPAD
TS	TIME STAMP
WQ	WIND REQUEST
WP	SUPPLEMENTAL NAV DATA BASE WAYPOINTS
WR	ALTERNATE AIRPORT WEATHER REQUEST

ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 7
IEI AND ASSOCIATED ELEMENTS

COMMENTARY

This section provides a guideline for relating elements to IEIs and defines the default text for all IEIs. This section is separated into basic IEIs (also dependent IEIs) and their associated elements, extended IEIs and their associated elements, and IMIs and their associated elements. The default IE content and structure is indicated by 'IEI CONTENT'. The content and order of list entries are indicated by 'LIST ENTRY'. Examples are provided to clarify the default text.

BASIC IEIs AND ASSOCIATED ELEMENTS

AC ACCEPT — Consists of a variable length field defining the message sequence number and stimulus code.

EXAMPLE: /AC12345,451

IEI CONTENT
MESSAGE SEQUENCE NUMBER
STIMULUS CODE

AK ACKNOWLEDGE — Consists of a variable length field defining the message sequence number and stimulus code.

EXAMPLE: /AK12345,451

IEI CONTENT
MESSAGE SEQUENCE NUMBER
STIMULUS CODE

CA COMPANY DISTRIBUTION — Consists of an airline internal distribution identifier.

EXAMPLE: /CAFLTOPS

IEI CONTENT
COMPANY DISTRIBUTION

CG TAKEOFF CENTER OF GRAVITY — Consists of a variable length field.

EXAMPLE: /CG200

IEI CONTENT
TAKEOFF CENTER OF GRAVITY

CO COMPANY ROUTE REQUEST — Consists of a variable length field.

EXAMPLE: /COKBFIKSFO01

IEI CONTENT
COMPANY ROUTE

ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 7 (cont'd)
IEI AND ASSOCIATED ELEMENTS

BASIC IEIs AND ASSOCIATED ELEMENTS (cont'd)

DD DESCENT FORECAST

Consists of a list of up to ten altitude wind entries, followed by the additional descent forecast elements.

EXAMPLE; /DD350270060.310270045.140260040.100230020;060,060030,180,M04,1013

IEI CONTENT
LIST ENTRY: ALTITUDE AND WIND
TAI ON ALTITUDE
TAI ON/OFF ALTITUDE
DESCENT TRANSITION ALTITUDE
DESCENT ISA DEVIATION
QNH

DQ DESCENT FORECAST REQUEST

Consists of a single parameter element defining the top of descent altitude.

EXAMPLE: /DQ390

IEI CONTENT
TOP OF DESCENT ALTITUDE

DT DESTINATION REPORT

Consists of a fixed format, fixed order field.

EXAMPLE: /DTKSFO,28L,0234,190023,003

IEI CONTENT
ARRIVAL AIRPORT IDENT
DESTINATION RUNWAY IDENT
PREDICTED FUEL REMAINING
ETA AT DESTINATION
REPORT STIMULUS

FN FLIGHT NUMBER

Consists of a variable length field.

EXAMPLE: /FNUAL1633A

IEI CONTENT
FLIGHT NUMBER

GA GROUND ADDRESS

Consists of a list of addresses. A copy of the network address not directly used for message routing purposes.

EXAMPLE: /GATULDDAA.HEQXESA

IEI CONTENT
LIST ENTRY: GROUND ADDRESS

ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 7 (cont'd)
IEI AND ASSOCIATED ELEMENTS

BASIC IEIs AND ASSOCIATED ELEMENTS (cont'd)

PD PERFORMANCE INITIALIZATION DATA Consists of a fixed format, fixed order field.

EXAMPLE: /PD2113,,270,,0150,23,,,,P12,M34

IEI CONTENT
ZERO FUEL WEIGHT
CRUISE CENTER OF GRAVITY
CRUISE ALTITUDE
PLAN OR BLOCK FUEL
RESERVE FUEL
COST INDEX
CRUISE WIND
TOC OR CRUISE TEMPERATURE
CLIMB TRANSITION ALTITUDE
FUEL FLOW FACTOR
DRAG FACTOR
PERF FACTOR
IDLE FACTOR
TROPOPAUSE ALTITUDE
TAXI FUEL
ZERO FUEL WEIGHT CENTER OF GRAVITY
MINIMUM FUEL TEMPERATURE

PQ PERFORMANCE INITIALIZATION REQUEST Consists of a fixed format, fixed order field.

EXAMPLE: /PD2113,,270,,0150,23,,,,P12,M34

IEI CONTENT
ZERO FUEL WEIGHT
CRUISE CENTER OF GRAVITY
CRUISE ALTITUDE
PLAN OR BLOCK FUEL
RESERVE FUEL
COST INDEX
CRUISE WIND
TOC OR CRUISE TEMPERATURE
CLIMB TRANSITION ALTITUDE
FUEL FLOW FACTOR
DRAG FACTOR
PERF FACTOR
IDLE FACTOR
TROPOPAUSE ALTITUDE
TAXI FUEL
ZERO FUEL WEIGHT CENTER OF GRAVITY
MINIMUM FUEL TEMPERATURE

ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 7 (cont'd)
IEI AND ASSOCIATED ELEMENTS

BASIC IEIs AND ASSOCIATED ELEMENTS (cont'd)

PR PERFORMANCE INITIALIZATION REPORT

Consists of a fixed format, fixed order field.

EXAMPLE: /PR2633,,270,0520,,0150,23,,,,P12,M34

IEI CONTENT
CURRENT GROSS WEIGHT
CRUISE CENTER OF GRAVITY
CRUISE ALTITUDE
FUEL REMAINING
PLAN OR BLOCK FUEL
RESERVE FUEL
COST INDEX
CRUISE WIND
TOC OR CRUISE TEMPERATURE
CLIMB TRANSITION ALTITUDE
FUEL FLOW FACTOR
DRAG FACTOR
PERF FACTOR
IDLE FACTOR
TROPOPAUSE ALTITUDE
TAXI FUEL
ZERO FUEL WEIGHT
ZERO FUEL WEIGHT CENTER OF GRAVITY
MINIMUM FUEL TEMPERATURE

RF POSITION REPORT FIX

Consists of a list of reporting points which when sequenced in flight, trigger the position report.

EXAMPLE: /RFORTIN.SEA.N3545W090256

IEI CONTENT
LIST ENTRY: WAYPOINT SEQUENCE

RI INACTIVE ROUTE

A variable length field that consists of flight plan elements that replace the inactive route. These flight plan elements define a flight plan in approximately the same fashion as ATC clearance language.

:DA:	DEPARTURE AIRPORT IDENT
:AA:	ARRIVAL AIRPORT IDENT
:CR:	COMPANY ROUTE
:R:	DEPARTURE RUNWAY IDENT
:D:	DEPARTURE PROCEDURE
:F:	FLIGHT PLAN SEGMENT
	PUBLISHED IDENT
	LATITUDE/LONGITUDE
	PLACE BEARING/PLACE BEARING
	PLACE BEARING DISTANCE
:A:	ARRIVAL PROCEDURE
:AP:	APPROACH PROCEDURE
()	ARRIVAL RUNWAY IDENT
:V:	WAYPOINT SPEED/ALTITUDE
:H:	HOLD AT WAYPOINT
:WS:	WAYPOINT STEP CLIMB
:AT:	ALONG TRACK WAYPOINT
:RP:	REPORTING POINTS
..	DIRECT FIX
.	TRANSITION OR AIRWAY VIA
:F:.	AIRWAY INTERCEPT
:IC:	INTERCEPT COURSE FROM

ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 7 (cont'd)
IEI AND ASSOCIATED ELEMENTS

BASIC IEIs AND ASSOCIATED ELEMENTS (cont'd)

RJ REJECT

Consists of a variable length field defining the message sequence number and the stimulus code.

EXAMPLE: /RJ12345,451

IEI CONTENT
MESSAGE SEQUENCE NUMBER
STIMULUS CODE

RP ACTIVE/INACTIVE ROUTE

A variable length field that consists of flight plan elements. These flight plan elements define a flight plan in approximately the same fashion as ATC clearance language.

THE FORMAT IS THE SAME AS DESCRIBED FOR THE RI IEI DESCRIPTION.

RQ RUNWAY DATA REQUEST

Consists of a fixed-list format, fixed order field consisting of data for up to two runway/intersection combinations.

EXAMPLE: /RQKSEA,31L,A9,,,156,2613,,P15,140012,1,15,2,,P40

IEI CONTENT
LIST ENTRY: DEPARTURE AIRPORT IDENT
TAKEOFF RUNWAY IDENT
RUNWAY INTERSECTION
POSITION SHIFT
RUNWAY LENGTH REMAINING
TAKEOFF CENTER OF GRAVITY
CURRENT GROSS WEIGHT
REFERENCE TAKEOFF GROSS WEIGHT
OAT OR SAT
TAKEOFF RUNWAY WIND
TAKEOFF RUNWAY CONDITION
TAKEOFF FLAPS
TAKEOFF THRUST RATING
VTR PERCENTAGE
SELECTED TEMPERATURE
BARO SETTING
FLAP/SLAT CONFIGURATION
THRUST REDUCTION ALTITUDE
ACCELERATION ALTITUDE
ENGINE-OUT ACCELERATION ALTITUDE

ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 7 (cont'd)
IEI AND ASSOCIATED ELEMENTS

BASIC IEIs AND ASSOCIATED ELEMENTS (cont'd)

RW RUNWAY DATA

Consists of a fixed-list entry format field consisting of data for up to six runway/intersection combinations followed by a departure airport.

EXAMPLE: /RW13R,A9,PO9,,0,1125,2613,2850,P23,U05,250015,1,15,1,08,P38,131139147,0,
15,1135,,130137145.31L,ETC:KBFI

IEI CONTENT
LIST ENTRY: TAKEOFF RUNWAY IDENT
    RUNWAY INTERSECTION
    POSITION SHIFT
    RUNWAY LENGTH REMAINING
    INVALID FLAG
    TRIM
    REFERENCE TAKEOFF GROSS WEIGHT
    STANDARD LIMIT TAKEOFF GROSS WEIGHT
    OAT OR SAT
    TAKEOFF RUNWAY SLOPE
    TAKEOFF RUNWAY WIND
    TAKEOFF RUNWAY CONDITION
    TAKEOFF FLAPS
    TAKEOFF THRUST RATING
    VTR PERCENTAGE
    ASSUMED TEMPERATURE
    TAKEOFF SPEEDS
    ALTERNATE THRUST RATING
    ALTERNATE FLAPS
    ALTERNATE TRIM
    ALTERNATE LIMIT TAKEOFF GROSS WEIGHT
    ALTERNATE TAKEOFF SPEEDS
    ALTERNATE ASSUMED TEMPERATURE
    FLAP/SLAT CONFIGURATION
    ALTERNATE FLAP/SLAT CONFIGURATION
    ALTERNATE VTR PERCENTAGE
DEPARTURE AIRPORT IDENT
BARO SETTING
THRUST REDUCTION ALTITUDE
ACCELERATION ALTITUDE
ENGINE-OUT ACCELERATION ALTITUDE

SN MESSAGE SEQUENCE

Consists of a variable length format field defining the message sequence number.

EXAMPLE: /SN12345

IEI CONTENT
MESSAGE SEQUENCE NUMBER

SP SCRATCHPAD

Consists of a variable length field that contains the contents of the CDU scratch pad.

EXAMPLE: /SPSCRATCHPADMESSAGE

IEI CONTENT
SCRATCHPAD

ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 7 (cont'd)
IEI AND ASSOCIATED ELEMENTS

BASIC IEIs AND ASSOCIATED ELEMENTS (cont'd)

TS TIME STAMP

Consists of a fixed length field.

EXAMPLE: /TS152533,200290

IEI CONTENT
GREENWICH MEAN TIME
DATA

WD ENROUTE WIND DATA

Consists of an altitude and a variable length list of entries that include the waypoint, the waypoint winds that apply to that altitude and the waypoint temperature.

EXAMPLE: /WD310,SEA,120015,350M35,N04030W120,130090

IEI CONTENT
WIND ALTITUDE
LIST ENTRY: WAYPOINT NAME OR POSITION
WAYPOINT WIND
WAYPOINT ALTITUDE/OAT

WQ WIND REQUEST

Consists of a list of elements defining altitudes for which winds are requested, followed by a list of elements defining waypoints in the route for which the request is being made.

EXAMPLE: /WQ350.370.390.410:SEA.N4030W110.ORD.ETC

IEI CONTENT
LIST ENTRY: WIND LEVEL ALTITUDE
LIST ENTRY: WIND LEVEL WAYPOINT

ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 7 (cont'd)
IEI AND ASSOCIATED ELEMENTS

IMIs AND ASSOCIATED ELEMENTS

POS POSITION REPORT — Consists of elements used to define a position report.

EXAMPLE: POSN47261W122185,SEA,093118,350,ORTIN,093436,BARRO,M32,120015,0485

CURRENT POSITION
(CROSSED) WAYPOINT IDENT
GREENWICH MEAN TIME
CURRENT ALTITUDE
GOTO (NEXT) WAYPOINT IDENT
ETA AT GOTO WAYPOINT
GOTO+1 (FOLLOWING) WAYPOINT IDENT
STATIC AIR TEMPERATURE (SAT)
ACTUAL WIND
FUEL REMAINING

REJ REJECT — Consists of the uplinked IMI, time uplink is received and a list of error codes.

EXAMPLE: REJPWI,HHMMSS,103,,006,CB/.108,,CB,/CB.109,,001,NOVALIDIEI/TShhmmss,mmddyy

UPLINKED IMI
TIME UPLINK RECEIVED
LIST ENTRY: ERROR TYPE CODE
- ERROR DATA CODE
- LITERAL ERROR DATA
- EXTENDED REJECTION DATA

RES RESPONSE — Consists of the uplinked IMI and either the AC, AK or RJ IEI.

EXAMPLE: RESFPN/AC,073

ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 7 (cont'd)
IEI AND ASSOCIATED ELEMENTS

EXTENDED IEIs AND ASSOCIATED ELEMENTS

AA COMPANY PREFERRED ALTERNATES REQUEST

EXAMPLE: /AAN47261W122185,BOE123,KSEA,KSFO,SEASFO

CURRENT POSITION
FLIGHT NUMBER
DEPARTURE AIRPORT IDENT
ARRIVAL AIRPORT IDENT
COMPANY ROUTE

AB ALTERNATES FLIGHT LIST REQUEST

EXAMPLE: /ABN47261W122185,BOE123,KSEA,KSFO, SEASFO

CURRENT POSITION
FLIGHT NUMBER
DEPARTURE AIRPORT IDENT
ARRIVAL AIRPORT IDENT
COMPANY ROUTE

AE COMPANY PREFERRED ALTERNATES DATA

EXAMPLE: /AEKSEA,1,09020,350P10,HUMPP,KMWH,2,080100,300M5,ELN:300,1290

LIST ENTRY: COMPANY PREFERRED ALTN IDENT
COMPANY PREFERRED ALTN PRIORITY
COMPANY PREFERRED ALTN WIND
COMPANY PREFERRED ALTN ALTITUDE/OAT
COMPANY PREFERRED ALTN OVERHEAD FIX
COMPANY PREFERRED ALTN ALTITUDE
COMPANY PREFERRED ALTN SPEED
COMPANY PREFERRED ALTN OFFSET

AI ALTERNATE INFORMATION DATA — Consists of a variable length list of entries consisting of alternate information.

EXAMPLE: /AIKSFO,D,1423,230,120045,M15.KLAX,M,1700,310,325020,P34

IEI CONTENT
LIST ENTRY: ALTERNATE IDENT
ALTERNATE TYPE
DISTANCE TO ALTERNATE
ALTITUDE TO ALTERNATE
ESTIMATED WIND TO ALTERNATE
TEMPERATURE AT ALTERNATE

AN ALTERNATES INHIBIT DATA

EXAMPLE: /ANKPAE.KSEA

LIST ENTRY: ALTN INHIBIT

ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 7 (cont'd)
IEI AND ASSOCIATED ELEMENTS

EXTENDED IEIs AND ASSOCIATED ELEMENTS (cont'd)

AP SUPPLEMENTAL NDB AIRPORTS — Consists of a list of airports to be included in the supplemental navigation data base.

EXAMPLE: /APKABC,N39152W121185,01740,E10.KDEF,N37440W119118,00900,W12

IEI CONTENT
LIST ENTRY: AIRPORT IDENT
AIRPORT LAT/LON
AIRPORT ELEVATION
AIRPORT MAGVAR

AR ALTERNATE INFORMATION REPORT — Consists of a variable length list consisting of alternate destination data.

EXAMPLE: /ARKSFO,D,132456,0120,0123,310,310050.KLAX,D,142523,0109,0206,325,340100

IEI CONTENT
LIST ENTRY: ALTERNATE IDENT
ALTERNATE TYPE
ETA AT ALTERNATE DESTINATION
FUEL REMAINING AT ALTERNATE DESTINATION
DISTANCE TO ALTERNATE
ALTITUDE TO ALTERNATE
CRUISE WIND TO ALTERNATE

AS ALTERNATES FLIGHT LIST DATA

EXAMPLE: /ASKDEN,18030,350M5.KLAX,02040,350P10

LIST ENTRY: ALTN FLIGHT LIST IDENT
ALTN FLIGHT LIST WIND
ALTN FLIGHT LIST ALTITUDE/OAT

AW ALTERNATE WIND DATA — Consists of a multi-parameter element defining the altitude and wind.

EXAMPLE: /AW220035040

IEI CONTENT
ALTITUDE AND WIND

CB CLIMB WIND DATA — Consists of a list of up to ten altitude wind entries.

EXAMPLE: /CB350270060.310270045.140260040.100230020

IEI CONTENT
LIST ENTRY: ALTITUDE AND WIND

ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 7 (cont'd)
IEI AND ASSOCIATED ELEMENTS

EXTENDED IEIs AND ASSOCIATED ELEMENTS (cont'd)

CQ CLIMB FORECAST REQUEST

Consists of a single parameter element defining the top of climb altitude.

EXAMPLE: /CQ370

IEI CONTENT
CRUISE ALTITUDE

DI DOWNLINK TIME INFORMATION

Consists of a fixed format, fixed order field containing time information.

EXAMPLE: /D1051632.-51635.051636

IEI CONTENT
TRIGGER TRIPPED TIME
DOWNLINK GENERATION TIME
GREENWICH MEAN TIME

ED SUPPLEMENTAL EFFECTIVITY DATE

Consists of a fixed length field defining the effectivity date of the supplemental navigation data base.

