ARINC

VHF DATA RADIO

ARINC CHARACTERISTIC 750-4

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FOREWORD

Aeronautical Radio, Inc., the AEEC, and ARINC Standards

Aeronautical Radio, Inc. (ARINC) was incorporated in 1929 by four fledgling airlines in the United States as a privately-owned company dedicated to serving the communications needs of the air transport industry. Today, the major U.S. airlines remain the Company's principal shareholders. Other shareholders include a number of non-U.S. airlines and other aircraft operators.

ARINC sponsors aviation industry committees and participates in related industry activities that benefit aviation at large by providing technical leadership and guidance and frequency management. These activities directly support airline goals: promote safety, efficiency, regularity, and cost-effectiveness in aircraft operations.

The Airlines Electronic Engineering Committee (AEEC) is an international body of airline technical professionals that leads the development of technical standards for airborne electronic equipment-including avionics and in-flight entertainment equipment-used in commercial, military, and business aviation. The AEEC establishes consensus-based, voluntary form, fit, function, and interface standards that are published by ARINC and are known as ARINC Standards. The use of ARINC Standards results in substantial benefits to airlines by allowing avionics interchangeability and commonality and reducing avionics cost by promoting competition.

There are three classes of ARINC Standards:

a) ARINC Characteristics – Define the form, fit, function, and interfaces of avionics and other airline electronic equipment. ARINC Characteristics indicate to prospective manufacturers of airline electronic equipment the considered and coordinated opinion of the airline technical community concerning the requisites of new equipment including standardized physical and electrical characteristics to foster interchangeability and competition.

b) ARINC Specifications – Are principally used to define either the physical packaging or mounting of avionics equipment, data communication standards, or a high-level computer language.

c) ARINC Reports – Provide guidelines or general information found by the airlines to be good practices, often related to avionics maintenance and support.

The release of an ARINC Standard does not obligate any airline or ARINC to purchase equipment so described, nor does it establish or indicate recognition or the existence of an operational requirement for such equipment, nor does it constitute endorsement of any manufacturer's product designed or built to meet the ARINC Standard.

In order to facilitate the continuous product improvement of this ARINC Standard, two items are included in the back of this volume:

a) An Errata Report solicits any corrections to the text or diagrams in this ARINC Standard.

b) An ARINC IA Project Initiation/Modification (APIM) form solicits any recommendations for addition of substantive material to this volume which would be the subject of a new Supplement.

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1.0 INTRODUCTION

1.1 Purpose of this Document

This document describes one of the airborne components defined in ARINC Specification 631, "VHF Digital Link Implementation Provisions". The intent of this document is to provide general and specific design guidance for the development and installation of the airborne equipment. As such, this guidance covers the desired operational capability of the system and the standards necessary to achieve interchangeability of the hardware. The VHF Data Radio (VDR) has various modes of operation which are described more fully in Chapter 3. c-3

Equipment manufacturers should note that this document aims to encourage them to produce maintenance-free, high performance equipment. They are at liberty to accomplish this by the use of design techniques they consider to be the most appropriate. Their airline customers are more interested in the end result than in the means to achieve it.

1.2 Airborne Subsystem Configuration

This document assumes that the airborne components implementing VDL Mode 2 are arranged as shown in Attachment 1 and that they function within the system operating rules outlined in ARINC Specification 631 and the ICAO ATN SARPs and VDL SARPs. c-3 c-2

The VDR has two basic domains of operation as a standard double sideband AM analog voice transceiver and as a data-capable transceiver. Depending on the selected data mode, the VDR performs transceiver, modem, and/or link layer functionality. In VDL Mode 2, the VDR is a link layer bridge for the VHF subnetwork. In ACARS, the VDR is either a simple transceiver with an analog interface to the MU or a MSK modem. c-3

As a VDL Mode 2 bridge, the VDR is an integral part of the VDL Mode 2/ATN communications protocol suite. Detailed background of VDL Mode 2/ATN can be found in ARINC Specification 631, ICAO VDL SARPs, and the ICAO ATN SARPs. c-3 c-4

As an ACARS modem, the VDR (bidirectionally) converts digital data to RF output. Detailed background of ACARS can be found in ARINC Specifications 618, 619, and 620.

Depending on the selected mode, the VDR operates with a Communications Management Unit (CMU) Mark-2 (see ARINC Characteristic 758), a Management Unit (MU) (see ARINC Characteristic 724, ARINC Characteristic 724B, and ARINC Specification 618), a Central Fault Display Interface Unit (CFDIU) (see ARINC Report 604) or Onboard Maintenance System (see ARINC Report 624), and/or an antenna with vertical polarization and omnidirectional azimuth radiation pattern coverage.

COMMENTARY

Throughout this document the nomenclature for the ACARS management unit is identified as MU. The nomenclature for the Communications Management Unit Mark-2 is identified as CMU. c-1

1.3 Interchangeability

1.3.1 General

One of the primary functions of an ARINC Equipment Characteristic is to designate, in addition to certain performance parameters, the interchangeability in an aircraft of equipment produced by various manufacturers. The manufacturer is referred to ARINC Report 607, "Design Guidance for Avionic Equipment", for definitions of terms and general requirements for the airline industry for interchangeability. As explained in that report, the degree of interchangeability considered necessary and attainable for each particular system is specified in the pertinent ARINC Equipment Characteristic for that system. c-1

1.3.2 Interchangeability Required for the ARINC 750 VHF Data Radio

Unit interchangeability is required for the VDR regardless of manufacturing source. In defining the equipment described in this characteristic, the air transport industry has chosen to depart from its previous data link standards. In order to achieve the full benefit of the economies offered by these changes, the industry desires that any provisions for backwards

1.0 INTRODUCTION

1.3.2 Interchangeability Required for the ARINC 750 VHF Data Radio (cont'd)

compatibility with VHF Communications equipment described by ARINC 716 be provided as basic provisions. The ARINC 750 radio is pin- and function-compatible with the ARINC 716 radio.

COMMENTARY

c-1 Exceptions to this are that the ARINC 750 radio has a maximum transmission cutoff enable function as described in Section 4.2.3.3 and additional ATE/BITE functionality as described in Sections 6 & 7. The cutoff function was added to be compliant with RTCA DO-207 and proposed TSO C-128. When this function is inhibited the ARINC 750 radio behaves just like a radio designed to ARINC Characteristic 716 or earlier, with the added benefit of enhanced ATE/BITE functionality.

1.4 Regulatory Approval

The equipment should meet all applicable regulatory requirements. Manufacturers are urged to obtain all necessary information for such regulatory approval. This information is not contained in this characteristic, nor is it available from ARINC.

1.5 Relationship to ICAO Documents

c-1 The basic signal-in-space definitions such as the VDR modulation for D8PSK as well as the Channel Sense and Transmitter-Receiver Interaction Performance standards are defined in the International Civil Aviation Organization (ICAO) Standards and Recommended Practices (SARPs) for VHF Digital Link (VDL). The ICAO SARPs for VDL also define the basic protocol suite. Additional interoperability information needed by the air transport industry is contained in ARINC
c-3 Specification 631, "VHF Digital Link Implementation Provisions".

COMMENTARY

c-1 A copy of the ICAO VDL SARPS and associated Guidance Material may be obtained upon request to the Secretariat of the ICAO Aeronautical Mobile Communications Panel (AMCP) by writing to:

c-2
ICAO
Air Navigation Bureau (ANB)
999 University Street
Montreal, Quebec, Canada H3C 5H7

1.6 Relationship to Other Documents

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See Appendix C, Bibliography, for the relationship of this Characteristic to other documents.

2.0 INTERCHANGEABILITY STANDARDS

2.1 Introduction

This Section sets forth the specific form factor, mounting provisions, interwiring, input and output interfaces and power supply characteristics desired for the VHF Data Radio.

Manufacturers should note that although this Characteristic does not preclude the use of different form factors and interwiring features, the practical problem of redesigning 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 standards set forth in this document.

2.2 Form Factors, Antenna Considerations, Connectors & Index Pin Coding

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2.2.1 VHF Data Radio (VDR)

The VDR should comply with the dimensional standards in ARINC Specification 600, "Air Transport Avionics Equipment Interfaces (NIC Phase 1)", for the 3 MCU form factor. The VDR should also comply with ARINC 600 standards in respect of weight, racking attachments, front and rear projections and cooling.

The VDR should be provided with a low insertion force, size 1 shell ARINC 600 service connector. This connection, which should accommodate service interconnections in its middle plug (MP) insert, service and automatic test equipment interconnections in its top plug (TP) insert and coaxial and power interconnections in its bottom plug (BP) insert, should be located on the center grid of the receiver's rear panel. Index pin code 04 should be used.