EXAMPLE: /EDJAN0191

IEI CONTENT
EFFECTIVITY DATE

FH FLIGHT PLAN HISTORY

Consists of a variable length list of parameters that are linked to the different waypoints of the flight plan.

EXAMPLE: /FHLACRE,132034,240K,0700,0197,P23,132016,235,Y,150,012,ILS32R,1100,etc

IEI CONTENT
LIST ENTRY: PREDICTED WAYPOINT IDENT
ETA AT PREDICTED WAYPOINT
PREDICTED AIRSPEED
ALTITUDE TO PREDICTED WAYPOINT
FUEL REMAINING AT PREDICTED WAYPOINT
OAT AT PREDICTED WAYPOINT
WIND AT PREDICTED WAYPOINT
TAS AT PREDICTED WAYPOINT
PROCEDURE INDICATOR
COURSE INTO PREDICTED WAYPOINT
DISTANCE TO PREDICTED WAYPOINT
PROCEDURE IDENTIFIER
CURRENT GROSS WEIGHT

ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 7 (cont'd)
IEI AND ASSOCIATED ELEMENTS

EXTENDED IEIs AND ASSOCIATED ELEMENTS (cont'd)

FP FUEL PLANNING Consists of a fixed format, fixed order field.

EXAMPLE: /FP1605,1100,12,220,08,140,110,P26,360

IEI CONTENT
TAKEOFF GROSS WEIGHT
LANDING GROSS WEIGHT
TAXI FUEL
TRIP FUEL
RESERVE FUEL
ALTERNATE FUEL
FINAL FUEL
EXTRA FUEL
PLAN OR BLOCK FUEL

GL GENERAL DATA Consists of a fixed order field.

EXAMPLE: /GL290690,757-200,,BE49005001,NWA105,BFMWH01,KBFI,KMWH,10,1750,
PW2040,KPDX,BFIMWO02,230,255

IEI CONTENT
DATE
AIRCRAFT TYPE
ENGINE THRUST
NAVIGATION DATA BASE IDENT
FLIGHT NUMBER
COMPANY ROUTE
DEPARTURE AIRPORT IDENT
ARRIVAL AIRPORT IDENT
COST INDEX
ZERO FUEL WEIGHT
ENGINE TYPE
ALTERNATE DESTINATION
ALTERNATE COMPANY ROUTE
CRUISE ALTITUDE
CENTER OF GRAVITY

ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 7 (cont'd)
IEI AND ASSOCIATED ELEMENTS

EXTENDED IEIs AND ASSOCIATED ELEMENTS (cont'd)

GP GENERAL PREDICTIONS

Consists of a fixed format, fixed order field.

EXAMPLE: /GPKBFI,140000,0201,0280,230,2700,2180,,,,,,,255,KSEA,0140,14033,206,230

IEI CONTENT
ARRIVAL AIRPORT IDENT
ETA AT DESTINATION
DISTANCE TO DESTINATION
PREDICTED DESTINATION FUEL
PRIMARY CRUISE ALTITUDE
TAKEOFF GROSS WEIGHT
LANDING GROSS WEIGHT
TOTAL FUELFOB
PLAN OR BLOCK FUEL
TRIP FUEL
RESERVE FUEL
EXTRA FUEL
FINAL FUEL
CENTER OF GRAVITY
ALTERNATE DESTINATION
ALTERNATE FUEL
ALTERNATE TIME
DISTANCE TO ALTERNATE
ALTERNATE CRUISE ALTITUDE

MQ MOD WIND REQUEST

Consists of a list of elements defining altitudes for which winds are requested, followed by a list of elements defining waypoints in the modified route for which the request is being made.

EXAMPLE: /MQ350.370.390.410:SEA.N4030W110.ORD.ETC

IEI CONTENT
LIST ENTRY: WIND LEVEL ALTITUDE
LIST ENTRY: WIND LEVEL WAYPOINT

MW MEAN WIND DATA

Consists of a fixed order, fixed format field.

EXAMPLE: /MWKBFI,KMWH,P045

IEI CONTENT
DEPARTURE AIRPORT IDENT
ARRIVAL AIRPORT IDENT
MEAN WIND

ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 7 (cont'd)
IEI AND ASSOCIATED ELEMENTS

EXTENDED IEIs AND ASSOCIATED ELEMENTS (cont'd)

NV SUPPLEMENTAL NDB NAVAIDS

Consists of a list of navaids to be included in the supplemental navigation data base.

EXAMPLE: /NVABCD,N25131W108473,11300,VTH,01250,W11

IEI CONTENT
LIST ENTRY: NAVAID IDENT
NAVAID LAT/LON
FREQUENCY
CLASS
NAVAID ELEVATION
NAVAID MAGVAR

PG PAGE INFO

EXAMPLE: /PG13

PAGE INFO

PH FLIGHT PHASE

Consists of a fixed format field defining FMC flight phase.

EXAMPLE: /PH2

IEI CONTENT
FLIGHT PHASE

PL PERFORMANCE LIMITS

Consists of a fixed format, fixed order field.

EXAMPLE: /PL25,210340,220340,240320,500820,650820,500780

IEI CONTENT
TIME ERROR TOLERANCE
CLIMB CAS LIMITS
CRUISE CAS LIMITS
DESCENT CAS LIMITS
CLIMB MACH LIMITS
CRUISE MACH LIMITS
DESCENT MACH LIMITS

RA ALTERNATE ROUTE

A variable length field that consists of flight plan elements that replace the inactive route. These flight plan elements define a flight plan in approximately the same fashion as ATC clearance language.

EXAMPLE:

THE FORMAT IS THE SAME AS DESCRIBED FOR THE RI IEI DESCRIPTION.

ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 7 (cont'd)
IEI AND ASSOCIATED ELEMENTS

EXTENDED IEIs AND ASSOCIATED ELEMENTS (cont'd)

RM	ROUTE MODIFICATION	A variable length field that consists of flight plan elements that replace the inactive route. These flight plan elements define a flight plan in approximately the same fashion as ATC clearance language. The RM cannot contain the "CR: or :DA: flight plan element identifiers.

THE FORMAT IS THE SAME AS DESCRIBED FOR THE RI IEI DESCRIPTION WITH THE ADDITION OF THE FOLLOWING:

:LO: LATERAL OFFSET

RR	RUNWAY DATA REPORT	Consists of a fixed format, fixed order field.

EXAMPLE: /RRKBFI,13R,A9,P09,,155,1125,2855,,P25,U35,250015,1,15,2,,P40,108119126

IEI CONTENT
DEPARTURE AIRPORT IDENT
TAKEOFF RUNWAY IDENT
RUNWAY INTERSECTION
POSITION SHIFT
RUNWAY LENGTH REMAINING
TAKEOFF CENTER OF GRAVITY
TRIM
CURRENT GROSS WEIGHT
REFERENCE TAKEOFF GROSS WEIGHT
OAT OR SAT
TAKEOFF RUNWAY SLOPE
TAKEOFF RUNWAY WIND
TAKEOFF RUNWAY CONDITION
TAKEOFF FLAPS
TAKEOFF THRUST RATING
VTR PERCENTAGE
SELECTED TEMPERATURE
TAKEOFF SPEEDS
BARO SETTING
FLAP/SLAT CONFIGURATION
THRUST REDUCTION ALTITUDE
ACCELERATION ALTITUDE
ENGINE-OUT ACCELERATION ALTITUDE

ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 7 (cont'd)
IEI AND ASSOCIATED ELEMENTS

EXTENDED IEIs AND ASSOCIATED ELEMENTS (cont'd)

SD SUPPLEMENTAL NAVIGATION DATABASE — Consists of an effectivity date and three separate lists that define the supplemental data base airport, navaid and waypoint elements in that order.

EXAMPLE: /SDJAN0190,KABC,N45240W119235,00911,W23.KJLL,etc:ABC,N45354W122506,11550, VTH,00530,W21.SEE,etc:ABCDE,N45354W122506,,,,W22.WPT01,etc

IEI CONTENT

EFFECTIVITY DATA

LIST ENTRY: AIRPORT IDENT
AIRPORT LAT/LON
AIRPORT ELEVATION
AIRPORT MAGVAR

LIST ENTRY: NAVAID IDENT
NAVAID LAT/LON
FREQUENCY
CLASS
NAVAID ELEVATION
NAVAID MAGVAR

LIST ENTRY: WAYPOINT IDENT
WAYPOINT LAT/LON
REFERENCE IDENT
REFERENCE LAT/LON
RADIAL/DISTANCE
WAYPOINT MAGVAR

WE WIND VECTOR MAGNITUDE DIFFERENCE — Consists of a fixed length field used to define the downlink trigger threshold for wind discrepancies.

EXAMPLE: /WE020

IEI CONTENT

WIND VECTOR MAGNITUDE DIFFERENCE

WM ENROUTE WIND MODIFICATION — Consists of an altitude and a variable length list of entries that include the waypoint, the waypoint winds that apply to that altitude and the waypoint temperature.

EXAMPLE: /WM310,SEA,120075,350M35.N04030W120,130090

IEI CONTENT

WIND ALTITUDE

LIST ENTRY: WAYPOINT NAME OR POSITION
WAYPOINT WIND
WAYPOINT ALTITUDE/OAT

ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 7 (cont'd)
IEI AND ASSOCIATED ELEMENTS

EXTENDED IEIs AND ASSOCIATED ELEMENTS (cont'd)

WP SUPPLEMENTAL NDB WAYPOINTS — Consists of a list of waypoints to be included in the supplemental navigation data base.

EXAMPLE: /WPEFGH,N21421W101113,SRP,1090020,W09

IEI CONTENT
LIST ENTRY: WAYPOINT IDENT
WAYPOINT LAT/LON
REFERENCE IDENT
RADIAL/DISTANCE
WAYPOINT MAGVAR

WR ALTERNATE AIRPORT WEATHER REQUEST — Consists of a variable length list of entries defining destination and alternate identifiers.

EXAMPLE: /WRKLAX.KSFO.KPHX

IEI CONTENT
LIST ENTRY: DESTINATION AND ALTERNATE IDENTS

ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 8
ELEMENT DEFINITIONS

COMMENTARY

This section contains an alphabetical table of defined elements indicating the formats and attributes of each element. This section will be updated as the need for new elements is identified. Users are requested to advise the AEEC staff when such a need arises.

NOTE ⟨1⟩ This element may require one or more elements to completely define the desired data.

NOTE ⟨2⟩ Some implementations require that this element be uplinked in a fixed length format of maximum character length.

NOTE ⟨3⟩ See Section 10 for further definition of codes.

NOTE ⟨4⟩ Millibars = Hectopascals = 100 newton/meter^2

ELEMENT DESCRIPTION	TYPE	LENGTH TYPE	ELEM TYPE	CHAR LENGTH	SCALE	UNITS	NOTES
ACARS CONFIG IDENT NUMBER	V	S	AN	10			
ACCELERATION ALTITUDE	V	S	N	5	1	Feet	
ACT PLAN CRUISE ALTITUDE	V	S	N	3	100	Feet	
ACTIVE CRZ WAYPOINT	V	S	AN	13			
ACTIVE CRZ WAYPOINT/WIND	V	S	AN	13			
ACTIVE DESCENT WIND	V	M	N	9			
ALTITUDE	F	S	N	3	100	Feet	
DIRECTIONAL	F	S	N	3	1	Degrees	
MAGNITUDE	V	S	N	3	1	Knots	⟨2⟩
ACTUAL WIND	V	M	N	6			
DIRECTIONAL	F	S	N	3	1	Degrees	
MAGNITUDE	V	S	N	3	1	Knots	
AIRCRAFT TYPE	V	S	AN	11			
AIRPORT ELEVATION	V	S	N	5	1	Feet	
AIRPORT IDENT	V	S	AN	4			

V = VARIABLE
F = FIXED
S = SINGLE PARAMETER
M = MULTIPARAMETER
A = ALPHA
AN = ALPHANUMERIC
N = NUMERIC
D = DIRECTIONAL

ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 8 (cont'd)
ELEMENT DEFINITIONS

ELEMENT DESCRIPTION	TYPE	LENGTH TYPE	ELEM TYPE	CHAR LENGTH	SCALE	UNITS	NOTES
AIRPORT LAT/LON	F	S	AN	13			
DIRECTIONAL	F		A	1		N=North S=South	
DEGREES	F		N	2	1	Degrees	
MINUTES	F		N	3	0.1	Minutes	
DIRECTIONAL	F		A	1		E=East W=West	
DEGREES	F		N	3	1	Degrees	
MINUTES	F		N	3	0.1	Minutes	
AIRPORT MAGVAR	V	S	AN	3			
DIRECTIONAL	F		A	1		E=East W=West	
MAGNITUDE	V		N	2	1	Degrees	
ALTERNATE ASSUMED TEMPERATURE	V	D	AN	3			
DIRECTIONAL	F		A	1		P=Plus M=Minus	
MAGNITUDE	V		N	2	1	°C	
ALTERNATE COMPANY ROUTE	V	S	AN	10			
ALTERNATE CRUISE ALTITUDE	V	S	N	3	100	Feet	
ALTERNATE DESTINATION	V	S	AN	4			⟨1⟩
ALTERNATE FLAP/SLAT CONFIGURATION	F	S	N	1			
ALTERNATE FLAPS	V	S	N	2	1	Degrees	
ALTERNATE FUEL	V	S	N	4	0.1	Klbs	
ALTERNATE IDENT	V	S	AN	10			
ALTERNATE LIMIT TAKEOFF GROSS WT	V	S	N	4	0.1	Klbs	

V = VARIABLE
F = FIXED
S = SINGLE PARAMETER
M = MULTIPARAMETER
A = ALPHA
AN = ALPHANUMERIC
N = NUMERIC
D = DIRECTIONAL

ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 8 (cont'd)
ELEMENT DEFINITIONS

ELEMENT DESCRIPTION	TYPE	LENGTH TYPE	ELEM TYPE	CHAR LENGTH	SCALE	UNITS	NOTES
ALTERNATE TAKEOFF SPEEDS	F	M	N	9			
V1	F	S	N	3	1	Knots	
VR	F	S	N	3	1	Knots	
V2	F	S	N	3	1	Knots	
ALTERNATE THRUST RATING	F	S	N	1		0=No derate 1=Derate 1 2=Derate 2 | 9=Derate 9	
ALTERNATE TIME	F	M	N	6			⟨1⟩
HOURS	F	S	N	2	1	Hour	
MINUTES	F	S	N	2	1	Minute	
SECONDS	F	S	N	2	1	Second	
ALTERNATE TRIM	V	D	AN	5			
DIRECTIONAL	F		A	1		P=Plus M=Minus	
MAGNITUDE	V		N	4	0.01	Degrees	
ALTERNATE TYPE	F	S	A	1		M=Missed Appr D=Dir to from Present Pos	⟨1⟩
ALTERNATE VTR PERCENTAGE	V	S	N	2	1	Percent	
ALTERNATE WIND	V	M	N	9			
ALTITUDE	F	S	N	3	100	Feet	
DIRECTIONAL	F	S	N	3	1	Degrees	
MAGNITUDE	V	S	N	3	1	Knots	
ALTITUDE AND WIND	V	M	N	9			
ALTITUDE	F	S	N	3	100	Feet	
DIRECTIONAL	F	S	N	3	1	Degrees	
MAGNITUDE	V	S	N	3	1	Knots	
ALTITUDE TO ALTERNATE	V	S	N	3	100	Feet	⟨1⟩
ALTITUDE TO PREDICTED WPT	V	S	N	4	10	Feet	⟨1⟩

V = VARIABLE
F = FIXED
S = SINGLE PARAMETER
M = MULTIPARAMETER
A = ALPHA
AN = ALPHANUMERIC
N = NUMERIC
D = DIRECTIONAL

ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 8 (cont'd)
ELEMENT DEFINITIONS

ELEMENT DESCRIPTION	TYPE	LENGTH TYPE	ELEM TYPE	CHAR LENGTH	SCALE	UNITS	NOTES
ALTN FLIGHT LIST ALT/OAT	V	M	AN	6			
ALTITUDE	F	S	N	3	100		
DIRECTIONAL	F	D	A	1			
MAGNITUDE	V		N	2	1		
ALTN FLIGHT LIST IDENT	V	S	AN	4			
ALTN FLIGHT LIST WIND	V	D	N	6			
DIRECTIONAL	F		N	3	1		
MAGNITUDE	V		N	3	1		
ALTN INHIBIT	V	S	AN	4			
ARRIVAL AIRPORT IDENT	V	S	AN	4			
ASSUMED TEMPERATURE	V	D	AN	3			
DIRECTIONAL	F		A	1		P=Plus M=Minus	
MAGNITUDE	V		N	2	1	°C	
BARO SETTING	V	D	AN	5			
DIRECTIONAL	F		A	1		H=QNH E=QFE	
MAGNITUDE	V		N	4	1	Hectopascals	4
CENTER IRS POSITION	F	S	AN	13			
DIRECTIONAL	F		A	1		N=North S=South	
DEGREES	F		N	2	1	Degrees	
MINUTES	F		N	3	0.1	Minutes	
DIRECTIONAL	F		A	1		E=East W=West	
DEGREES	F		N	3	1	Degrees	
MINUTES	F		N	3	0.1	Minutes	
CENTER OF GRAVITY	V	S	N	3	0.1	Percent	
CLASS OF NAVAID	V	S	A	4			1
CLIMB CAS LIMITS	F	M	N	6			
MINIMUM CLB CAS	F	S	N	3	1	Knots	
MAXIMUM CLB CAS	F	S	N	3	1	Knots	

V = VARIABLE S = SINGLE PARAMETER A = ALPHA N = NUMERIC
F = FIXED M = MULTIPARAMETER AN = ALPHANUMERIC D = DIRECTIONAL

ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 8 (cont'd)
ELEMENT DEFINITIONS