The ATE interconnection insert (TP) is not to be included in the mating half of the connector installed in the aircraft since ATE interconnections are employed in the bench testing of the receiver only, except as required for the expanded functionality identified in Attachment 3. This insert should be provided with a protective cover to prevent contamination of the contacts during the time the receiver is installed in the aircraft. Further guidance on the ATE interface can be found in Chapter 6 of this document.

2.2.2 Antennas

There are no specific form factors set forth herein for the antennas to be employed with this particular equipment as there are numerous designs presently on the market for this purpose. Designers of new antennas are encouraged to survey the present antenna mounting provisions and maintain compatibility insofar as is practicable with the present standard mountings, depending upon, of course, the particular aircraft type for which the antenna is intended and the need to minimize weight. It is recognized that for most air transport applications the antennas are integrated into the airframe design and it is, therefore, only in special installations or retrofit installations where specific "antenna units" would be needed. The design in this Characteristic is based on the use of a 0 dBi antenna. Airlines should realize that one of the factors limiting the potential throughput of the VHF communication system is the signal loss associated with the cabling between the VDR and the antenna.

2.2.3 Antenna Considerations for Multiple Systems Operations

The installation designer should note that, to permit multiple VHF transceivers to be used simultaneously on the same aircraft, it is necessary to provide adequate space isolation between the antennas of each unit to ensure that the use of one transmitter does not interfere with reception on another receiver. A minimum of 50 dB of space isolation should be provided between antennas mounted on opposite sides (top and bottom) of the fuselage. A minimum of 35 dB of space isolation should be provided between antennas mounted on the same side of the fuselage. Any steps which can be taken to provide further isolation in new aircraft and antenna designs is encouraged.

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2.3 Standard Interwiring

The standard interwiring to be installed for the VDR is set forth in Attachment 3. This interwiring is designed to provide the degree of interchangeability specified in Section 1.3. Manufacturers are cautioned not to rely upon special wires, cabling or shielding for use with particular units because they do not exist in the standard installation.

2.0 INTERCHANGEABILITY STANDARDS

2.3 Standard Interwiring (cont'd)

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 negotiation with the airframe manufacturer so that the latter can proceed with engineering and initial fabrication prior to airline commitment on 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 is also cautioned to give due consideration to the specific notes in Attachment 4 as they apply to the standard interwiring.

2.4 Power Circuitry

2.4.1 Primary Power Input

The VDR should be designed to use 27.5 Vdc primary power. The aircraft power supply characteristics, utilization, equipment design limitations, and general guidance material are set forth in ARINC Report 413A, "Guidance for Aircraft Electrical Power Utilization and Transient Protection".

One 10A circuit breaker should be provided in the standard installation.

2.4.2 Power Control Circuitry

There should be no master on/off power switching within the VDR. Any user desiring power on/off control for the unit should provide, through the medium of a switching function installed in the airframe, means of interrupting the primary power to the equipment. It should be noted that primary power on/off switches for the VDR are not needed in most installations, and power is wired directly to the equipment from the circuit breaker panel.

2.4.3 The Common Ground

The wires designated as "Common Ground" (or as chassis ground) are used for the dc ground return to the aircraft structure and may be grounded to the chassis of the equipment if the manufacturer so desires.

In any event, they are grounded to the ship's structure. They should not be used as common returns for any circuits carrying alternating currents.

2.4.4 Internal Circuit Protection

The basic master power protection means for the VDR is to be external to the unit and utilize a standard circuit breaker rating. Within the equipment, no master power protection means is to be provided, although subdistribution circuit protection is acceptable where the set manufacturer feels this would improve the overall reliability of the equipment.

If internal protection by fuses is employed, these fuses should not be accessible when the set is installed in the aircraft radio rack but should be replaceable only when the equipment goes through the service shop.

If such subdistribution circuit protection is by means of circuit breakers, the majority prefer that these be accessible on the front panel of the equipment so that they can be reset in service.

2.5 System Functions and Signal Characteristics

A list of the system functions and signal characteristics required to ensure the desired level of interchangeability for the VDR is set forth in Chapters 4 and 5 of this document.

2.0 INTERCHANGEABILITY STANDARDS

2.6 Environmental Conditions

The VDR should be specified environmentally in terms of the requirements of RTCA Document DO-160C, "Environmental Conditions and Test Procedures for Airborne Equipment", dated December 1989 and Change 1 dated September 27, 1990. Attachment 5 to this characteristic tabulates the relevant environmental categories.

2.7 Cooling

The VDR should be designed to accept, and airframe manufacturers should configure the installation to provide forced air cooling as defined in ARINC Specification 600. The standard installation should provide an air flow rate of 13.6 kg/hr of 40°C air and the unit should not dissipate more than an average of 75 watts of energy. The coolant air pressure drop through the equipment should be 5±3 mm at standard conditions of 1013.25 mbars. This pressure drop does not include the drop through a returning orifice when such orifice is located external to the equipment case. A loss of cooling should not cause total loss of functionality, although a partial reduction in duty cycle is acceptable.

COMMENTARY

The specified cooling air flow rate is based on an estimated average power dissipation. However, it should be noted that power dissipation during transmission is higher than the estimated average. Thus, the specified air flow rate would be less than the rate recommended in ARINC Specification 600 (NIC) for the maximum dissipation.

Equipment failures in aircraft due to inadequate thermal management have plagued the airlines for many years. In Section 3.5 of ARINC Specification 600 they have written down everything they believe airframe and equipment suppliers need to know to prevent such problems in the future. They regard this material as "required reading" for all potential suppliers of VDR and aircraft installation.

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 1 of ARINC Specification 404A on the subject of equipment and radio rack grounding and bonding.

2.9 Standardized Signaling

The standard electrical inputs and outputs from the systems should be in the form of a digital format or switch contact. Standards should be established exactly to assure the desired interchangeability of equipment.

Certain basic standards established herein are applicable to all signals. Unless otherwise specified, the signals should conform with the standards set forth in the subparagraphs below.

2.9.1 ARINC 429 DITS Data Bus

ARINC Specification 429 "Mark 33 Digital Information Transfer System (DITS)" is the controlling document for data word formats, refresh rates, resolutions, etc. Material in this document on these topics is included for reference purposes only. In the event of conflict between this document and ARINC Specification 429, the latter should be assumed to be correct.

2.9.2 Standard "Open"

The standard "open" signal is characterized by a resistance of 100,000 ohms or more with respect to signal common.

COMMENTARY

In many installations, a single switch is used to supply a logic input to several LRUs. One or more of these LRUs may utilize a pull-up resistor in its input circuitry. The result is that an "open" may be accompanied by the presence of +27.5 Vdc nominal. The signal could range from 12 to 36 Vdc.

2.0 INTERCHANGEABILITY STANDARDS

2.9.3 Standard "Ground"

A standard "ground" signal may be generated by either a solid state or mechanical type switch. For mechanical switch-type circuitry a resistance of 10 ohms or less to signal common would represent the "ground" condition. Semiconductor circuitry should exhibit a voltage of 3.5 Vdc or less with respect to signal common in the "ground" condition.

2.9.4 Standard "Applied Voltage" Output

The standard "applied voltage" is defined as having a nominal value of +27.5 Vdc. This voltage should be considered to be "applied" when the actual voltage under the specified load conditions exceeds 18.5 volts (+36 Vdc maximum) and should be considered to be "not applied" when the equivalent impedance to the voltage source exceeds 100,000 ohms.

2.9.5 Standard Discrete Input

A standard Discrete Input should recognize incoming signals having two possible states, "open" and "ground". The characteristics of these two states are defined in Sections 2.9.2 and 2.9.3 of this Characteristic. The maximum current flow in the "ground" state should not exceed 20 milliamperes.

The "true" condition may be represented by either of the two states (ground or open) depending on the aircraft configuration.

COMMENTARY

In the past installations there have been a number of voltage levels and resistances for Discrete states. In addition, the assignments of "Valid" and "Invalid" states for the various voltage levels and resistances were sometimes interchanged, which caused additional complications. In this Characteristic a single definition of Discrete levels is being used in an attempt to "standardize" conditions for Discrete signals.

The voltage levels and resistances used are, in general, acceptable to hardware manufacturers and airlines. This definition of Discretes is also being used in the other 700-Series Characteristics, however, there are few exceptions for special conditions.

The logic sources for the Discrete Inputs to the VDR are expected to take the form of switches mounted on the airframe component (flap, landing gear, etc.) from which the input is desired. These switches either connect the Discrete Input pins on the connector to airframe dc ground or leave them open circuit as necessary to reflect the physical condition of the related components. The VDR, in each case, is expected to provide the dc signal to be switched. Typically, this is done through a pull-up resistor. The VDR input should sense the voltage on each input to determine the state (open or closed) of each associated switch.