ELEMENT DESCRIPTION	TYPE	LENGTH TYPE	ELEM TYPE	CHAR LENGTH	SCALE	UNITS	NOTES
CLIMB MACH LIMITS	F	M	N	6			
MINIMUM CLB MACH	F	S	N	3	0.001	Mach	
MAXIMUM CLB MACH	F	S	N	3	0.001	Mach	
CLIMB TRANSITION ALTITUDE	V	S	N	3	100	Feet	
CLIMB WIND	V	M	N	9			
ALTITUDE	F	S	N	3	100	Feet	
DIRECTIONAL	F	S	N	3	1	Degrees	
MAGNITUDE	V	S	N	3	1	Knots	
COMPANY DISTRIBUTION	V	S	AN	10			
COMPANY PREFERRED ALTN ALTITUDE	V	S	N	3	100	Feet	
COMPANY PREFERRED ALTN ALT/OAT	V	M	AN	6			
ALTITUDE	F	S	N	3	100		
DIRECTIONAL	F	D	A	1			
MAGNITUDE	V		N	2	1		
COMPANY PREFERRED ALTN IDENT	V	S	AN	4			
COMPANY PREFERRED ALTN OFFSET	V	D	AN	3			
DIRECTIONAL	F		A	1			
DISTANCE	V		N	2	1		
COMPANY PREF ALTN OVERHEAD FIX	V	S	AN	13			
COMPANY PREFERRED ALTN PRIORITY	F	S	N	1			
COMPANY PREFERRED ALTN SPEED	V	M	N	4			
TYPE	F	S	N	1			
SPEED VALUE	V	S	N	S	1, 0.001		
COMPANY PREFERRED ALTN WIND	V	M	N	6			
DIRECTIONAL	F	S	N	3	1		
MAGNITUDE	V	S	N	3	1		
COMPANY ROUTE	V	S	AN	10			

V = VARIABLE
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D = DIRECTIONAL

ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 8 (cont'd)
ELEMENT DEFINITIONS

ELEMENT DESCRIPTION	TYPE	LENGTH TYPE	ELEM TYPE	CHAR LENGTH	SCALE	UNITS	NOTES
COST INDEX	V	S	N	4			
COURSE IN	F	S	N	3	1	Degrees	
COURSE INTO PREDICTED WAYPOINT	V	S	N	3	1	Degrees	1
CROSS TRACK DEVIATION	V	D	AN	4			
DIRECTIONAL	F		A	1		L or R	
DISTANCE	V		N	3	0.1	NM	
CROSSED WAYPOINT IDENT	V	S	AN	13			
CRUISE ALTITUDE	V	S	N	3	100	Feet	
CRUISE CAS LIMITS	F	M	N	6			
MINIMUM CRZ CAS	F	S	N	3	1	Knots	
MAXIMUM CRZ CAS	F	S	N	3	1	Knots	
CRUISE CENTER OF GRAVITY	V	S	N	3	0.1	Percent	
CRUISE MACH LIMITS	F	M	N	6			
MINIMUM CRZ MACH	F	S	N	3	0.001	Mach	
MAXIMUM CRZ MACH	F	S	N	3	0.001	Mach	
CRUISE WAYPOINT WIND	V	M	N	6			
DIRECTIONAL	F	S	N	3	1	Degrees	
MAGNITUDE	V	S	N	3	1	Knots	2
CRUISE WIND	V	M	N	6			
DIRECTIONAL	F	S	N	3	1	Degrees	
MAGNITUDE	V	S	N	3	1	Knots	2
CRUISE WIND TO ALTERNATE	V	M	N	6			1
DIRECTIONAL	F	S	N	3	1	Degrees	
MAGNITUDE	V	S	N	3	1	Knots	
CURRENT ALTITUDE	V	S	N	3	100	Feet	

V = VARIABLE
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ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 8 (cont'd)
ELEMENT DEFINITIONS

ELEMENT DESCRIPTION	TYPE	LENGTH TYPE	ELEM TYPE	CHAR LENGTH	SCALE	UNITS	NOTES
CURRENT CALIBRATED AIRSPEED	F	D	AN	4	1 or		
SPEED VALUE CAS/MACH	F		N	3	0.001	Knots, Mach	
UNIT IDENTIFIER	F		A	1		K or M	
CURRENT GROSS WEIGHT	V	S	N	4	0.1	Klbs	
CURRENT GROSS WEIGHT AT PRED WPT	V	S	N	4	0.1	Klbs	⟨1⟩
CURRENT GROUND SPEED	F	S	N	3	1	Knots	
CURRENT POSITION	F	S	AN	13			
DIRECTIONAL	F		A	1		N=North S=South	
DEGREES	F		N	2	1	Degrees	
MINUTES	F		N	3	0.1	Minutes	
DIRECTIONAL	F		A	1		E=East W=West	
DEGREES	F		N	3	1	Degrees	
MINUTES	F		N	3	0.1	Minutes	
CURRENT TRUE AIRSPEED	F	D	AN	4	1 or		
SPEED VALUE CAS/MACH	F		N	3	0.001	Knots,Mach	
UNIT IDENTIFIER	F		A	1		K or M	
CURRENT VERTICAL SPEED	V	D	AN	5			
DIRECTIONAL	F		A	1		U or D	
SPEED VALUE	V		N	4	1	Feet/min	
DATE	F	M	N	6			
DAY	F	S	N	2		Day	
MONTH	F	S	N	2		Month	
YEAR	F	S	N	2		Year	
DEPARTURE AIRPORT IDENT	V	S	AN	4			
DESCENT CAS LIMITS	F	M	N	6			
MINIMUM DES CAS	F	S	N	3	1	Knots	
MAXIMUM DES CAS	F	S	N	3	1	Knots	

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ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 8 (cont'd)
ELEMENT DEFINITIONS

ELEMENT DESCRIPTION	TYPE	LENGTH TYPE	ELEM TYPE	CHAR LENGTH	SCALE	UNITS	NOTES
DESCENT ISA DEVIATION	V	D	AN	3			
DIRECTIONAL	F		A	1		P=Plus M=Minus	
MAGNITUDE	V		N	2	1	°C	
DESCENT MACH LIMITS	F	M	N	6			
MINIMUM DES MACH	F	S	N	3	0.001	Mach	
MAXIMUM DES MACH	F	S	N	3	0.001	Mach	
DESCENT TRANSITION ALTITUDE	V	S	N	3	100	Feet	
DESCENT WIND	V	M	N	9			
ALTITUDE	F	S	N	3	100	Feet	⟨2⟩
DIRECTIONAL	F	S	N	3	1	Degrees	
MAGNITUDE	V	S	N	3	1	Knots	
DESIRED TRACK	V	S	N	3	1	Degrees	
DESTINATION AND ALTERNATE IDENTS	V	S	AN	10			
DESTINATION RUNWAY IDENT	F	D	AN	3			
RUNWAY NUMBER	F		N	2			
RUNWAY SUFFIX	F		A	1		L=Left C=Center R=Right O=None	
DISTANCE TO ALTERNATE	V	S	N	4	1	NM	
DISTANCE TO DESTINATION	V	S	N	4	1	NM	
DISTANCE TO PREDICTED WAYPOINT	V	S	N	4	1	NM	⟨1⟩
DISTANCE TO WAYPOINT	V	S	N	4	1	NM	
DOWNLINK GENERATION TIME	F	M	N	6			
HOURS	F	S	N	2	1	Hours	
MINUTES	F	S	N	2	1	Minutes	
SECONDS	F	S	N	2	1		

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ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 8 (cont'd)
ELEMENT DEFINITIONS

ELEMENT DESCRIPTION	TYPE	LENGTH TYPE	ELEM TYPE	CHAR LENGTH	SCALE	UNITS	NOTES
DRAG FACTOR	V	D	AN	3			
DIRECTIONAL	F		A	1		P=Plus M=Minus	
MAGNITUDE	V		N	2	0.1	Percent	
EFFECTIVITY DATE	F	M	AN	7			
MONTH	F	S	A	3		Month	
DAY	F	S	A	2		Day	
YEAR	F	S	N	2		Year	
ENGINE-OUT ACCELERATION ALTITUDE	V	S	N	5	1	Feet	
ENGINE THRUST	F	S	N	3	0.1	Klbs	
ENGINE TYPE	V	S	AN	15			
ENTERED IRS HEADING	F	S	N	3	1	Degrees	
ERROR DATA CODE	F	S	N	3			3
ERROR TYPE CODE	F	S	N	3			3
ESTIMATED WIND TO ALTERNATE	V	M	N	6			1
DIRECTIONAL	F	S	N	3	1	Degrees	
MAGNITUDE	V	S	N	3	1	Knots	2
ETA AT ALTERNATE DESTINATION	F	M	N	6			1
HOURS	F	S	N	2	1	Hour	
MINUTES	F	S	N	2	1	Minute	
SECONDS	F	S	N	2	1	Second	
ETA AT DESTINATION	F	M	N	6			
HOURS	F	S	N	2	1	Hour	
MINUTES	F	S	N	2	1	Minute	
SECONDS	F	S	N	2	1	Second	
ETA AT GOTO WAYPOINT	F	M	N	6			
HOURS	F	S	N	2	1	Hour	
MINUTES	F	S	N	2	1	Minute	
SECONDS	F	S	N	2	1	Second	

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ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 8 (cont'd)
ELEMENT DEFINITIONS

ELEMENT DESCRIPTION	TYPE	LENGTH TYPE	ELEM TYPE	CHAR LENGTH	SCALE	UNITS	NOTES
ETA AT PREDICTED WAYPOINT	F	M	N	6			1
HOURS	F	S	N	2	1	Hour	
MINUTES	F	S	N	2	1	Minute	
SECONDS	F	S	N	2	1	Second	
ETA CHANGE VARIABLE	F	S	N	1	1	Minutes	
EXTENDED REJECTION DATA	V	S	AN	25			
EXTRA FUEL	V	D	AN	4			
DIRECTIONAL	F		A	1		P=Plus M=Minus	
MAGNITUDE	V		N	3	0.1	Klbs	
FINAL FUEL	V	S	N	4	0.1	Klbs	
FLAP/SLAT CONFIGURATION	F	S	N	1			
FLIGHT NUMBER	V	S	AN	10			
FLIGHT PATH ANGLE	V	D	AN	3			
DIRECTIONAL	F		A	1		P=Plus M=Minus	
ANGLE	V		N	2	0.1	Degrees	
FLIGHT PHASE	F	S	N	1		0=Preflight 1=Takeoff 2=Climb 3=Cruise 4=Descent 5=Approach 6=Go Around 7=Done	
FMC BEST POSITION	F	S	AN	13			
DIRECTIONAL	F		A	1		N=North S=South	
DEGREES	F		N	2	1	Degrees	
MINUTES	F		N	3	0.1	Minutes	
DIRECTIONAL	F		A	1		E=East W=West	
DEGREES	F		N	3	1	Degrees	
MINUTES	F		N	3	0.1	Minutes	

V = VARIABLE
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ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 8 (cont'd)
ELEMENT DEFINITIONS

ELEMENT DESCRIPTION	TYPE	LENGTH TYPE	ELEM TYPE	CHAR LENGTH	SCALE	UNITS	NOTES
FMC POSITION PRIOR TO POS UPDATE	F	S	AN	13			
DIRECTIONAL	F		A	1		N=North S=South	
DEGREES	F		N	2	1	Degrees	
MINUTES	F		N	3	0.1	Minutes	
DIRECTIONAL	F		A	1		E=East W=West	
DEGREES	F		N	3	1	Degrees	
MINUTES	F		N	3	0.1	Minutes	
FMC SOFTWARE PART NUMBER	F	S	N	10			
FMC SYSTEM DATE	F	M	N	6			
DAY	F	S	N	2	1		
MONTH	F	S	N	2	1		
YEAR	F	S	N	2	1		
FMC SYSTEM TIME	F	M	N	6			
HOURS	F	S	N	2	1	Hours	
MINUTES	F	S	N	2	1	Minutes	
SECONDS	F	S	N	2	1	Seconds	
FREQUENCY	F	S	N	5	0.01	MHz	1
FUEL AT DESTINATION	V	S	N	4	0.1	Klbs	
FUEL FLOW FACTOR	V	D	AN	3			
DIRECTIONAL	F		A	1		P=Plus M=Minus	
MAGNITUDE	V		N	2	0.1	Percent	
FUEL REMAINING	V	S	N	4	0.1	Klbs	
FUEL REMAINING AT ALTN DEST	V	S	N	4	0.1	Klbs	1
FUEL REMAINING AT PREDICTED WPT	V	S	N	4	0.1	Klbs	1
GOTO (NEXT) WPT IDENT	V	S	AN	13			
GOTO+1 (FOLLOWING) WPT IDENT	V	S	AN	13			

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D = DIRECTIONAL

ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 8 (cont'd)
ELEMENT DEFINITIONS

ELEMENT DESCRIPTION	TYPE	LENGTH TYPE	ELEM TYPE	CHAR LENGTH	SCALE	UNITS	NOTES
GREENWICH MEAN TIME	F	M	N	6			
HOURS	F	S	N	2	1	Hour	
MINUTES	F	S	N	2	1	Minute	
SECONDS	F	S	N	2	1	Seconds	
GROUND ADDRESS	V	S	AN	7			
HOLD EFC TIME	F	M	N	4			
HOURS	F	S	N	2	1	Hours	
MINUTES	F	S	N	2	1	Minutes	
IDLE FACTOR	V	D	AN	3			
DIRECTIONAL	F		A	1		P=Plus M=Minus	
MAGNITUDE	V		N	2	0.1	Percent	
INACTIVE COMPANY ROUTE	V	S	AN	10			
INVALID FLAG	F	S	N	1		Nothing 0=Valid 1=Invalid	
IRS-C MODE	F	S	N	1		1=Align 2=Nav 3=Attitude	
IRS-L MODE	F	S	N	1		1=Align 2=Nav 3=Attitude	
IRS-R MODE	F	S	N	1		1=Align 2=Nav 3=Attitude	
IRS MONITOR	F	M	N	9			
LEFT IRS DRIFT	F	S	N	3	0.1	NM/hour	
CENTER IRS DRIFT	F	S	N	3	0.1	NM/hour	
RIGHT IRS DRIFT	F	S	N	3	0.1	NM/hour	
LABEL CODE	F	S	N	3			

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ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 8 (cont'd)
ELEMENT DEFINITIONS

ELEMENT DESCRIPTION	TYPE	LENGTH TYPE	ELEM TYPE	CHAR LENGTH	SCALE	UNITS	NOTES
LANDING GROSS WEIGHT	V	S	N	4	0.1	Klbs	
LEFT DME DISTANCE	V	S	N	4	0.1	NM	
LEFT DME FREQUENCY	F	S	N	5	0.01	MHz	
LEFT GNSS POSITION	F	S	AN	13			
DIRECTIONAL	F		A	1		N=North S=South	
DEGREES	F		N	2	1	Degrees	
MINUTES	F		N	3	0.1	Minutes	
DIRECTIONAL	F		A	1		E=East W=West	
DEGREES	F		N	3	1	Degrees	
MINUTES	F		N	3	0.1	Minutes	
LEFT ILS FREQUENCY	F	S	N	5	0.01	MHz	
LEFT IRS POSITION	F	S	AN	13			
DIRECTIONAL	F		A	1		N=North S=South	
DEGREES	F		N	2	1	Degrees	
MINUTES	F		N	3	0.1	Minutes	
DIRECTIONAL	F		A	1		E=East W=West	
DEGREES	F		N	3	1	Degrees	
MINUTES	F		N	3	0.1	Minutes	
LEFT VOR BEARING	F	S	N	4	0.1	Degrees	
LEFT VOR FREQUENCY	F	S	N	5	0.01	MHz	
LITERAL ERROR DATA	V	S	AN	13			
LOCALIZER DEVIATION	V	D	AN	4		DDM	
DIRECTIONAL	F		A	1		L = Left R = Right	
MAGNITUDE	V		N	3	0.001		
MANEUVER MARGIN	V	S	N	3	0.01		

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ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 8 (cont'd)
ELEMENT DEFINITIONS

ELEMENT DESCRIPTION	TYPE	LENGTH TYPE	ELEM TYPE	CHAR LENGTH	SCALE	UNITS	NOTES
MAXIMUM CLIMB CAS	F	S	N	3	1	Knots	
MAXIMUM CLIMB MACH	F	S	N	3	0.001	Mach	
MAXIMUM CRUISE CAS	F	S	N	3	1	Knots	
MAXIMUM CRUISE MACH	F	S	N	3	0.001	Mach	
MAXIMUM DESCENT CAS	F	S	N	3	1	Knots	
MAXIMUM DESCENT MACH	F	S	N	3	0.001	Mach	
MEAN WIND	V	D	AN	4			
DIRECTIONAL	F		A	1		P=Plus M=Minus	
MAGNITUDE	V		N	3	1	Knots	
MESSAGE SEQUENCE NUMBER	V	S	AN	10			
MINIMUM CLIMB CAS	F	S	N	3	1	Knots	
MINIMUM CLIMB MACH	F	S	N	3	0.001	Mach	
MINIMUM CRUISE CAS	F	S	N	3	1	Knots	
MINIMUM CRUISE MACH	F	S	N	3	0.001	Mach	
MINIMUM CRUISE TIME	F	S	N	1	1	Minutes	
MINIMUM DESCENT CAS	F	S	N	3	1	Knots	
MINIMUM DESCENT MACH	F	S	N	3	0.001	Mach	
MINIMUM FUEL TEMPERATURE	V	D	AN	3		P=Plus	
DIRECTIONAL	F		A	1		M=Minus	
MAGNITUDE	V		N	2	1	°C	

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ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 8 (cont'd)
ELEMENT DEFINITIONS

ELEMENT DESCRIPTION	TYPE	LENGTH TYPE	ELEM TYPE	CHAR LENGTH	SCALE	UNITS	NOTES
MINIMUM R/C - CLB	V	S	N	3	1	Feet/min	
MINIMUM R/C - CRZ	V	S	N	3	1	Feet/min	
MINIMUM R/C - ENG OUT	V	S	N	3	1	Feet/min	
MOD CRZ WAYPOINTS	V	S	AN	13			
MOD PLAN CRUISE ALTITUDE	V	S	N	3	100	Feet	
MONITOR CODE	F	S	N	2			
NAVAID ELEVATION	V	S	N	5	1	Feet	1
NAVAID IDENT	V	S	AN	4			
NAVAID LAT/LON	F	S	AN	13			1
DIRECTIONAL	F		A	1		N=North S=South	
DEGREES	F		N	2	1	Degrees	
MINUTES	F		N	3	0.1	Minutes	
DIRECTIONAL	F		A	1		E=East W=West	
DEGREES	F		N	3	1	Degrees	
MINUTES	F		N	3	0.1	Minutes	
NAVAID MAGVAR	V	D	AN	3			1
DIRECTIONAL	F		A	1		E=East W=West	
MAGNITUDE	V		N	2	1	Degrees	
NAVAID TYPE	F	S	A	1		D=DME V=VOR	
NAVIGATION DATABASE IDENT	V	S	AN	10			
NETWORK ADDRESS	V	S	AN	7			