The selection of the values of voltages (and resistances) which define the state of an input is based on the assumption that the Discrete Input utilizes a ground-seeking circuit. When the circuit senses a low resistance or a voltage of less than 3.5 Vdc, the current flow from the input signifies a "ground" state. When a voltage level between 18.5 and 36 Vdc is present or a resistance of 100,000 ohms or greater is presented at the input, little or no current should flow. The input may utilize an internal pull-up to provide for better noise immunity when a true "open" is present at the input. This type of input circuit seems to be the "favorable" among both manufacturers and users.

Because the probability is quite high that the sensors (switches) may be providing similar information to a number of users, the probability is also high that unwanted signals may be impressed on the inputs to the VDR from other equipment, especially when the switches are in the open condition. For this reason, equipment manufacturers are advised to base their logic sensing on the "ground" state of each input. Also, both equipment and airframe suppliers are cautioned concerning the need for isolation to prevent sneak circuits from "fouling up" the logic. Typically diode isolation is used to prevent this from happening.

2.0 INTERCHANGEABILITY STANDARDS

2.9.6 Standard Discrete Output

A standard Discrete output should exhibit two states, "open" and "ground" as defined in Sections 2.9.2 and 2.9.3. In the "open" state, provision should be made to present an output resistance of at least 100,000 ohms. In the "ground" state provision should be made to sink at least 20 milliamperes of current. Non-Standard current sinking capability may be defined.

COMMENTARY

Not all Discrete output needs can be met by the Standard Discrete output defined above. Some Discrete outputs may need to sink more current than the standard value specified above.

A Discrete output may need to source current. Discrete outputs which are to source current should utilize the standard "Applied Voltage" output defined in Section 2.9.4. These special cases are noted in the text describing each applicable Discrete output function and in the notes to interwiring.

COMMENTARY

Although defined here, Discrete outputs which provide a current output rather than a current sink are not "Standard Discrete outputs".

2.9.7 Standard Program Pin Input

Program pins may be assigned on the VDR service connector for the purpose of identifying a specific aircraft configuration or to select (enable) optional performance. The optional operational function may be in effect at all times or only under certain conditions, such as when the aircraft is on the ground (identified by the enabling of the Air/Ground Discrete input).

COMMENTARY

Program pins may be used for a variety of purposes. Program pins enable a piece of equipment to be used over a greater number of airframe types. One way this is done is by identifying the unique characteristics of the airframe in which the unit is installed. Another is to identify the location (left, right, center) of the unit. Often program pins are used to enable (turn on) options for alternate or extended performance characteristics.

The encoding logic of the Program pin relies upon two possible states of the designated input pin. One state is an "open" as defined in Section 2.9.2 of this Characteristic. The other state is a connection (short circuit i.e., 10 ohms or less) to the pin designated as the "Program Common" pin (MP10A).

COMMENTARY

Normally, the "primary" location or "usual", "common" or "standard" function is defined by the "open" logic and the optional response is programmed (encoded) by connection to Program Common.

3.0 MODES OF OPERATION

3.1 Introduction

There are three primary modes of operation of the VDR: 716 Voice compatibility mode, 716 Data compatibility mode, and 750 Data mode. The 716 Voice and 716 Data modes emulate ARINC 716 functionality. The 750 Data mode, as defined in this section, refers to a particular instance of any collection of data mode protocols supported by a VDR. This section describes the methods and procedures by which a VDR may determine its designated mode of operation.

3.2 Description of the Modes

3.2.1 716 Voice Mode

716 Voice mode is the basic VHF COMM compatible voice mode defined in ARINC Characteristic 716, retained for backward compatibility. Voice signals are provided via normal audio I/O, with transmit and receive conditions initiated by the operator with the microphone. The RF signal-in-space is double sideband AM. Tuning/frequency selection is made by low-speed ARINC 429 data words from an associated radio control panel.

3.2.2 716 Data Mode

716 Data mode is the basic VHF COMM compatible data mode defined in ARINC Characteristic 716, retained for backward compatibility. Data is transferred via analog discrete methods, using two conductor twisted pairs. Tuning data is provided via a low speed ARINC 429 data bus, while transmit/receive commands are discrete digital signals from the CMU.

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3.2.3 750 Data Mode

When operating in 750 Data mode the VDR is controlled and tuned by data received over a high-speed ARINC 429 port. ARINC 429 BOP are used for all VDR to CMU 750 Data Mode command, control, and data transfer communications.

COMMENTARY

Various CMU and VDR operational configurations will occur in air transport aircraft. These include:

a. ACARS VDR Mode A only

b. VDL Mode 2 only

c. Both Mode A and Mode 2. In this case the mode of operation will be selected by the CMU dynamically depending on the RF operational environment, namely whether or not Mode 2 service is available.

For those VDRs configured to operate in VDR Mode A and VDL Mode 2, at least two implementations can be found: (1) units using ARINC 429 BOP Version 1 for Mode A, and Version 3 for Mode 2. This configuration corresponds to a transition scenario where both ACARS and ACARS over AVLC (AOA) air/ground protocols are supported; (2) other manufacturers will implement only ARINC 429 BOP Version 3 for both Mode A and Mode 2. It should be noted that these VDRs will not be interoperable with an early model [CMU or ATSU] that is only capable of VDR Mode A operation and can only communicate using ARINC 429 BOP Version 1.

3.0 MODES OF OPERATION

3.3 Mode Determination

At all times during operation, the VDR determines its current operating mode based on the content of the following three state variables:

a. VD_STATUS state variable.

b. CMU_STATUS state variable.

c. A750_STATUS state variable.

Table 3-1 summarizes these variables, their contents and the transition events.

Table 3-1 - State Variables

State Variables	Content	Transition Event
CMU_STATUS See Section 3.3.2	NULL	CMU is ABSENT or STANDBY See Section 3.3.2
	PRIMARY	CMU becomes ACTIVE or Unsuccessful ALOHA or receives an ALO word. See Section 3.3.2.1
	BOP	(transmit ALR) or (received ALR and version is supported) See Section 3.3.2.2
VD_STATUS See Section 3.3.1	VOICE	Determined by ARINC 429 Label 276 or Voice/Data discrete content. See Section 3.3.1
	DATA	
A750_STATUS See Section 3.3.3	A716	Upon initialization or voice to data transition or VDR exits state S7. See Section 3.3.3.1
	A750	Command received from CMU. See Section 3.3.3.2

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3.3.1 VD_STATUS State Variable

The content of the VD_STATUS state variable is referenced in Table A8-17 VDR State Transition Table, and it can contain one of two values, VOICE or DATA. If this variable contains VOICE, the VDR executes in the ARINC 716 Voice mode of operation, regardless of any other mode determining inputs. This voice priority feature is included to allow the pilot to select voice operation by manual override using for example, a switch mounted on the cockpit Radio Tuning Panel (RTP). If this variable contains DATA, the VDR executes one of the two data modes, ARINC 716 Data Mode or ARINC 750 Data Mode.

The content of the VD_STATUS state variable is determined by two external signals:

a. The ACTIVE/INACTIVE status and contents of the ARINC 429 Label 276 word received on the selected ARINC 429 tuning bus (low-speed).

b. The state of the Voice/Data Select rear connector discrete (MP7C).

If the ARINC 429 Label 276 word is determined to be ACTIVE, then the content of the VD_STATUS state variable is determined by the ARINC 429 Label 276 word content. If the ARINC 429 Label 276 word is determined to be INACTIVE, then the content of the VD_STATUS state variable is determined by the setting of the Voice/Data Select discrete.

3.0 MODES OF OPERATION

3.3.1.1 ARINC 429 Label 276 Word

The ARINC 429 Label 276 word may be present on the selected low-speed ARINC 429 tuning bus. The function of this word was added to ARINC Characteristic 750 to provide aircraft manufacturers and airlines the ability to select the voice or data operation of the VDR without having the external Voice/Data select discrete wired in the airframe. If the Label 276 word is ACTIVE on the selected low-speed ARINC 429 tuning bus, then its content is used to determine the value of the VD_STATUS state variable in lieu of the value of the Voice/Data Select discrete. The choice of which of the two tuning buses is used is determined by the VDR's Frequency Control Port A-B Select rear connector discrete (MP11D).

When the Label 276 status is INACTIVE and the VDR receives Label 276 for 2 consecutive 500 msec intervals and each word has an SSM code value of NORMAL, then the VDR will change the Label 276 status from INACTIVE to ACTIVE.