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N = NUMERIC
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ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 8 (cont'd)
ELEMENT DEFINITIONS

ELEMENT DESCRIPTION	TYPE	LENGTH TYPE	ELEM TYPE	CHAR LENGTH	SCALE	UNITS	NOTES
OAT OR SAT	V	D	AN	3			
DIRECTIONAL	F		A	1		P=Plus M=Minus	
MAGNITUDE	V		N	2	1	°C	
OAT AT PREDICTED WAYPOINT	V	D	AN	3			
DIRECTIONAL	F		A	1		P=Plus M=Minus	
MAGNITUDE	V		N	2	1	°C	
PAGE ID	V	M	AN	3			
PAGE NUMBER	V		N	2	1		
LAST PAGE FLAG	F		N	1		Blank=Page to Follow E=END	
PAGE INFO	F	M	N	2			
PAGE NUMBER	F	S	N	1			
NUMBER OF PAGES	F	S	N	1			
PERF DEFAULTS CONFIG NO.	V	S	A	10			
PERF FACTOR	V	D	AN	3			
DIRECTIONAL	F		A	1		P=Plus M=Minus	
MAGNITUDE	V		N	2	0.1	Percent	
PLAN OR BLOCK FUEL	V	S	N	4	0.1	Klbs	
POSITION SHIFT	V	D	AN	3			
DIRECTIONAL	F		A	1		P=Plus M=Minus	
SHIFT	V		N	2	100	Feet	
PREDICTED AIRSPEED	F	D	AN	4			1
SPEED	F		N	3	1 or		
TYPE	F		A	1	0.001	K=Knot M=Mach	
PREDICTED DESTINATION FUEL	V	S	N	4	0.1	Klbs	1
PREDICTED FUEL REMAINING	V	S	N	4	0.1	Klbs	1
PREDICTED WAYPOINT IDENT	V	S	AN	13			
PRIMARY CRUISE ALTITUDE	V	S	N	3	100	Feet	

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ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 8 (cont'd)
ELEMENT DEFINITIONS

ELEMENT DESCRIPTION	TYPE	LENGTH TYPE	ELEM TYPE	CHAR LENGTH	SCALE	UNITS	NOTES
PROCEDURE INDICATOR	F	S	A	1		Y= Proc.mbr. N=Not Proc.mbr.	⟨1⟩
PROCEDURE IDENT	V	S	AN	6			⟨1⟩
PROCEDURE WAYPOINT	F	S	A	1		Y or N	
QNH	V	S	N	4	1	Hectopascals	⟨4⟩
QRH T/O SPD CONFIG NUM	V	S	A	10			
RADIAL/DISTANCE	F	M	AN	7			⟨1⟩
RADIAL	F	S	N	3	1	Degrees	
DASH	F	S	AN	1			
DISTANCE	F	S	N	3	1	NM	
RADIO MEASUREMENT	V	S	N	4	0.1	NM or degrees	
REFERENCE CRZ WAYPOINT IDENT	V	S	AN	13			
REFERENCE IDENT	V	S	AN	5			⟨1⟩
REFERENCE LAT/LON	F	S	AN	13			⟨1⟩
DIRECTIONAL	F		A	1		N=North S=South	
DEGREES	F		N	2	1	Degrees	
MINUTES	F		N	3	0.1	Minutes	
DIRECTIONAL	F		A	1		E=East W=West	
DEGREES	F		N	3	1	Degrees	
MINUTES	F		N	3	0.1	Minutes	
REFERENCE RTA WAYPOINT IDENT	V	S	AN	13			
REFERENCE TAKEOFF GROSS WEIGHT	V	S	N	4	0.1	Klbs	
REPORT STIMULUS	F	S	N	3			⟨3⟩

V = VARIABLE
F = FIXED
S = SINGLE PARAMETER
M = MULTIPARAMETER
A = ALPHA
AN = ALPHANUMERIC
N = NUMERIC
D = DIRECTIONAL

ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 8 (cont'd)
ELEMENT DEFINITIONS

ELEMENT DESCRIPTION	TYPE	LENGTH TYPE	ELEM TYPE	CHAR LENGTH	SCALE	UNITS	NOTES
RESERVE FUEL	V	S	N	4	0.1	Klbs	
RIGHT DME DISTANCE	V	S	N	4	0.1	NM	
RIGHT DME FREQUENCY	F	S	N	5	0.01	MHz	
RIGHT GPS POSITION	F	S	AN	13			
DIRECTIONAL	F		A	1		N=North S=South	
DEGREES	F		N	2	1	Degrees	
MINUTES	F		N	3	0.1	Minutes	
DIRECTIONAL	F		A	1		E=East W=West	
DEGREES	F		N	3	1	Degrees	
MINUTES	F		N	3	0.1	Minutes	
RIGHT ILS FREQUENCY	F	S	N	5	0.01	MHz	
RIGHT IRS POSITION	F	S	AN	13			
DIRECTIONAL	F		A	1		N=North S=South	
DEGREES	F		N	2	1	Degrees	
MINUTES	F		N	3	0.1	Minutes	
DIRECTIONAL	F		A	1		E=East W=West	
DEGREES	F		N	3	1	Degrees	
MINUTES	F		N	3	0.1	Minutes	
RIGHT VOR BEARING	F	S	N	4	0.1	Degrees	
RIGHT VOR FREQUENCY	F	S	N	5	0.01	MHz	
RTA COST INDEX	V	D	AN	5			
DIRECTIONAL	F		A	1		P=Plus M=Minus	
COST INDEX	V		N	4	1		
RTA TAKEOFF WINDOW TIMES	F	M	N	12			
FIRST HOURS	F	S	N	2	1	Hours	
FIRST MINUTES	F	S	N	2	1	Minutes	
FIRST SECONDS	F	S	N	2	1	Seconds	
LAST HOURS	F	S	N	2	1	Hours	
LAST MINUTES	F	S	N	2	1	Minutes	
LAST SECONDS	F	S	N	2	1	Seconds	

V = VARIABLE
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S = SINGLE PARAMETER
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AN = ALPHANUMERIC
N = NUMERIC
D = DIRECTIONAL

ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 8 (cont'd)
ELEMENT DEFINITIONS

ELEMENT DESCRIPTION	TYPE	LENGTH TYPE	ELEM TYPE	CHAR LENGTH	SCALE	UNITS	NOTES
RTA TIME	F	M	N	6			
HOURS	F	S	N	2	1	Hours	
MINUTES	F	S	N	2	1	Minutes	
SECONDS	F	S	N	2	1	Seconds	
RTA TIME ERROR TOLERANCE	V	S	N	2	1	Seconds	
RTA WAYPOINT IDENT	V	S	AN	13			
RTA WINDOW TIMES	F	M	N	12			
FIRST HOURS	F	S	N	2	1	Hours	
FIRST MINUTES	F	S	N	2	1	Minutes	
FIRST SECONDS	F	S	N	2	1	Seconds	
LAST HOURS	F	S	N	2	1	Hours	
LAST MINUTES	F	S	N	2	1	Minutes	
LAST SECONDS	F	S	N	2	1	Seconds	
RUNWAY INTERSECTION	V	S	AN	3			
RUNWAY LENGTH REMAINING	V	S	N	3	100	Feet	
SCRATCHPAD	V	S	AN	24			
SELECTED TEMPERATURE	V	D	AN	3			
DIRECTIONAL	F		A	1		P=Plus M=Minus	
MAGNITUDE	V		N	2	1	°C	
STANDARD LIMIT TAKEOFF GR WT	V	S	N	4	0.1	Klbs	
STATIC AIR TEMPERATURE (SAT)	V	D	AN	3			
DIRECTIONAL	F		A	1		P=Plus M=Minus	
MAGNITUDE	V		N	2	1	°C	
STEADY/INTERMITTENT	F	S	A	1	S or I		
STIMULUS CODE	F	S	N	3			3
SYSTEM CODE	F	S	N	2			

V = VARIABLE   S = SINGLE PARAMETER   A = ALPHA   N = NUMERIC
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ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 8 (cont'd)
ELEMENT DEFINITIONS

ELEMENT DESCRIPTION	TYPE	LENGTH TYPE	ELEM TYPE	CHAR LENGTH	SCALE	UNITS	NOTES
TAI ON ALTITUDE	V	S	N	3	100	Feet	
TAI ON/OFF ALTITUDE	F	M	N	6			
TAI ON ALTITUDE	F	S	N	3	100	Feet	
TAI OFF ALTITUDE	F	S	N	3	100	Feet	
TAKEOFF CENTER OF GRAVITY	V	S	N	3	0.1	Percent	
TAKEOFF FLAPS	V	S	N	2	1	Degrees	
TAKEOFF GROSS WEIGHT	V	S	N	4	0.1	Klbs	
TAKEOFF RUNWAY CONDITION	F	S	N	1		1=Wet 2=Dry 3=1/4 water 4=1/2 water 5=1/4 slush 6=1/2 slush 7=compact snow	
TAKEOFF RUNWAY IDENT	F	D	AN	3			
RUNWAY NUMBER	F		N	2			
RUNWAY SUFFIX	F		A	1		L=Left C=Center R=Right O=None	
TAKEOFF RUNWAY SLOPE	V	D	AN	3			
DIRECTIONAL	F		A	1		U=Up D=Down	
MAGNITUDE	V		N	2	0.1	Percent	
TAKEOFF RUNWAY WIND	V	M	N	6			
DIRECTIONAL	F	S	N	3	1	Degree	
MAGNITUDE	V	S	N	3	1	Knots	2
TAKEOFF SPEEDS	F	M	N	9			
V1	F	S	N	3	1	Knots	
VR	F	S	N	3	1	Knots	
V2	F	S	N	3	1	Knots	

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ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 8 (cont'd)
ELEMENT DEFINITIONS

ELEMENT DESCRIPTION	TYPE	LENGTH TYPE	ELEM TYPE	CHAR LENGTH	SCALE	UNITS	NOTES
TAKEOFF THRUST RATING	F	S	N	1		0=No derate 1=Derate 1 2=Derate 2 | | 9=Derate 9	
TAKEOFF TIME	F	M	N	4			
HOURS	F	S	N	2	1	Hour	
MINUTES	F	S	N	2	1	Minute	
TAS AT PREDICTED WAYPOINT	V	S	N	3	1	Knots	⟨1⟩
TAXI FUEL	V	S	N	4	0.1	Klbs	
TEMPERATURE AT ALTERNATE	V	D	AN	3			⟨1⟩
DIRECTIONAL	F		A	1		P=Plus M=Minus	
MAGNITUDE	V		N	2	1	°C	
THRUST REDUCTION ALTITUDE	V	S	N	5	1	Feet	
TIME DETERMINED	F	M	N	6			
HOURS	F	S	N	2	1	Hours	
MINUTES	F	S	N	2	1	Minutes	
SECONDS	F	S	N	2	1	Seconds	
TIME ERROR TOLERANCE	V	S	N	2	1	Seconds	
TIME TO GO TO DESTINATION 1	V	S	N	3	1	Minutes	
TIME TO GO TO DESTINATION 2	V	S	N	3	1	Minutes	
TIME TO GO TO DESTINATION 3	V	S	N	3	1	Minutes	
TIME TO GO TO DESTINATION 4	V	S	N	3	1	Minutes	
TIME TO GO TO DESTINATION 5	V	S	N	3	1	Minutes	

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ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 8 (cont'd)
ELEMENT DEFINITIONS

ELEMENT DESCRIPTION	TYPE	LENGTH TYPE	ELEM TYPE	CHAR LENGTH	SCALE	UNITS	NOTES
TIME TO GO TRIGGER	V	S	N	3	1	Minutes	
TIME UPLINK IS RECEIVED	F	M	N	6			
HOURS	F	S	N	2	1	Hours	
MINUTES	F	S	N	2	1	Minutes	
SECONDS	F	S	N	2	1	Seconds	
TOC OR CRUISE TEMPERATURE	V	D	AN	3			
DIRECTIONAL	F		A	1		P=Plus M=Minus	
MAGNITUDE	V		N	2	1	°C	
TOP OF DESCENT ALTITUDE	V	S	N	3	100	Feet	
TOTAL FUEL/FOB	V	S	N	4	0.1	Klbs	
TRACK ANGLE MAG	F	S	N	3	1	Degrees	
TRIGGER NUMBER	F	S	N	3	1		
TRIGGER TRIPPED TIME	F	M	N	6			
HOURS	F	S	N	2	1	Hours	
MINUTES	F	S	N	2	1	Minutes	
SECONDS	F	S	N	2	1	Seconds	
TRIGGER UPLINK TIME	F	M	N	6			
HOURS	F	S	N	2	1	Hours	
MINUTES	F	S	N	2	1	Minutes	
SECONDS	F	S	N	2	1	Seconds	
TRIM	V	D	AN	5			
DIRECTIONAL	F		A	1		P=Plus M=Minus	
MAGNITUDE	V		N	4	0.1	Degrees	
TRIP FUEL	V	S	N	4	0.1	Klbs	
TROPOPAUSE ALTITUDE	F	S	N	5	1	Feet	
UPLINKED IMI	F	S	A	3			

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ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 8 (cont'd)
ELEMENT DEFINITIONS

ELEMENT DESCRIPTION	TYPE	LENGTH TYPE	ELEM TYPE	CHAR LENGTH	SCALE	UNITS	NOTES
VERTICAL DEVIATION	V	D	AN	6			
DISTANCE	V		N	5	1	Feet	
DIRECTIONAL	F		A	1		H or L	
VTR PERCENTAGE	V	S	N	2	1	Percent	
WAYPOINT ALTITUDE/OAT	V	M	AN	6			1
ALTITUDE	F	S	N	3	100	Feet	
OAT DIRECTIONAL	F	D	N	1		P=Plus M=Minus	
OAT MAGNITUDE	V		N	2	1	°C	
WAYPOINT BEARING	F	S	N	3	1	Degrees	1
WAYPOINT IDENT	V	S	AN	5			
WAYPOINT LAT/LON	F	S	AN	13			1
DIRECTIONAL	F		A	1		N=North S=South	
DEGREES	F		N	2	1	Degrees	
MINUTES	F		N	3	0.1	Minutes	
DIRECTIONAL	F		A	1		E=East W=West	
DEGREES	F		N	3	1	Degrees	
MINUTES	F		N	3	0.1	Minutes	
WAYPOINT MAGVAR	V	D	AN	3			1
DIRECTIONAL	F		A	1		E=East W=West	
MAGNITUDE	V		N	2	1	Degrees	
WAYPOINT NAME OR POSITION	V	S	AN	13			
WAYPOINT SEQUENCE	V	S	AN	13			
WAYPOINT WIND	V	M	N	6			
DIRECTIONAL	F	S	N	3	1	Degrees	1
MAGNITUDE	V	S	N	3	1	Knots	2
WIND ALTITUDE	V	S	N	3	100	Feet	

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N = NUMERIC
D = DIRECTIONAL

ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 8 (cont'd)
ELEMENT DEFINITIONS

ELEMENT DESCRIPTION	TYPE	LENGTH TYPE	ELEM TYPE	CHAR LENGTH	SCALE	UNITS	NOTES
WIND AT PREDICTED WAYPOINT	V	M	N	6			1
DIRECTIONAL	F	S	N	3	1	Degrees	
MAGNITUDE	V	S	N	3	1	Knots	
WIND LEVEL ALTITUDE	V	S	N	3	100	Feet	
WIND LEVEL WAYPOINT	V	S	AN	13			
WIND VECTOR MAGNITUDE DIFFERENCE	V	S	N	3	1	Knots	
ZERO FUEL WEIGHT	V	S	N	4	0.1	Klbs	
ZERO FUEL WEIGHT CG	V	S	N	3	0.1	Percent	

V = VARIABLE S = SINGLE PARAMETER A = ALPHA N = NUMERIC
F = FIXED M = MULTIPARAMETER AN = ALPHANUMERIC D = DIRECTIONAL

ATTACHMENT 8B (cont'd
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 9
FLIGHT PLAN ELEMENT DEFINITIONS

COMMENTARY

This section contains the flight plan element identifiers and a complete description of each flight plan element.

FPEI	DESCRIPTION	ELEMENT DESCRIPTION	LGTH TYPE	ELEM TYPE	CHAR TYPE	LGTH	SCALE	UNITS
:DA:	DEPARTURE AIRPORT							
		AIRPORT IDENTIFIER	V	S	AN	4		
:AA:	ARRIVAL AIRPORT							
		AIRPORT IDENTIFIER	V	S	AN	4		
:CR:	COMPANY ROUTE							
		COMPANY ROUTE	V	S	AN	10		
:R:	DEPARTURE RUNWAY							
		RUNWAY IDENTIFIER	F	D	AN	3		
		RWY NUMBER			N	2		
		RWY SUFFIX			A	1		L=LEFT C=CENTER R=RIGHT O=NO SUFFIX
:D:	DEPARTURE PROCEDURE							
		PROCEDURE IDENT	V	S	AN	6		
:F:	FLIGHT PLAN SEGMENT							
	PUBLISHED IDENT							
		FIX IDENTIFIER	V	S	AN	5		
		OPTIONAL INTRO.(,)						
		OPTIONAL LAT/LON	F	M	AN	13		
		DIRECTIONAL			A	1		N OR S
		DEGREES			N	5		
		DIRECTIONAL			A	1		E OR W
		DEGREES			N	6		
	LAT/LON							
		LATITUDE/LONGITUDE	V	M	AN	13		
		DIRECTIONAL			A	1		N OR S
		DEGREES			N	5		
		DIRECTIONAL			A	1		E OR W
		DEGREES			N	6		

V=VARIABLE
S=SINGLE PARAMETER
A=ALPHA
N=NUMERIC
F=FIXED
M=MULTIPARAMETER
AN=ALPHANUMERIC
D=DIRECTIONAL

ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 9 (cont'd)
FLIGHT PLAN ELEMENT DEFINITIONS

COMMENTARY

This section contains the flight plan element identifiers and a complete description of each flight plan element.