When the Label 276 status is ACTIVE and the VDR does NOT receive Label 276 OR every word has an SSM code value other than NORMAL for five consecutive 500 ms intervals, then the VDR will change the Label 276 status from ACTIVE to INACTIVE.

If the VDR determines that the Label 276 word is ACTIVE, then the state of bit 11, 12, or 13 of the Label 276 word determines the value of the VD_STATUS state variable depending on the installed position of the VDR. The state of bits 11, 12, and 13 correspond to the selected Voice/Data state for VHF1, VHF2, and VHF3 respectively (see Attachment 8, Table A8-4). A bit value of 0 assigns the value VOICE to the VD_STATUS state variable. A bit value of 1 assigns the value DATA to the VD_STATUS state variable.

c-3

When the selected tuning bus changes (can be caused by pin MP11D changing from open to ground or vice versa), then Label 276 will be considered INACTIVE until the criteria for ACTIVE status is met.

3.3.1.2 Voice/Data Select Discrete Input

The Voice/Data Select discrete is the rear connector input MP7C and is used to determine the value of the VD_STATUS state variable when Label 276 is INACTIVE (see Section 3.3.1.1). When Label 276 is ACTIVE then the Voice/Data Select Discrete Input is ignored.

If this input is floating (open) and Label 276 is INACTIVE, then the VD_STATUS state variable is assigned the value VOICE. If the input is grounded and Label 276 is INACTIVE, then the VD_STATUS state variable is assigned the value DATA.

3.3.2 CMU_STATUS State Variable

The CMU_STATUS state variable can contain one of three values, NULL, PRIMARY, and BOP, that indicate the state of the high-speed ARINC 429 data transfer bus between the CMU and the VDR.

a. If the VDR has determined that a CMU is not present (absent) or not active (standby), then the content of the CMU_STATUS state variable is NULL. See Section 3.3.2.1.

b. If the VDR has declared a CMU to be present and active, then the content of the CMU_STATUS state variable is PRIMARY. If an ALOHA event results in the CMU being declared "not bit oriented", then the content of the CMU_STATUS state variable is PRIMARY.

c. If the VDR has successfully negotiated a Williamsburg protocol (Version 1 or 3) with the PRIMARY CMU using the ARINC 429 ALOHA mechanism, then the content of the CMU_STATUS state variable is BOP.

These states are an indication of the sequential nature of the establishment of ARINC 429 data transfer between the CMU and the VDR. At system initialization the CMU_STATUS is NULL. After a CMU has been determined to be both PRESENT and ACTIVE, then the CMU_STATUS is PRIMARY. After a CMU is determined to be PRIMARY and the

3.0 MODES OF OPERATION

Williamsburg version has been negotiated, then the CMU_STATUS is BOP. The CMU_STATUS states and events are shown in the following state diagram:

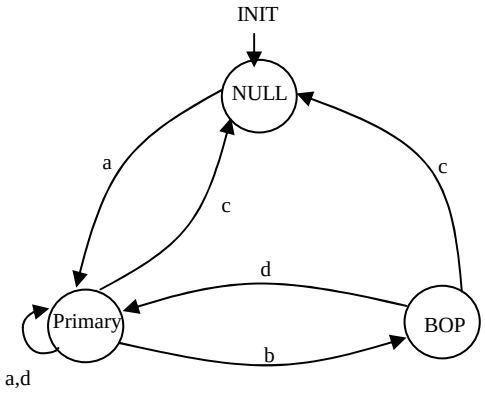


Figure 3-1 - CMU_STATUS State Diagram

The events in Figure 3-1 are defined as follows:

a. CMU becomes both PRESENT and ACTIVE (declared PRIMARY). See Section 3.3.2.1.1 and 3.3.2.1.2.

b. VDR transmits or receives an ALOHA response containing a version number that is supported by the VDR. ALO/ALR handshake successful (CMU declared "bit oriented" BOP). May occur due to either a change of the supported Williamsburg version number or a change from PRIMARY to a supported version. c-3

c. CMU becomes ABSENT or PRESENT/STANDBY. See Section 3.3.2.1.1 and 3.3.2.1.2.

d. VDR transmits or receives an ALO word. ALOHA process started OR ALO/ALR handshake unsuccessful (CMU declared "not bit oriented"). May occur when a common Williamsburg version can not be found.