FPEI	DESCRIPTION	ELEMENT DESCRIPTION	LGTH TYPE	ELEM TYPE	CHAR TYPE	LGTH	SCALE	UNITS
	PB/PB							
		FIX IDENTIFIER	V	S	AN	5		
		OPTIONAL INTRO.(,)						
		OPTIONAL LAT/LON	F	M	AN	13		
		DIRECTIONAL			A	1		N OR S
		DEGREES			N	5		
		DIRECTIONAL			A	1		E OR W
		DEGREES			N	6		
		OPTIONAL TERM.(,)						
		BEARING	F	S	N	3	1	DEGREES
		DASH						
		FIX IDENTIFIER	V	S	AN	5		
		OPTIONAL INTRO.(,)						
		OPTIONAL LAT/LON	F	M	AN	13		
		DIRECTIONAL			A	1		N OR S
		DEGREES			N	5		
		DIRECTIONAL			A	1		E OR W
		DEGREES			N	6		
		OPTIONAL TERM.(,)						
		BEARING	F	S	N	3	1	DEGREES
	PBD							
		FIX IDENTIFIER	V	S	AN	5		
		OPTIONAL INTRO.(,)						
		OPTIONAL LAT/LON	F	M	AN	13		
		DIRECTIONAL			A	1		N OR S
		DEGREES			N	5		
		DIRECTIONAL			A	1		E OR W
		DEGREES			N	6		
		OPTIONAL TERM.(,)						
		BEARING	F	S	N	3	1	DEGREES
		DASH						
		DISTANCE	F	S	N	4	0.1	NM
..	DIRECT FIX	SAME AS :F:						
:A:	ARRIVAL PROCEDURE							
		PROCEDURE IDENT	V	S	AN	6		
:AP:	APPROACH PROCEDURE							
		PROCEDURE IDENT	V	S	AN	6		

V=VARIABLE S=SINGLE PARAMETER A=ALPHA N=NUMERIC
F=FIXED M=MULTIPARAMETER AN=ALPHANUMERIC D=DIRECTIONAL

ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 9 (cont'd)
FLIGHT PLAN ELEMENT DEFINITIONS

COMMENTARY

This section contains the flight plan element identifiers and a complete description of each flight plan element.

FPEI	DESCRIPTION	ELEMENT DESCRIPTION	LGTH TYPE	ELEM TYPE	CHAR TYPE	LGTH	SCALE	UNITS
()	ARRIVAL RUNWAY							
		RUNWAY IDENTIFIER	F	M	AN	3		
		RWY NUMBER		S	N	2		
		RWY SUFFIX		S	A	1		L=LEFT C=CENTER R=RIGHT O=NO SUFFIX
:V:	WAYPOINT SPD/ALT							
		FIX IDENTIFIER	V	S	AN	13		
		COMMA (,)						
		SPEED	F	S	N	3	1	KNOTS
		COMMA (,)						
		ALTITUDE	V	D	AN	6		
		DIRECTIONAL	F		A	2		AA=AT OR ABOVE AB=AT OR BELOW AT=AT
		ALTITUDE	V		N	4	10	FEET
		COMMA (,)						
		OPTIONAL ALTITUDE	V	D	AN	6		
		DIRECTIONAL	F		A	2		AA=AT OR ABOVE AB=AT OR BELOW AT=AT
		ALTITUDE	V		N	4	10	FEET

V=VARIABLE S=SINGLE PARAMETER A=ALPHA N=NUMERIC
F=FIXED M=MULTIPARAMETER AN=ALPHANUMERIC D=DIRECTIONAL

ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 9 (cont'd)
FLIGHT PLAN ELEMENT DEFINITIONS

COMMENTARY

This section contains the flight plan element identifiers and a complete description of each flight plan element.

FPEI	DESCRIPTION	ELEMENT DESCRIPTION	LGTH TYPE	ELEM TYPE	CHAR TYPE	LGTH	SCALE	UNITS
:H:	HOLD AT WAYPOINT							
		FIX IDENTIFIER	V	S	AN	13		
		COMMA (,)						
		SPEED	F	S	N	3	1	KNOTS
		COMMA (,)						
		ALTITUDE	V	D	AN	6		
		DIRECTIONAL	F		A	2		AA=AT OR ABOVE AB=AT OR BELOW AT=AT
		ALTITUDE	V	S	N	4	10	FEET
		COMMA (,)						
		TARGET SPEED	F	S	N	3	1	KNOTS
		COMMA (,)						
		TURN DIRECTION	F	S	A	1		L=LEFT R=RIGHT
		COMMA (,)						
		INBOUND COURSE	F	S	N	3	1	DEGREES
		COMMA (,)						
		EFC TIME	F	M	N	4		
		HOURS	F	S	N	2	1	00-24 HOURS
		MINUTES	F	S	N	2	1	MINUTES
		COMMA (,)						
		LEG TIME	F	S	N	2	0.1	MINUTES
		COMMA (,)						
		LEG DISTANCE	V	S	N	3	0.1	NM
:WS:	WAYPOINT STEP CLIMB							
		FIX IDENTIFIER	V	S	AN	13		
		COMMA (,)						
		ALTITUDE	V	S	N	3	100	FEET

V=VARIABLE	S=SINGLE PARAMETER	A=ALPHA	N=NUMERIC
F=FIXED	M=MULTIPARAMETER	AN=ALPHANUMERIC	D=DIRECTIONAL

ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 9 (cont'd)
FLIGHT PLAN ELEMENT DEFINITIONS

COMMENTARY

This section contains the flight plan element identifiers and a complete description of each flight plan element.

FPEI	DESCRIPTION	ELEMENT DESCRIPTION	LGTH TYPE	ELEM TYPE	CHAR TYPE	LGTH	SCALE	UNITS
:AT:	ALONG TRACK WAYPOINT							
		FIX IDENTIFIER	V	S	AN	5		
		DASH (-)						
		DISTANCE	V	D	AN	5	0.1	NM
		DIRECTIONAL	F		A	1		P=PLUS M=MINUS
		DISTANCE	V		N	4	0.1	NM
		COMMA (,)						
		SPEED	F	S	N	3	1	KNOTS
		COMMA (,)						
		ALTITUDE	V	D	AN	6		
		DIRECTIONAL	F		A	2		AA=AT OR ABOVE AB=AT OR BELOW AT=AT
		ALTITUDE	V	S	N	4	10	FEET
		COMMA (,)						
		OPTIONAL ALTITUDE	V	D	AN	6		
		DIRECTIONAL	F		A	2		AA=AT OR ABOVE AB=AT OR BELOW AT=AT
		ALTITUDE	V	S	N	4	10	FEET
:RP:	REPORTING POINTS							
	LATITUDE RP	LATITUDE	V	M	AN	3		
		DIRECTIONAL	F	S	A	1		N=NORTH S=SOUTH
		DEGREES	V	S	N	2		DEGREES
		OPTIONAL DASH						
		DEGREE INCREMENT	V	S	N	2		
	LONGITUDE RP	LONGITUDE	V	M	AN	4		
		DIRECTIONAL	F	S	A	1		E=EAST W=WEST
		DEGREES	V	S	N	3		DEGREES
		OPTIONAL DASH						
		DEGREE INCREMENT	V	S	N	2		
.	TRANSITION							
		TRANSITION IDENT	V	S	AN	5		

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N=NUMERIC
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ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 9 (cont'd)
FLIGHT PLAN ELEMENT DEFINITIONS

COMMENTARY

This section contains the flight plan element identifiers and a complete description of each flight plan element.

FPEI	DESCRIPTION	ELEMENT DESCRIPTION	LGTH TYPE	ELEM TYPE	CHAR TYPE	LGTH	SCALE	UNITS
.	AIRWAY VIA/EXIT VIA AIRWAY VIA							
		AIRWAY IDENTIFIER	V	S	AN	5		
.	AIRWAY EXIT VIA							
		FIX IDENTIFIER	V	S	AN	6		
:LO:	LATERAL OFFSET	OFFSET	V	D	AN	3		
		DIRECTIONAL	F		A	1		L=LEFT R=RIGHT
		DISTANCE	V		N	2	1	NM
:F:.	AIRWAY INTERCEPT							
		AIRWAY IDENTIFIER	V	S	AN	5		
:IC:	INTERCEPT COURSE FROM							
		PUBLISHED IDENT, PB/PB or PBD as defined in the :F: FLIGHT PLAN FPE, followed by a COMMA (,) and COURSE:						
		COURSE	V	S	N	3	1	DEG

V=VARIABLE
F=FIXED
S=SINGLE PARAMETER
M=MULTIPARAMETER
A=ALPHA
AN=ALPHANUMERIC
N=NUMERIC
D=DIRECTIONAL

ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 10
CODES AND TRIGGERS

SECTION 10.1
ERROR TYPE CODES

COMMENTARY

Error type codes are listed as decimal and hexadecimal values. Depending on implementation, this code may be downlinked as either a decimal or hexadecimal value.

DEC CODE	HEX CODE	DESCRIPTION
001	001	END TO END CRC
002	002	INVALID ATC
003	003	SYNTAX ERROR
004	004	MISSING ELEMENT
005	005	RESERVED FOR DEFINITION (B-737)
006	006	N/A FOR IN AIR
007	007	MISSING ALL DATA FOR DEPENDENT ELEMENT
008	008	INCOMPATIBLE DATA
009	009	FMC DOWNMODE
010	00A	REFERENCE MISMATCH
011	00B	NOT IN NDB
012	00C	DUPLICATE WAYPOINT
013	00D	ROUTE FULL ERROR
014	00E	DATA BASE FULL ERROR
015	00F	ENTRY SLOT UNAVAILABLE
016	010	DUPLICATE SUPPLEMENT NDB DEFINITION
017	011	RESERVED FOR DEFINITION (B-737)
018	012	RESERVED FOR DEFINITION (B-737)
019	013	RESERVED FOR DEFINITION (B-737)
020	014	RESERVED FOR DEFINITION (B-737)
021	015	NO MINIMUM FLIGHT PLAN
022	016	NO ACTIVE ROUTE FOR DOWNLINK
023	017	UNSOLICITED UPLINK
024	018	DATA NOT ALLOWED IN TAKEOFF PHASE
025	019	DATA NOT ALLOWED IN CLIMB PHASE
026	01A	DATA NOT ALLOWED IN CRUISE PHASE
027	01B	DATA NOT ALLOWED IN DESCENT PHASE
028	01C	INCOMPATIBLE RANGE
029	01D	DEPARTURE AIRPORT DOES NOT EXIST
030	01E	DESTINATION AIRPORT DOES NOT EXIST
031	01F	ATO DISTANCE IS ENTERED OVER AN INVALID LEG
032	020	NEGATIVE ATO IS ENTERED OVER MOD DIRECT TO WPT
033	021	ATO DISTANCE IS GREATER THAN LEG LENGTH
034	022	INITIAL FIX IS FLOATER OR PPOS
035	023	PBPB WAYPOINT WITH NO VALID INTERSECTION
036	024	DIRECT WPT AFTER INTERCEPT WAYPOINT
037	025	HOLD ENTERED ON NON-HARD WAYPOINT
038	026	ALTITUDE RESTRICTION ON ALT ONLY WAYPOINT
039	027	TO FIX EQUALS FROM ON ROUTE PAGE
040	028	RESERVED FOR DEFINITION (B-737)
041	029	TO FIX IS NOT ON AIRWAY
042	02A	TO FIX CAUSES CHANGE OF DIRECT ON AIRWAY
043	02B	FROM AND TO NOT ON ENTERED AIRWAY
044	02C	CRUISE ALTITUDE LESS THAN MIN CRUISE ALT
045	02D	EPC MORE THAN 6 HOURS PAST HOLD FIX ETA
046	02E	RUNWAY REMAINING GREATER THAN RUNWAY LENGTH
047	02F	RESERVED FOR DEFINITION (B-737)
048	030	UNSOLICITED MOD WIND BECAUSE OF LONG DELETE
049	031	INAPPROPRIATE DATA TYPE
050	032	RESERVED FOR DEFINITION (B-737)

ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 10 (cont'd)
CODES AND TRIGGERS

SECTION 10.1 (cont'd)
ERROR TYPE CODES

DEC CODE	HEX CODE	DESCRIPTION
051	033	UNSOLICITED MOD WIND
052	034	CRUISE WIND IN DESCENT
053	035	DATA NOT ALLOWED IN PHASE
054	036	HOLD ENTERED ON HOLD EXIT WITH EXIT ARMED
055	037	VIA TYPE OF PROCEDURE TO FIX ENTRY NOT ALLOWED
056	038	ENTERED AIRPORT ID - DIRECT
057	039	VIA ENTERED FOR FIRST ROUTE SEGMENT
058	03A	AIRWAY UNPACK WAS UNSUCCESSFUL
059	03B	COMPANY ROUTE UNPACK UNSUCCESSFUL
060	03C	N/A FOR AIRCRAFT STATE
061	03D	PROCEDURE NOT FOUND (FOR ENROUTE AFTER)
062	03E	N/A FOR AIRCRAFT INSTALLATION
063	03F	DATA ELEMENT NOT ALLOWED ON GROUND
064	040	NO OFFSET EXISTS
065	041	NO OFFSET AT LEG
066	042	OFFSET IS ACTIVE
067	043	OFFSET DATA INCOMPATIBLE
068	044	NO OFFSETABLE LEG EXISTS
069	045	IMI LOST DUE TO WARM START
070	046	IMI LOST DUE TO OVERFLOW
071-100	047-064	RESERVED FOR DEFINITION (B-737)
101	065	BUFFER FULL
102	066	INCOMPATIBLE IEI
103	067	INVALID IEI FORMAT
104	068	INVALID IMI FORMAT
105	069	NOT ALLOWED ON GROUND
106	06A	INVALID REQUEST LABEL
107	06B	NO IEIs IN MESSAGE
108	06C	NO DATA IN ELEMENT TEXT
109	06D	INVALID FORMAT AND/OR RANGE
110	06E	NOT ALLOWED WHEN AIRBORNE
111	06F	NO APPLICABLE ROUTE
112	070	NO APPLICABLE IEI
113	071	NO REPORTING POINTS CREATED
114	072	ZERO FUEL WEIGHT CAUSES INVALID GROSS WEIGHT
115	073	PRIORITY MESSAGE PENDING
116	074	MULTIPLE ROUTE IEI
117	075	NO ROUTE IEI
118	076	NO FLIGHT PLAN ELEMENTS
119	077	NO ACTIVE ROUTE
120	078	FIRST FLIGHT PLAN ELEMENT INVALID
121	079	RESERVED FOR DEFINITION (BOEING AIRCRAFT)
122	07A	RESERVED FOR DEFINITION (BOEING AIRCRAFT)
123	07B	RESERVED FOR DEFINITION (BOEING AIRCRAFT)
124	07C	RESERVED FOR DEFINITION (BOEING AIRCRAFT)
125	07D	MULTIPLE DIRECT TO FIX
126	07E	MULTIPLE OF FLIGHT PLAN ELEMENT NOT ALLOWED
127	07F	FROM FIX IS NOT ON AIRWAY
128	080	AIRWAY/AIRWAY INTERSECTION NOT FOUND
129	081	RESERVED FOR DEFINITION (BOEING AIRCRAFT)
130	082	NO FIX MATCH IN ROUTE
131	083	MULTIPLE HOLD AT FIX

ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 10 (cont'd)
CODES AND TRIGGERS

SECTION 10.1 (cont'd)
ERROR TYPE CODES

DEC CODE	HEX CODE	DESCRIPTION
132	084	BASE PROCEDURE UNDEFINED
133	085	LAT/LON REPORTING POINT NOT FOUND
134	086	CURRENT FLIGHT PLAN CONDITIONS INVALID FOR OFFSET
135	087	FPEI INCOMPATIBLE WITH IEI
136	088	NO COMPATIBLE RUNWAYS
137	089	AIRWAY FLIGHT PLAN ELEMENT IS NOT CLOSED
138	08A	NO FROM FIX FOR AIRWAY FLIGHT PLAN ELEMENT
139	08B	SPARE
140	08C	EXCEEDS CHARACTER LIMIT
141	08D	DERATE OPTION NOT SELECTED
142	08E	PAGES OUT OF SEQUENCE
143	08F	TIMED OUT
144	090	NO VALID RWY RECORDS
145-200	091-0C8	RESERVED FOR DEFINITION (BOEING AIRCRAFT)
201	0C9	DEPENDENT IMI REJECTED
202	0CA	DUPLICATE IEIs
203	0CB	REPORT NOT ALLOWED WITH INVALID A/C POSITION
204	0CC	BLOCK NOT SUFFICIENT FOR TAXI AND ROUTE RESERVE
205	0CD	WINDOW ALTITUDE CONSTRAINT NOT ALLOWED
206	0CE	NOT ALLOWED FOR ALTERNATE FLIGHT PLAN
207	0CF	DESTINATION DOES NOT MATCH ORIGIN OF ALTERNATE
208	0D0	PILOT DEFINED STORE IS FULL
209-300	0D1-12C	RESERVED FOR DEFINITION (AIRBUS AIRCRAFT)

ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 10 (cont'd)
CODES AND TRIGGERS

SECTION 10.2
ERROR DATA CODES

COMMENTARY

Error type codes are listed as decimal and hexadecimal values. Depending on implementation, this code may be downlinked as either a decimal or hexadecimal value.

DEC CODE	HEX CODE	DESCRIPTION
001	001	RTA WAYPOINT DATA CODE
002	002	RTA TIME DATA CODE
003	003	ALTERNATE AIRPORT ID DATA CODE
004	004	ALTERNATE AIRPORT TYPE DATA CODE
005	005	ALTERNATE AIRPORT DISTANCE DATA CODE
006	006	ALTERNATE AIRPORT ALTITUDE DATA CODE
007	007	ALTERNATE AIRPORT WIND DATA CODE
008	008	CLEAR FLIGHT PLAN DATA CODE
009	009	FLIGHT NUMBER DATA CODE
010	00A	COST INDEX DATA CODE
011	00B	CRUISE ALTITUDE DATA CODE
012	00C	CRUISE (TOC) TEMP DATA CODE
013	00D	ZERO FUEL WEIGHT DATA CODE
014	00E	CRUISE WIND DATA CODE
015	00F	RESERVE FUEL DATA CODE
016	010	CRUISE CENTER OF GRAVITY DATA CODE
017	011	CLIMB TRANSITION ALTITUDE DATA CODE
018	012	TAKEOFF DEPARTURE RUNWAY ID DATA CODE
019	013	RUNWAY INTERSECTION DATA CODE
020	014	RUNWAY POSITION SHIFT DATA CODE
021	015	RUNWAY LENGTH REMAINING DATA CODE
022	016	T/O RUNWAY INVALID FLAG DATA CODE
023	017	TRIM DATA CODE
024	018	TAKEOFF REFERENCE GROSS WEIGHT DATA CODE
025	019	TAKEOFF FLAPS DATA CODE
026	01A	V1 SPEED DATA CODE
027	01B	V2 SPEED DATA CODE
028	01C	VR SPEED DATA CODE
029	01D	TAKEOFF SEL TEMP DATA CODE (ASSUMED TEMP)
030	01E	T/O RUNWAY SLOPE DATA CODE
031	01F	T/O RUNWAY WIND DATA CODE
032	020	T/O RUNWAY CONDITION DATA CODE
033	021	TAKEOFF DERATE DATA CODE
034	022	RESERVED FOR DEFINITION (B-737)
035	023	OUTSIDE AIR TEMP DATA CODE
036	024	DESCENT WIND ALT DATA CODE
037	025	DESCENT WIND DIR/MAG DATA CODE
038	026	TAKEOFF CENTER OF GRAVITY DATA CODE
039	027	RESERVED FOR DEFINITION (B-737)
040	028	BLOCK FUEL DATA CODE (PLAN FUEL)
041	029	DESCENT TRANSITION ALTITUDE DATA CODE
042	02A	TAI ON DATA CODE
043	02B	TAI ON/OFF ALTITUDE DATA CODE
044	02C	DESCENT ISA DEV DATA CODE
045	02D	QNH DATA CODE
046	02E	TIME ERROR TOLERANCE DATA CODE
047	02F	MIN CLB CAS DATA CODE
048	030	MIN CLB MACH DATA CODE
049	031	MIN CRZ CAS DATA CODE
050	032	MIN CRZ MACH DATA CODE

ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 10 (cont'd)
CODES AND TRIGGERS

SECTION 10.2 (cont'd)
ERROR DATA CODES

DEC CODE	HEX CODE	DESCRIPTION
051	033	MIN DES CAS DATA CODE
052	034	MIN DES MACH DATA CODE
053	035	MAX CLB CAS DATA CODE
054	036	MAX CLB MACH DATA CODE
055	037	MAX CRZ CAS DATA CODE
056	038	MAX CRZ MACH DATA CODE
057	039	MAX DES CAS DATA CODE
058	03A	MAX DES MACH DATA CODE
059	03B	DEPARTURE AIRPORT DATA CODE
060	03C	DESTINATION AIRPORT DATA CODE
061	03D	COMPANY ROUTE DATA CODE
062	03E	DEPARTURE RUNWAY DATA CODE
063	03F	DEPARTURE BASE PROCEDURE DATA CODE
064	040	DEPARTURE TRANSITION PROCEDURE DATA CODE
065	041	AIRWAY VIA DATA CODE
066	042	INITIAL FIX WAYPOINT DATA CODE
067	043	INITIAL FIX PBD DATA CODE
068	044	INITIAL FIX PBPB DATA CODE
069	045	INITIAL FIX LAT/LON DATA CODE
070	046	DIRECT WPT AFTER SID DATA CODE
071	047	DIRECT PBD AFTER SID DATA CODE
072	048	DIRECT PBPB AFTER SID DATA CODE
073	049	DIRECT LAT/LON AFTER SID DATA CODE
074	04A	DIRECT WAYPOINT AFTER STAR DATA CODE
075	04B	DIRECT PBD AFTER STAR DATA CODE
076	04C	DIRECT PBPB AFTER STAR DATA CODE
077	04D	DIRECT LAT/LON AFTER STAR DATA CODE
078	04E	DIRECT WAYPOINT AFTER APPROACH DATA CODE
079	04F	DIRECT PBD AFTER APPROACH DATA CODE
080	050	DIRECT PBPB AFTER APPROACH DATA CODE
081	051	DIRECT LAT/LON AFTER APPROACH DATA CODE
082	052	DIRECT TO WAYPOINT DATA CODE
083	053	DIRECT TO PBD DATA CODE
084	054	DIRECT TO PBPB DATA CODE
085	055	DIRECT LAT/LON DATA CODE
086	056	ENROUTE WAYPOINT DATA CODE
087	057	DIRECT WAYPOINT DATA CODE
088	058	DIRECT PBD DATA CODE
089	059	DIRECT PBPB DATA CODE
090	05A	DIRECT LAT/LON DATA CODE
091	05B	RESERVED FOR DEFINITION (B-737)
092	05C	REF WAYPOINT 2 LAT/LON DATA CODE
093	05D	STAR BASE PROCEDURE DATA CODE
094	05E	STAR TRANS PROCEDURE DATA CODE
095	05F	APPROACH BASE PROCEDURE DATA CODE
096	060	APPROACH TRANSITION PROCEDURE DATA CODE
097	061	DESTINATION RUNWAY DATA CODE
098	062	HOLD ID AND ALT RESTRICTION DATA CODE
099	063	HOLD TARGET SPEED DATA CODE
100	064	HOLD TURN DIRECTION DATA CODE
101	065	HOLD INBOUND COURSE DATA CODE
102	066	HOLD EFC TIME DATA CODE

ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 10 (cont'd)
CODES AND TRIGGERS

SECTION 10.2 (cont'd)
ERROR DATA CODES

DEC CODE	HEX CODE	DESCRIPTION
103	067	HOLD LEG TIME DATA CODE
104	068	HOLD LEG DISTANCE DATA CODE
105	069	ATO WAYPOINT INFORMATION DATA CODE
106	06A	UPLINK REQUESTING DOWNLINK DATA CODE
107	06B	WAYPOINT SPD/ALT RESTRICTION DATA CODE
108	06C	NETWORK ADDRESS DATA CODE
109	06D	COMPANY ROUTING ADDRESS DATA CODE
110	06E	MESSAGE SEQUENCE NUMBER DATA CODE
111	06F	REFERENCE CRUISE WIND ALT DATA CODE
112	070	ENROUTE WIND WAYPOINT ID DATA CODE
113	071	ENROUTE WIND DIR/MAG DATA CODE
114	072	SUPP EFFECT DATE DATA CODE
115	073	SUPP AIRPORT ID DATA CODE
116	074	SUPP AIRPORT LAT DATA CODE
117	075	SUPP AIRPORT LON DATA CODE
118	076	SUPP AIRPORT ELEVATION DATA CODE
119	077	SUPP AIRPORT MAG VAR DATA CODE
120	078	SUPP NAVAID ID DATA CODE
121	079	SUPP NAVAID LAT DATA CODE
122	07A	SUPP NAVAID LON DATA CODE
123	07B	SUPP NAVAID ELEVATION DATA CODE
124	07C	SUPP NAVAID MAG VAR DATA CODE
125	07D	SUPP NAVAID FREQUENCY DATA CODE
126	07E	SUPP NAVAID CLASS DATA CODE
127	07F	SUPP WAYPOINT ID DATA CODE
128	080	SUPP WAYPOINT LAT DATA CODE
129	081	SUPP WAYPOINT LON DATA CODE
130	082	SUPP WAYPOINT MAG VAR DATA CODE
131	083	SUPP REF WAYPOINT ID DATA CODE
132	084	SUPP REF WAYPOINT REF LAT/LON DATA CODE
133	085	SUPP REF WAYPOINT RADIAL DATA CODE
134	086	SUPP REF WAYPOINT DISTANCE DATA CODE
135	087	WIND VECTOR MAGNITUDE DIFFERENCE DATA CODE
136	088	WAYPOINT SEQUENCE ID DATA CODE
137	089	ETA CHANGE DATA CODE
138	08A	ETA TO DEST 1 DATA CODE
139	08B	ETA TO DEST 2 DATA CODE
140	08C	ETA TO DEST 3 DATA CODE
141	08D	ETA TO DEST 4 DATA CODE
142	08E	ETA TO DEST 5 DATA CODE
143	08F	RESERVED FOR DEFINITION (B-737)
144	090	RESERVED FOR DEFINITION (B-737)
145	091	ROUTE BUILDING PARAMETER DATA CODE
146	092	ROUTE DATA TYPE CODE
147	093	PERF INIT DATA TYPE CODE
148	094	TAKEOFF REF DATA TYPE CODE
149	095	RTA DATA TYPE CODE
150	096	ALTERNATE INFO DATA TYPE CODE
151	097	SUPP NDB DATA TYPE CODE
152	098	AUTO INSERT DATA TYPE CODE
153	099	ACTIVE WIND DATA TYPE CODE
154	09A	MOD WIND DATA TYPE CODE

ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 10 (cont'd)
CODES AND TRIGGERS

SECTION 10.2 (cont'd)
ERROR DATA CODES

DEC CODE	HEX CODE	DESCRIPTION
155	09B	DESCENT FORECAST DATA TYPE CODE
156	O9C	PERF LIMITS DATA TYPE CODE
157	09D	SPARE DATA TYPE CODE
158	09E	LATERAL OFFSET DIST DATA CODE
159	09F	LATERAL OFFSET START WPT DATA CODE
160	0A0	LATERAL OFFSET END WPT DATA CODE
161-200	0A1-0C8	RESERVED FOR DEFINITION (B-737)
201	0C9	FUEL FLOW FACTOR DATA CODE
202	0CA	DRAG FACTOR DATA CODE
203	0CB	LIMIT TAKEOFF GROSS WEIGHT DATA CODE
204	0CC	THRUST RATING DATA CODE
205	0CD	VTR PERCENTAGE DATA CODE
206	0CE	ALTERNATE FLAPS DATA CODE
207	0CF	ALTERNATE TRIM DATA CODE
208	0D0	ALTERNATE LIMIT TAKEOFF GROSS WEIGHT DATA CODE
209	0D1	TAKEOFF SPEEDS DATA CODE
210	0D2	ALTERNATE TAKEOFF SPEEDS DATA CODE
211	0D3	WAYPOINT ALTITUDE/OAT DATA CODE
212	0D4	LATERAL OFFSET DATA CODE
213	0D5	ALONG TRACK OFFSET DATA CODE
214	0D6	WAYPOINT STEP CLIMB DATA CODE
215	0D7	LAT/LON REPORTING POINT DATA CODE
216	0D8	GROUND ADDRESS DATA CODE
217	0D9	DIRECT FIX DATA CODE
218	0DA	HOLD SPEED RESTRICTION DATA CODE
219	0DB	POSITION REPORTING POINT DATA CODE
220	0DC	ENROUTE WIND SEGMENT DATA CODE
221	0DD	ENROUTE SEGMENT DATA CODE
222	0DE	OPEN ENDED AIRWAY DATA CODE
223	0DF	ALTERNATE THRUST RATING DATA CODE
224	0E0	SEQUENCE NUMBER DATA CODE
225	0E1	MINIMUM FUEL TEMPERATURE DATA CODE
226	0E2	COMPANY PREFERRED AIRPORT IDENT DATA CODE
227	0E3	COMPANY PREFERRED PRIORITY DATA CODE
228	0E4	COMPANY PREFERRED WIND DATA CODE
229	0E5	COMPANY PREFERRED ALT/OAT DATA CODE
230	0E6	COMPANY PREFERRED OVERHEAD FIX DATA CODE
231	0E7	COMPANY PREFERRED ALTITUDE DATA CODE
232	0E8	COMPANY PREFERRED SPEED DATA CODE
233	0E9	COMPANY PREFERRED OFFSET DATA CODE
234	0EA	FLIGHT LIST AIRPORT IDENT DATA CODE
235	0EB	FLIGHT LIST WIND DATA CODE
236	0EC	FLIGHT LIST ALT/OAT DATA CODE
237	0ED	ALTERNATE INHIBIT AIRPORT IDENT DATA CODE
238	OEE	ALTERNATE TAKEOFF VTR PERCENTAGE DATA CODE
239	0EF	THRUST REDUCTION ALTITUDE DATA CODE
240	0F0	ACCELERATION ALTITUDE DATA CODE
241	0F1	ENGINE-OUT ACCELERATION ALTITUDE DATA CODE
242	0F2	PAGING DATA CODE
243	0F3	INTERCEPT COURSE FROM IDENT DATA CODE
244	0F4	INTERCEPT COURSE FROM COURSE DATA CODE
245-300	0F5-12C	RESERVED FOR DEFINITION (BOEING AIRCRAFT)

ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 10 (cont'd)
CODES AND TRIGGERS

SECTION 10.2 (cont'd)
ERROR DATA CODES

DEC CODE	HEX CODE	DESCRIPTION
301	12D	PERF FACTOR DATA CODE
302	12E	TAXI FUEL DATA CODE
303	12F	ZERO FUEL WEIGHT CG DATA CODE
304	130	TROPOPAUSE ALTITUDE DATA CODE
305	131	IDLE FACTOR DATA CODE
306	132	MEAN WIND DATA CODE
307	133	CLIMB WIND ALTITUDE DATA CODE
308	134	CLIMB WIND DIR/MAG DATA CODE
309	135	ALTERNATE DESTINATION WIND ALTITUDE DATA CODE
310	136	ALTERNATE DESTINATION WIND DIR/MAG DATA CODE
311	137	STAR/ENROUTE TRANSITION DATA CODE
312	138	THRUST REDUCTION ALTITUDE DATA CODE
313	139	ACCELERATION ALTITUDE DATA CODE
314	13A	ENGINE-OUT ACCELERATION ALTITUDE DATA CODE
315	13B	ALTERNATE ASSUMED TEMP DATA CODE
316-400	13C-190	RESERVED FOR DEFINITION (AIRBUS AIRCRAFT)

ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 10 (cont'd)
CODES AND TRIGGERS

SECTION 10.3
EXTENDED ERROR CODES

COMMENTARY

Extended error codes are listed as decimal and hexadecimal values. Depending on implementation, this code may be downlinked as either a decimal or hexadecimal value.

DEC CODE	HEX CODE	DESCRIPTION
001	001	ALL OF MESSAGE TEXT DISCARDED
002	002	REMAINDER OF MESSAGE TEXT DISCARDED
003	003	ALL OF DATA TYPE DISCARDED
004	004	REMAINDER OF DATA TYPE DISCARDED
005	005	ALL OF ELEMENT TEXT DISCARDED
006	006	REMAINDER OF ELEMENT TEXT DISCARDED
007	007	ALL OF LIST DISCARDED
008	008	REMAINDER OF LIST DISCARDED
009	009	ALL OF LIST ELEMENT DISCARDED
010	00A	ALL OF MULTI-PARAMETER ELEMENT DISCARDED
011	00B	ALL OF ROUTE BUILDING PARAMETER DISCARDED
012	00C	ALL APPROACH PROCEDURE RELATED DATA DISCARDED
013	00D	ALL DEPARTURE AIRPORT RELATED DATA DISCARDED
014	00E	ALL ARRIVAL AIRPORT RELATED DATA DISCARDED
015	00F	ALL SID RELATED DATA DISCARDED
016	010	ALL STAR RELATED DATA DISCARDED
017	011	NEXT AIRWAY DISCARDED
018	012	SINGLE ELEMENT DISCARDED
019-100	013-064	RESERVED FOR DEFINITION (B-737)
101	065	ALL OF LIST ENTRY DISCARDED
102	066	ALL OF ENROUTE SEGMENT DISCARDED
103	067	ALTERNATE RUNWAY DATA DISCARDED
104	068	RESERVED FOR DEFINITION (BOEING AIRCRAFT)
105	069	ALL OF ELEMENT TEXT DISCARDED
106-200	06A-0C8	RESERVED FOR DEFINITION (BOEING AIRCRAFT)
201-300	0C9-12C	RESERVED FOR DEFINITION (AIRBUS AIRCRAFT)

ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 10 (cont'd)
CODES AND TRIGGERS

SECTION 10.4
TRIGGERS, STIMULUS CODE AND REPORT STIMULUS CODES

COMMENTARY

Triggers, stimulus codes and report stimulus codes are listed as decimal and hexadecimal values. Depending on implementation, this code may be downlinked as either a decimal or hexadecimal value.

DEC CODE	HEX CODE	DESCRIPTION
001	001	4R INIT REF
002	002	4L SUPP NAV DATA INDEX
003	003	4R SUPP NAV DATA INDEX
004	004	5R PERF INIT
005	005	5L PERF LIMITS
006	006	5R PERF LIMITS
007	007	4L TAKEOFF REF 1/2
008	008	6R MOD LEGS EXTENDED DATA
009	009	6L ALTERNATE DEST
010	00A	1L DATA LINK
011	00B	2L DATA LINK
012	00C	3L DATA LINK
013	00D	4L DATA LINK
014	00E	5L DATA LINK
015	00F	1R DATA LINK
016	010	2R DATA LINK
017	011	3R DATA LINK
018	012	4R DATA LINK
019	013	5R DATA LINK
020	014	6R DATA LINK
021	015	1R MAINT BITE INDEX
022	016	2R MAINT BITE INDEX
023	017	3R MAINT BITE INDEX
024	018	4R MAINT BITE INDEX
025	019	5R MAINT BITE INDEX
026	01A	6R MAINT BITE INDEX
027	01B	6R FMCS BITE INDEX
028	01C	6R FMCS SENSOR STATUS 2/2
029	01D	6R FMCS ANALOG DISCRETES
030	01E	6R IRS MONITOR
031	01F	6R FMCS INFLIGHT FAULTS 3/3
032	020	6R FMCS FLIGHT SELECT
033	021	6R FMCS FLIGHT 'N'
034	022	3R ROUTE
035	023	6R ACT LEGS EXTENDED DATA
036	024	5L PROGRESS 3/3
037	025	5R PROGRESS 3/3
038	026	6L PROGRESS 3/3
039	027	6R PROGRESS 3/3
040	028	DES FORECAST
041	029	TIME TO DESTINATION 1
042	02A	TIME TO DESTINATION 2
043	02B	TIME TO DESTINATION 3
044	02C	TIME TO DESTINATION 4
045	02D	TIME TO DESTINATION 5
046	02E	CHANGE IN DESTINATION ETA
047	02F	CHANGE IN DESTINATION AIRPORT
048	030	CHANGE IN ARRIVAL RUNWAY
049	031	EFC ENTRY

ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 10 (cont'd)
CODES AND TRIGGERS

SECTION 10.4 (cont'd)
TRIGGERS, STIMULUS CODE AND REPORT STIMULUS CODES

DEC CODE	HEX CODE	DESCRIPTION
050	032	WIND DISCREPANCY
051	033	WAYPOINT SEQUENCE
052	034	POS SHIFT TO IRS LEFT
053	035	POS SHIFT TO IRS RIGHT
054	036	POS SHIFT TO IRS CENTER
055	037	POS SHIFT TO RADIO
056	038	POS SHIFT TO GPS LEFT
057	039	POS SHIFT TO GNSS RIGHT
058	03A	VERIFY POSITION MESSAGE
059	03B	INSUFFICIENT FUEL MESSAGE
060	03C	MOD PLAN EXECUTION
061	03D	CRUISE ALTITUDE CHANGE
062	03E	RTA UNACHIEVABLE MESSAGE
063	03F	HOLDING PATTERN EXIT
064	040	HOLDING PATTERN ENTRY
065	041	FMC FAULT
066	042	SENSOR FAILURE
067	043	BAD NAVAID
068	044	INAIR
069	045	COMPANY UPLINK TEXT ERROR
070	046	ATC UPLINK TEXT ERROR
071	047	COMPANY UPLINK ACKNOWLEDGE
072	048	ATC UPLINK ACKNOWLEDGE
073	049	COMPANY ROUTE DATA ACCEPTED
074	04A	ATC ROUTE DATA ACCEPTED
075	04B	COMPANY ROUTE DATA ACCEPTED WITH EDIT
076	04C	ATC ROUTE DATA ACCEPTED WITH EDIT
077	04D	COMPANY ROUTE DATA REJECTED
078	04E	ATC ROUTE DATA REJECTED
079	04F	COMPANY RTA DATA ACCEPTED
080	050	ATC RTA DATA ACCEPTED
081	051	COMPANY RTA DATA ACCEPTED WITH EDIT
082	052	ATC RTA DATA ACCEPTED WITH EDIT
083	053	COMPANY RTA DATA REJECTED
084	054	ATC RTA DATA REJECTED
085	055	COMPANY WIND DATA ACCEPTED
086	056	ATC WIND DATA ACCEPTED
087	057	COMPANY WIND DATA ACCEPTED WITH EDIT
088	058	ATC WIND DATA ACCEPTED WITH EDIT
089	059	COMPANY WIND DATA REJECTED
090	05A	ATC WIND DATA REJECTED
091	05B	COMPANY DESCENT FORECAST DATA ACCEPTED
092	05C	ATC DESCENT FORECAST DATA ACCEPTED
093	05D	COMPANY DESCENT FORECAST DATA ACCEPTED WITH EDIT
094	05E	ATC DESCENT FORECAST DATA ACCEPTED WITH EDIT
095	05F	COMPANY DESCENT FORECAST DATA REJECTED
096	060	ATC DESCENT FORECAST DATA REJECTED
097	061	COMPANY PERF INIT DATA ACCEPTED
098	062	ATC PERF INIT DATA ACCEPTED
099	063	COMPANY PERF INIT DATA ACCEPTED WITH EDIT
100	064	ATC PERF INIT DATA ACCEPTED WITH EDIT
101	065	COMPANY PERF INIT DATA REJECTED
102	066	ATC PERF INIT DATA REJECTED
103	067	COMPANY PERF LIMIT DATA ACCEPTED

ATTACHMENT 8B (cont'd)
TABLE-BASED FORMATS FOR FMC IMI/IEI MESSAGES

SECTION 10 (cont'd)
CODES AND TRIGGERS

SECTION 10.4 (cont'd)
TRIGGERS, STIMULUS CODE AND REPORT STIMULUS CODES

DEC CODE	HEX CODE	DESCRIPTION
104	068	ATC PERF LIMIT DATA ACCEPTED
105	069	COMPANY PERF LIMIT DATA ACCEPTED WITH EDIT
106	06A	ATC PERF LIMIT DATA ACCEPTED WITH EDIT
107	06B	COMPANY PERF LIMIT DATA REJECTED
108	06C	ATC PERF LIMIT DATA REJECTED
109	06D	RESERVED FOR DEFINITION (B-737)
110	06E	RESERVED FOR DEFINITION (B-737)
111	06F	RESERVED FOR DEFINITION (B-737)
112	070	RESERVED FOR DEFINITION (B-737)
113	071	RESERVED FOR DEFINITION (B-737)
114	072	RESERVED FOR DEFINITION (B-737)
115	073	UPLINK REQUESTING A DOWNLINK
116	074	TIME TO TOP OF DESCENT 1
117	075	TIME TO TOP OF DESCENT 2
118	076	TIME TO TOP OF DESCENT 3
119	077	TIME TO TOP OF DESCENT 4
120	078	TIME TO TOP OF DESCENT 5
121-200	079-0C8	RESERVED FOR DEFINITION (B-737)
201-300	0C9-12C	RESERVED FOR DEFINITION (BOEING AIRCRAFT)
301	12D	MULTI-LEVEL WIND DATA ACCEPTED
302	12E	MULTI-LEVEL WIND DATA REJECTED
303-400	12F-190	RESERVED FOR DEFINITION (AIRBUS AIRCRAFT)

APPENDIX 1

CHRONOLOGY AND BIBLIOGRAPHY

Deleted by Supplement 6

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SUPPLEMENT 1
TO
ARINC CHARACTERISTIC 702
FLIGHT MANAGEMENT COMPUTER SYSTEM

Published: January 29, 1980

Prepared by the Airlines Electronic Engineering Committee

Adopted by the Airlines Electronic Engineering Committee: August 29, 1979

A. PURPOSE OF THIS DOCUMENT

This Supplement adds an FMC/map display interface specification to Characteristic 702 and re-designates the applications of certain FMC digital data input and output ports to match the selected map display system architecture. The Supplement also adds guidance material to the Characteristic on computer crosstalk in dual FMC installations and on FMC data base loading.

ARINC STAFF NOTE: Because AEEC adopted this Supplement before Characteristic 702 had been published, its incorporation into the first printing of the Characteristic proved possible. Thus, no separate distribution of the Supplement will be made. The changes to the Characteristic made by the Supplement are identified by "¢-1" indicators in the margins of the pages on which they appear.

B. CHANGES TO CHARACTERISTIC 702 INTRODUCED BY THIS SUPPLEMENT

This section presents a complete tabulation of the changes and additions to the Characteristic introduced by this Supplement. Each change or addition is identified by the title and section number currently employed in the Characteristic, or by the title and section number that will be employed when the Supplement is eventually incorporated. In each case there is included a brief description of the addition or change, and, for other than very minor revisions, any text originally contained in the Characteristic is reproduced for reference.

2.2.2 Control Display Unit (CDU)

CDU connector type changed from MS3112E18-32PX to M83723/72R1831N.

3.1.3 Dual System Configuration

Sentence added to refer reader to Section 4.4 for guidance concerning the design of the intersystem bus interface.

3.2.4 Thrust Axis Control

Limit mode selection, N_1/EPR and CAS/Mach commands specified as thrust axis control commands to the FMC and the TCC.

ORIGINAL TEXT FOLLOWS:

The FMC should generate thrust axis limit data and commands consistent with the lateral and vertical navigation and performance specifications of this Characteristic. This information should include a thrust axis command, limit mode selection for the TCC and command for the N_1/EPR indicators.

COMMENTARY

> The thrust axis command parameter has not yet been selected. The choice of this parameter should take into consideration the need for a fuel-efficient cruise mode. This mode may require integration of the vertical and thrust axes in order to prevent excessive throttle activity. AEEC Letter 78-099/SAI-74 refers.

3.6 Growth Features

Data link interface and digital clock input removed from list of growth features as the consequence of the elevation of the status of these interfaces to standard FMC features in this Supplement.

4.1.2.3 "Standard Ground" Signal

Residual voltage specification changed from 1.0 volt to 3.5 volts in accordance with latest industry standards.

4.1.2.4 "Standard Open" Signal

Minimum impedance specification changed from 50,000 ohms to 100,000 ohms in accordance with latest industry standards.

4.2.1 FMCU Digital Data Inputs

Section expanded to discuss use of digital input ports and need for adequate capability in FMC to service all specified ports. Commentary added.

ORIGINAL TEXT FOLLOWS:

The digital input ports required by the FMCU are listed in the following paragraphs.

4.2.1.6 Flight Control System Input Ports

Section revised to delete input port for FCC data.

ORIGINAL TEXT FOLLOWS:

Two input ports will receive data from an ARINC 701 Flight Control Computer System. Data from the FCC will be delivered to one port and data from the glare shield controller to the other.

4.2.1.8 Data Update Input Ports

Section amended to define two ports for bulk data storage update, one dedicated to a proprietary bulk loading device input and the other to an interface with the ACARS data link.

ORIGINAL TEXT FOLLOWS:

One input port is dedicated to receive data to update bulk storage integral to the FMCU.

4.2.1.11 Electronic Flight Instrument System Input Ports

Section revised to specify one port to receive data from an EFI system and to reserve connector pins for a second.

ORIGINAL TEXT FOLLOWS:

Two input ports are provided for data from Electronic Flight Instrument systems.

4.2.1.12 Digital Clock Input

New section added by this Supplement. Old Section 4.2.1.12 (Reserved Ports for Growth Inputs) renumbered 4.2.1.13.

4.2.1.13 Reserved Ports for Growth Inputs

As a consequence to the change to Section 4.2.1.8 above, the reference to the reserved data link input port is deleted.

4.2.2 FMCU Digital Data Outputs

Number of output ports specified changed from seven to nine. Sentence added defining their applications.

4.2.2.1 FMC Intersystem Output

Note deleted.

ORIGINAL TEXT FOLLOWS:

NOTE: The air transport industry expects to develop complete interface standards for FMCU/FMCU intercommunications. They will be added to this document by means of a Supplement.

4.2.2.4 Instrumentation Data Output

Section amended to define Electronic Flight Instruments as the only sinks expected to utilize the data delivered from these ports. Commentary added.

ORIGINAL TEXT FOLLOWS:

Two ports are dedicated to supplying data for the Electronic Flight Instrument systems or digital electro-mechanical instruments. These buses should operate at the high data rate defined in ARINC Specification 429.

4.2.2.7 FDSU/Data Loader Output

Reference to data loader use of this port added. Prior to this Supplement, only FDSU application was addressed.

4.2.2.8 Data Link Output

Title changed (from "Reserved Port for Growth Outputs") text amended to specify port assignment as interface with ACARS data link downlink.

ORIGINAL TEXT FOLLOWS:

One low speed port is reserved for future growth. A possible use is for a data link interface.

4.3.2.2 Off-Side CDU Enable

Section revised and re-titled to define the discrete function more clearly.

ORIGINAL TEXT FOLLOWS:

4.3.2.2 CDU Master/Slave Discrete

This input discrete is provided for use if necessary to enable the FMCU to determine which CDU has control of data entry in a single FMCU/dual CDU configuration. An open circuit condition indicates that the prime CDU for that FMC is in control.

4.3.2.9 CDU Active Input Identification Discrete

New section added by this Supplement.

4.3.2.10 CDU Primary/Secondary Status Input Discrete

New section added by this Supplement.

4.3.2.11 MAG/True Input Discretes

New section added by this Supplement.

4.3.1.12 Data Loader Discretes

New section added by this Supplement.

4.4 FMC/FMC Intersystem Communications

New section added by this Supplement.

4.5 FMCU/ACARS Interface

New section added by this Supplement.

5.4 Panel Illumination

Sentence added concerning master dimming provisions.

8.0 Electronic Flight Instrument System Interface

Existing chapter replaced completely.

ARINC STAFF NOTE: We are not reproducing the original text of Chapter 8. The material was largely tentative in nature. What has remained relevant has been incorporated into the replacement version.

Attachment 2 - Standard Interwiring

The following FMCU connector pin assignment changes are made by this Supplement:

Attachment 2 - Standard Interwiring (cont'd)

FMCU Pin	Characteristic 702 Assignment	Supplement 1 Assignment
TP3D	Flight Control Computer	Future Spare
TP3E	Input	Future Spare
TP4K	Future Spare	MAG/True Input Discrete #1
TP6K	Future Spare	MAG/True Input Discrete #2
TP9F	Future Spare	RESERVED (Navigation Data Base Update Enable Discrete)
TP15K	Future Spare	RESERVED (CDU Message Origin Discrete Output)
MP3D	RESERVED for Digital Clock	Digital Clock A
MP3E	Input	Input B
MP3G	RESERVED (Data	ACARS Data A
MP3H	Link Input)	Link Input B
MP9A	RESERVED (Spare Data	Output to ACARS A
MP9B	Output Port)	Data Link B
MP11A	RESERVED (Program Function)	RESERVED (Operating Program Update Enable Discrete)
MP11B	RESERVED (Program Function)	RESERVED (Performance Data Base Update Enable Discrete)
MP11K	RESERVED (Program Function)	RESERVED (Target Speed Discrete Output)
MP13K	RESERVED (Program Function)	RESERVED (Target N_1/EPR Discrete Output)

The pin assignments made by this Supplement for the CDU connector type it introduced into Section 2.2.2 are as follows:

Pin	Assignment
1	Future Spare
2	Data Input A
3	Port "A" B
4	Future Spare
5	Data Input A
6	Port "B" B
7	Future Spare
8	Data Output A
9	to FMC B
10	Active Port Program
11	Primary/Secondary Program
12	RESERVED (FMC Failure Warn Discrete I/P)
13	RESERVED (CDU Failure Warning Discrete Output)
14	RESERVED (CDU Message Original Disc. I/P (#1 FMC))
15	RESERVED (CDU Message Origin Disc. I/P (#2 FMC))
16	Future Spare
17	
18	
19	
20	
21	
22	
23	Lamp Test Discrete I/P
24	Future Spare
25	Chassis Ground
26	28 VDC Bright/Dim Lo
27	28 VDC Bright/Dim Hi
28	5 VAC Panel Light Supply Hi
29	5 VAC Panel Light Supply Lo
30	115 VAC Primary Power Hot
31	115 VAC Primary Power Cold

Wire I/R values added to the interwiring diagram together with Note 6. Note 2 modified to eliminate reference to the use of connector pins to carry digital bus shield grounds into the FMCU and other units.

Connector insert pin layout diagrams added.

Attachment 6 - FMC/EFI Interface

New attachment added by this Supplement.

Attachment 7 - FMC/FMC Intersystem Communications

New attachment added by this Supplement.

Attachment 8 - FMC/ACARS Information Exchange

New attachment added by this Supplement.

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SUPPLEMENT 2
TO
ARINC CHARACTERISTIC 702
FLIGHT MANAGEMENT COMPUTER SYSTEM

Published: April 24, 1981

Prepared by the Airlines Electronic Engineering Committee

Adopted by the Airlines Electronic Engineering Committee: March 12, 1981

A. PURPOSE OF THIS DOCUMENT

This Supplement deletes from Characteristic 702 material concerning an external Flight Data Storage Unit (FDSU), revises the material on discrete input and program pin usage and updates the description of ACARS data link use with the FMC.

B. ORGANIZATION OF THIS SUPPLEMENT

The first page of this document, printed on buff-colored paper, contains descriptions of the changes introduced into the Characteristic by this Supplement, and where appropriate, extracts from the original text for comparison purposes. The second part consists of replacement white pages for the Characteristic, modified to reflect these changes. The modified and added material on each replacement page is identified with "¢-2" symbols in the margins. Existing copies of Characteristic 702 may be updated by simply inserting the replacement white pages where necessary and destroying the pages they replace. The buff-colored pages should be inserted inside the rear cover of the Characteristic.

C. CHANGES TO CHARACTERISTIC 702 INTRODUCED BY THIS SUPPLEMENT

This section presents a complete tabulation of the changes and additions introduced by this Supplement. Each change and addition is identified by the section number and title employed in the Characteristic. In each case, there is a brief description of the addition or change and, for other than very minor revisions, any text originally contained in the Characteristic is reproduced for reference.

1.3 Brief Description of the System

Section amended to delete reference to an optional external Flight Data Storage Unit (FDSU).

ORIGINAL TEXT FOLLOWS:

1.3 Brief Description of the System

The ARINC 702 Flight Management Computer System comprises two units, one a rack-mounted computer unit and the other a cockpit-located control and display unit. The system may also employ an optional Flight Data Storage Unit (FDSU). However, as noted below, a system design goal should be to provide storage for all data required by the system in the FMC itself.

1.4.3 Flight Data Storage Unit (Optional)

Section deleted.

ORIGINAL TEXT FOLLOWS:

1.4.3 Flight Data Storage Unit (Optional)

A supplementary Flight Data Storage Unit (FDSU) may be used if it is not possible to store all of the required data base within the Flight Management Computer. The storage medium should be chosen and the storage unit designed such that efficient data stacking and rapid data transfer is possible in order to avoid increased cockpit workload due to delays in displayed data.

COMMENTARY

> As noted in Sections 1.3 and 1.4.1 above, the system designer’s goal should be to provide all necessary storage in the FMC.

2.2.3 Optional Flight Data Storage Unit (FDSU)

Section deleted.

ORIGINAL TEXT FOLLOWS:

2.2.3 Optional Flight Data Storage Unit (FDSU)

The FDSU, if used, should comply with the standards established in ARINC Specification 600 for the 4 MCU form factor, and be provided with a Size 1 shell ARINC 600 series connector with pin assignments as set forth in Attachment 2. An outline drawing showing the location of the connector is shown in Attachment 1C. Index pin code 06 should be used.

NOTE: The fact that the FDSU described here refers to a rack mounted unit does not preclude the use of a cockpit mounted data reader unit for insertion of flight plan data, etc. Section 3.2.7 of this Characteristic addresses such implementations.

2.4.1 Primary Power Input

References to FDSU in paragraphs 1 and 2 deleted. Text added to specify needed FMCU breaker capability to handle FMCU and data loader power.

ORIGINAL TEXT FOLLOWS:

(Paragraphs 1 and 2 only)

2.4.1 Primary Power Input

The FMCU, the CDU and the FDSU (if used) should be designed to use 115 volt 400 Hz single phase power from a system designed for Category (A) utilization equipment per ARINC Specification 413A.

The primary power inputs to the FMCU, the CDU and the FDSU (if used) will each be protected by a circuit breaker of the size shown in Attachment 2 to this Characteristic.

2.5 Environmental Conditions

Reference to flight data storage units deleted.

ORIGINAL TEXT FOLLOWS:

2.5 Environmental Conditions

The FMCU, CDU and any flight data storage units should meet the requirements of RTCA Document DO-160. Attachment 5 to this Characteristic tabulates the relevant environmental categories.

4.2.1.8 Data Update Input Ports

First paragraph of this Section amended to define the ARINC 603 data loader as the source of FMCU bulk storage updates.

ORIGINAL TEXT FOLLOWS:

4.2.1.8 Data Update Input Ports

Two input ports are dedicated to receive data to update bulk storage integral to the FMCU. One of these ports is intended for an interface with a loading device designed specifically for use with that FMCU. The characteristics of the digital data us carrying this data are not constrained by this specification, although it is recommended that choices be made which permit the use of the DITS transmission medium specified in ARINC Specification 429, so that special EMI provisions do not have to be made to accommodate the use of a bulk loading device on the aircraft.

4.2.2 FMCU Digital Data Outputs

References to FDSU in item (v) and third sentence deleted.

ORIGINAL TEXT FOLLOWS:

4.2.2 FMCU Digital Data Outputs

Nine separate, buffered digital data output ports are provided to drive the CDUs and other subsystems requiring FMC system data. These are (i) Intersystem, (ii) General Data Output (2), (iii) EFI (2), (iv) CDU Output (2), (v) FDSU/Data Loader and (vi) ACARS. The characteristics of the digital data bus(es) carrying data to the CDU(s) and FDSU (if used) are not constrained by this specification, although it is recommended that choices be made which permit the use of the DITS transmission medium specified in ARINC Specification 429 and do not result in a need to make special EMI provisions in the aircraft.

4.2.5 FDSU Digital Data Input (Option)

Section deleted.

ORIGINAL TEXT FOLLOWS:

4.2 5 FDSU Digital Data Input (Option)

The FDSU, if installed as part of the system, should have a digital data input port connected to the FMCU output bus defined in paragraph 4.2.2 of this Characteristic.

4.2.6 FDSU Digital Data Output (Option)

Section deleted.

ORIGINAL TEXT FOLLOWS:

4.2.6 FDSU Digital Data Output (Option)

The FDSU, if installed as part of the FMC system, should have a digital data output bus similar to that defined in paragraph 4.2.2 of this Characteristic, which will communicate with the FMCU.

4.3.2 Discrete Inputs and Outputs

Section (made up of sub-sections 4.3.2.1 through 4.3.2.12) revised completely.

ORIGINAL TEXT FOLLOWS:

4.3.2 Discrete Inputs and Outputs

4.3.2.1 Program Pins

Program pins are incorporated to differentiate between functions of the system dependent on the installation in the airplane. Twenty-nine program pin inputs are reserved in Attachment 2 to this Characteristic.

4.3.2.2 Off-Side CDU Enable

The input discrete is provided for use if necessary to enable data entry into the FMC from the off-side CDU (the non-"prime" CDU) in a dual CDU configuration. An open circuit condition indicates the off-side CDU input to the FMC is enabled.

4.3.2.3 Autotune Master/Slave Discrete

This input discrete is provided for use, where necessary, in determining which FMCU in a dual system configuration has control of NAVAID Autoselection. An open circuit condition indicates that the FMCU to which it is applied is in control.

4.3.2.4 Oleo Strut Switch Discrete

A "standard ground" input discrete will be supplied to the FMCU when the airplane oleo strut switch indicates an "on the ground" condition.

4.3.2.5 Maintenance Test Discrete

The FMC should accept an input discrete for initiating a maintenance test. A "standard ground" condition of this discrete constitutes a test command.

4.3.2.6 Manual/Auto Discretes

Two input discretes are provided to determine the state of the captain and first officer Manual/Auto tuning switches. A "standard ground" condition indicates the selection of Manual tune.

4.3.2.7 Source/Destination Identifier (SDI)

Three input discretes are provided to enable the FMCU to recognize/encode the SDI code specified in ARINC Specification 429. (See Attachment 2 to this document.)

4.3.2.8 CDU Message Alert Discrete

The FMC should provide a "standard ground" output discrete for activating a "CDU message alert" annunciator when it is necessary to draw the flight crew's attention to a message displayed on the CDU.

4.3.2.9 CDU Active Input Identification Discrete

A discrete input to the CDU should be provided to enable it to determine which FMC data input port to activate. A "standard open" signal should indicate that it should activate the port connected to the FMC for which it is the prime CDU.

4.3.2.10 CDU Primary/Secondary Status Input Discrete

An input discrete to the CDU should be provided to define the CDU as primary or secondary. An open circuit condition signified primary status.

Attachment 2 - Standard Interwiring

The following connector in assignment changes are made by this Supplement.

FMCU

Pin	Characteristic 702-1 Assignment	Supplement 2 Assignment
MP9J	Future Spare	"Data Loader
MP9K	Future Spare	Connected" Input
TP6K	MAG/True Disc. #2	RESERVED (Future Discrete)
TP9F	RESERVED (Nav. Data Base Update Enable Discrete)	Nav. Data Base Update Enable Discrete
TP11G	Data O/P to A	Data Output A
TP11H	FDSU B	to Data Loader B
MP11A	RESERVED (Operating Pgm. Update Enable Discrete)	Operating Pgm. Update Enable Discrete
MP11B	RESERVED (Performance Data Base Update Enable Discrete)	Performance Data Base Update Enable Discrete
MP11C thru MP11J	RESERVED (Program Functions)	RESERVED (Application-Unique Discrete Inputs)
MP13A thru MP13J	RESERVED (Program Functions)	RESERVED (Application-Unique Discrete Inputs)
MP15A thru MP15G	RESERVED (Program Functions)	RESERVED (Application-Unique Discrete Inputs)
MP15H	Future Spare	RESERVED (Future
MP15J	Future Spare	Discretes)

4.3.2.11 MAG/True Input Discretes

Two input discretes are provided to the FMC to indicate whether the navigation outputs should be referenced to magnetic or true north. A standard ground condition indicates the selection of the true north reference.

4.3.2.12 Data Loader Discretes

Three FMCU service connector pins should be reserved for data loader discrete inputs. These pins are expected to be associated with Operating Program, Navigation Data Base and Performance Data Base update enabling functions.

4.3.4 FMCU Enable Data Loading Function

New Section added by this Supplement.

7.2.2 Use of ATLAS Language

ARINC Specification 616 substituted for IEEE Standard 416-1976 as source of ATLAS test language definition.

Attachment 1C - FDSU Connector Positioning

Attachment deleted.

FDSU

All FDSU pin assignments and references to FDSU deleted. Wiring to aircraft interface provided for external data loader substituted.

Notes Applicable to Standard Interwiring

Mention of optional FDSU in Note 1 deleted.

Note 7 added.

Connector Insert Pin Layout Diagrams

Diagrams amended to show new pin assignments listed in the table above. Layout diagrams for the FDSU connector inserts deleted.

Attachment 3 - FMCS Configuration Diagrams

References to FDSU deleted from "FDSU/Data Loader" blocks on the three configuration diagrams.

Attachment 8 - FMC/ACARS Information Exchange

Attachment revised completely.

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SUPPLEMENT 3
TO
ARINC CHARACTERISTIC 702
FLIGHT MANAGEMENT COMPUTER SYSTEM

Published: March 22, 1982

Prepared by the Airlines Electronic Engineering Committee

Adopted by the Airlines Electronic Engineering Committee: December 9, 1981

A. PURPOSE OF THIS DOCUMENT

This Supplement amends the CDU power dissipation value and updates the description of ACARS data link use with the FMC.

B. ORGANIZATION OF THIS SUPPLEMENT

The first page of this document, printed on buff-colored paper, contains descriptions of the changes introduced into the Characteristic by this Supplement, and where appropriate, extracts from the original text for comparison purposes. The second part consists of replacement white pages for the Characteristic, modified to reflect these changes. The modified and added material on each replacement page is identified with "¢-3" symbols in the margins. Existing copies of Characteristic 702 may be updated by simply inserting the replacement white pages where necessary and destroying the pages they replace. The buff-colored pages should be inserted inside the rear cover of the Characteristic.

C. CHANGES TO CHARACTERISTIC 702 INTRODUCED BY THIS SUPPLEMENT

This section presents a complete tabulation of the changes and additions introduced by this Supplement. Each change and addition is identified by the section number and title employed in the Characteristic. In each case, there is a brief description of the addition or change and, for other than very minor revisions, any text originally contained in the Characteristic is reproduced for reference.

2.5.1.2 CDU

Internal power dissipation changed from 70W to 92W.

Attachment 8 - FMC/ACARS Information Exchange

Attachment revised to incorporate changes made to the material extracted from ARINC Characteristic 724 by Supplement 2 to that document.

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SUPPLEMENT 4
TO
ARINC CHARACTERISTIC 702
FLIGHT MANAGEMENT COMPUTER SYSTEM

Published: November 18, 1991

Prepared by the Airlines Electronic Engineering Committee

Adopted by the Airlines Electronic Engineering Committee: October 25, 1989

A. PURPOSE OF THIS DOCUMENT

This Supplement proposes changes to ARINC Characteristic 702 to revise text of Attachment 8 which was introduced in Supplement 3 to provide for an end-to-end Cyclic Redundancy Check (CRC). The new text gives specific direction as to how the CRC is to be performed.

As an editorial change, the clarity of the ISO 5 baudot subset and data word diagrams in Attachment 8 were improved.

B. ORGANIZATION OF THIS SUPPLEMENT

The first page of this document, printed on buff-colored paper, contains descriptions of the changes introduced in Characteristic 702 by this Supplement. The second part consists of replacement white pages for the Characteristic, modified to reflect these changes. The modified and added material on each replacement page is identified by the "¢-4" symbols in the margins. Existing copies of Characteristic 702 may be updated by simply inserting the replacement pages where necessary and destroying the pages they replace. The buff-colored pages should be inserted inside the rear cover of the Characteristic.

C. CHANGES TO CHARACTERISTIC 702 INTRODUCED BY THIS SUPPLEMENT

This section presents a complete tabulation of the changes and additions to Characteristic 702 introduced by this Supplement. Each change or addition is entitled by the section number and title currently employed in the Characteristic, or by the section number and title that will be employed when the Supplement is eventually incorporated. In each case, there is included a brief description of the addition or change.

Attachment 8

A portion of this attachment, extracted from Attachment 11 of ARINC Characteristic 724, was revised to increase the extent of the definition and implementation of the end-to-end integrity check for messages exchanged across an RF data link utilizing a character-oriented data transmission format. To increase the structure of the attachment and avoid confusion concerning the titles of the various components, Attachment 8 was divided into Attachments 8A through 8F as follows:

Attachment	Title
8A	FMC/ACARS Information Exchange
8B	Sublabel Assignments and Onboard Message Handling and Accountability Codes
8C	ISO Alphabet No. 5 Subset for Ground Computer/Airborne Computer Message Exchange via ACARS
8D	ISO Representation of Hexadecimal Characters for Binary Data Transmission
8E	Text-Imbedded Error Check for Ground Computer/Airborne Computer Messages
8F	Text Standards for Ground Computer/Airborne Computer Message Exchanges via ACARS

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SUPPLEMENT 5
TO
ARINC CHARACTERISTIC 702©
FLIGHT MANAGEMENT COMPUTER SYSTEM

Published: February 20, 1992

Prepared by the Airlines Electronic Engineering Committee

Adopted by the Airlines Electronic Engineering Committee: January 31, 1992

A. PURPOSE OF THIS DOCUMENT

This Supplement adds the capability of utilizing ARINC 743 GPS Sensor to interface with the ARINC 702 FMCS to provide enhanced navigation functions. It also includes new material on text-imbedded error checking for ground computer/airborne computer messages and table-based formats for the FMC IMI/IEI messages.

B. ORGANIZATION OF THIS SUPPLEMENT

The first page of this document, printed on buff-colored paper, contains descriptions of the changes introduced into the Characteristic by this Supplement. The second part consists of replacement white pages for the Characteristic, modified to reflect these changes. The modified and added material on each replacement page is identified by the "¢-5" symbols in the margins. Existing copies of Characteristic 702 may be updated by simply inserting the replacement white pages where necessary and destroying the pages they replace. The buff-colored pages should be inserted inside the rear cover of the Characteristic.

C. CHANGES TO CHARACTERISTIC 702 INTRODUCED BY THIS SUPPLEMENT

This section presents a complete tabulation of the changes and additions to Characteristic 702 introduced by this Supplement. Each change or addition is defined by the section number and the title that will be employed when the Supplement is eventually incorporated. In each case, a brief description of the change or addition is included.

1.2 Summary of Operational Characteristics

The second paragraph, fifth sentence was modified to include GPS.

1.4.2 Control/Display Unit (CDU)

The second paragraph was modified to include GPS.

3.1.1 Single System Configuration

The first paragraph was modified to include GPS.

3.2.9 GPS Initialization

A new section was added to describe the GPS initialization.

4.2.1.14 GPS Input Ports

A new section was added to describe the GPS input ports.

Attachment 2 - Standard Interwiring and Connector insert Pin Layouts

The standard interwiring and connector insert pin layouts have been updated to reflect the added capability of utilizing ARINC 743 GPS Sensor to interface with the ARINC 702 FMCS.

Attachment 3 - Flight Management Computer System

The three figures, Configuration 1: Single System Installation, Configuration 2: Single System/Dual CDU Installation and Configuration 3: Dual System Installation have been updated to reflect the added capability of utilizing ARINC 743 GPS Sensor to interface with the ARINC 702 FMCS.

Attachment 4 - FMCS Data Inputs

The four tables have been updated to reflect the added capability of utilizing ARINC 743 GPS Sensor to interface with the ARINC 702 FMCS.

Attachment 8 - FMC/ACARS Information Exchange

Attachment 8 was completely revised to describe FMC/ACARS information exchange. Specifically, the encoding of the Cyclic Redundancy Check (CRC) was introduced. The table-based formats for IMI/IEI messages were also updated.

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SUPPLEMENT 6
TO
ARINC CHARACTERISTIC 702©
FLIGHT MANAGEMENT COMPUTER SYSTEM

Published: June 10, 1994

Prepared by the Airlines Electronic Engineering Committee

Characteristic 702 Adopted by the Airlines Electronic Engineering Committee: June 10, 1994

A. PURPOSE OF THIS DOCUMENT

This Supplement adds the 4 MCU form factor as an optional size for the Flight Management Computer (FMC). The term "FMC" is widely recognized as the accepted acronym for this equipment, and it replaces the term "FMCU" used in previous versions of this document. The intersystem data bus description is revised. The definition of data link element is updated and the table of IMIs/IEIs to support the B-777 aircraft is included. The GPS interwiring first introduced in Supplement 5 is revised. The GNSS Sensor is introduced. This Supplement corrects several errors of omission in Supplement 5.

B. ORGANIZATION OF THIS DOCUMENT

The first part of this document, printed on buff-colored paper, contains descriptions of changes introduced into the Characteristic by this Supplement. The second part consists of replacement sections of the Characteristic, modified to reflect the changes. The modified and added material on each page is identified by a ¢-6 symbol in the margins. ARINC Characteristic 702 has been completely revised by incorporating the new material introduced by this Supplement. Replacement white pages are unavailable.

C. CHANGES TO ARINC CHARACTERISTIC 702 INTRODUCED BY THIS SUPPLEMENT

This section presents a complete tabulation of the changes and additions to the Characteristic introduced by this Supplement. Each change or addition is defined by the section number and the title. In each case, a brief description of the change or addition is included.

1.2 Summary of Operational Characteristics

This section was revised to introduce the role of the Global Navigation Satellite System (GNSS) sensor. Editorial inputs were introduced to clarify the role of the Flight Management Computer System (FMS) and the Flight Management Computer (FMC) unit.

1.4.2 Control/Display Unit (CDU)

The second paragraph of this section was modified to include GNSS.

1.5.1 General

The reference to ARINC Report 414 was deleted as the document is obsolete.

2.2.1 Flight Management Computer (FMC) Unit

This section was revised to introduce the optional 4 MCU form factor.

3.1.1 Single System Configuration

The first paragraph of this section was modified to include GNSS.

3.2.1.2 Performance Data Base

The reference to "flight data storage unit" was deleted.

3.2.7 Data Update Interface

This section was revised to describe current data upload techniques. The reference to "FDSU" was deleted.

3.2.9 GNSS Initialization

This section was revised to describe GNSS initialization.

3.4.1.3.1 Waypoint Identifier

The maximum size of the waypoint identifier was increased to seven alphanumeric characters.

3.4.1.7 Assigned Time at a Fix

This section was revised to state that Assigned Time at a Fix should be specified in hours, minutes, and optionally in tenths of minutes.

4.1.2.2 Standard "Applied Voltage"

The reference to ARINC Specification 410 was deleted as the document is obsolete.

4.2.1.9 Intersystem Data Input Port

This section is revised to accommodate provisions for a high-speed data bus for local data transfer between two FMCs.

4.2.1.12 Digital Clock Input

This section was revised to state that the clock input may be provided from a GNSS source.

4.2.1.14 GNSS Input Ports

This section was revised to describe the GNSS input ports.

4.2.2.1 FMC Intersystem Output

This section was revised to describe the capabilities of the high-speed intersystem bus.

4.2.2.7 Data Loader Output

The reference to "FDSU" was deleted.

4.4 FMC/FMC Intersystem Communications

This section was completely revised to describe the use of the intersystem communication bus.

4.5 FMC/ACARS Interface

This section was revised to identify the applicable ACARS protocol standards.

Attachment 2 - Standard Interwiring and Connector Insert Pin Layouts

The standard interwiring and connector insert pin layouts in Attachment 2 were updated to reflect the added capability of utilizing ARINC 743A GNSS Sensor to interface with the ARINC 702 FMC.

Attachment 3 - Flight Management Computer System

The three figures in Attachment 3, Configuration 1 - Single System Installation, Configuration 2 - Single System/Dual CDU Installation and Configuration 3 - Dual System Installation were updated to reflect the ARINC 743A GNSS Sensor interface to the ARINC 702 FMC. The drawings were redrawn for clarification.

Attachment 4 - FMC Data Inputs

The tables in Attachment 4 were updated to reflect the added capability of utilizing ARINC 743A GNSS Sensor to interface with the ARINC 702 FMC.

Attachment 7 - FMC/FMC Intersystem Communications

Attachment 7 was deleted by Supplement 6.

Attachment 8B - Table-Based Formats for FMC IMI/IEI Messages

Attachment 8B was extensively revised to describe the element definitions for Imbedded Message Identifiers (IMI) and Imbedded Element Identifiers (IEI) used on the B-777.

Appendix 1 - Chronology and Bibliography

Appendix 1 was deleted by Supplement 6.

ATTACHMENT 7
FMC/FMC INTERSYSTEM COMMUNICATIONS

OBSOLETE

ATTACHMENT 7 (cont'd)
FMC/FMC INTERSYSTEM COMMUNICATIONS

OBSOLETE

ATTACHMENT 7 (cont’d)
FMC/FMC INTERSYSTEM COMMUNICATIONS

OBSOLETE

ATTACHMENT 7 (cont’d)
FMC/FMC INTERSYSTEM COMMUNICATIONS

OBSOLETE

APPENDIX 1
CHRONOLOGY AND BIBLIOGRAPHY

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