3.3.2.1 PRIMARY CMU Determination

The VDR may be connected to one or two CMUs. The VDR has a separate high-speed ARINC 429 input port for each CMU. The VDR provides one high-speed ARINC 429 output port which is connected to both CMUs. The VDR communicates with only one CMU at a time. The VDR communicates with the CMU which the VDR has determined to be the PRIMARY CMU according to the logic herein. A CMU's presence on an ARINC 429 bus can be represented by two state variables: ABSENT/PRESENT and STANDBY/ACTIVE. The state of these two variables for both CMUs will determine which CMU is considered PRIMARY by the VDR.

3.3.2.1.1 ABSENT/PRESENT Determination

The VDR monitors both ARINC 429 inputs for Label 270 words. If the rate of the received Label 270 word is greater than once every second and the SSM code is set to "Normal" (00_b) or "Functional Test" (10_b), then that CMU is considered PRESENT. Else, its status is ABSENT. It's possible, and normal, for both CMUs to be PRESENT.

3.3.2.1.2 ACTIVE/STANDBY Determination

When the CMU is determined by the VDR to be PRESENT, then the VDR can determine whether the CMU is ACTIVE or STANDBY. If bit #20 (active/standby bit), of the CMU's Label 270 status word is set to "1" for five seconds, then the CMU is ACTIVE. If bit #20 of the CMU's Label 270 status word is set to "0" for five seconds, then the CMU is STANDBY. Normally only one CMU will indicate ACTIVE and only one will indicate STANDBY.

3.0 MODES OF OPERATION

3.3.2.1.3 Primary CMU Determination Algorithm

The VDR uses the following procedure to determine the PRIMARY CMU:

a. At VDR initialization both CMUs are declared to be ABSENT.

b. If CMU1 is determined to be both PRESENT and ACTIVE, then CMU1 is declared to be PRIMARY.

c. Else, if CMU2 is determined to be both PRESENT and ACTIVE, then CMU2 is declared to be PRIMARY.

d. Else, both CMUs are declared not PRIMARY and each CMU is periodically monitored for a change in status to ACTIVE and PRESENT.

e. If the status of the PRIMARY CMU changes then the VDR resets to its initialization state.

Once a CMU has been declared by the VDR to be PRIMARY, the VDR uses that CMU for all communications until that CMU's ACTIVE/STANDBY or ABSENT/PRESENT status changes.

3.3.2.1.4 Primary CMU Notification

When the VDR has declared a CMU to be PRIMARY, it broadcasts this information to both CMUs. The information is conveyed periodically in the VDR's Label 270 status word in Bits 15 and 16, the Primary CMU field. This field is used to indicate which CMU the VDR considers to be PRIMARY and should be set to the SDI code of the PRIMARY CMU. If neither CMU is declared to be PRIMARY, then both bits in the field should be set to "1".

The VDR should use the SDI codes as received from the CMUs even if the SDI codes are erroneous (reversed or identical).

c-3

3.3.2.2 BOP CMU Determination

When the CMU_STATUS state variable becomes PRIMARY then the ARINC 429 BOP version is negotiated with the CMU. There is more than one version of ARINC 429 BOP and the VDR uses the Aloha mechanism described in ARINC 429 to determine which version to use.

When the VDR transmits or receives an ALOHA response word containing a version number which is supported by the VDR then the CMU_STATUS state variable is given the value BOP.

When the VDR transmits or receives an ALO word then the CMU_STATUS state variable is given the value PRIMARY. This is done so that there is a state change when the VDR/CMU switch versions of BOP.

3.3.3 A750_STATUS State Variable

The A750_STATUS state variable can contain one of two values, A716 or A750, which indicate whether the VDR is in the ARINC 716 or ARINC 750 mode of operation. The A750_STATUS state variable value is A716 upon initialization. Following the procedural states as defined in Table A8-17, the value changes from A716 to A750 when the VDR sends a MODE_SET.confirm message to the PRIMARY CMU. Reversion of the value back to A716 from A750 occurs when the VDR switches from data to voice or the VDR resets or the CMU_STATUS indicates either NULL or PRIMARY.

Bit 19 of the VDR's broadcast status Label 270 word also indicates the value of the A750_STATUS state variable. A value of 0 indicates A716 and a value of 1 indicates A750.

3.3.3.1 A716 Determination

The A750_STATUS state variable defaults to A716 at power up or reset. When the VD_STATUS state variable indicates voice, then the value of the A750_STATUS state variable switches to A716. When the CMU_STATUS indicates either NULL or PRIMARY, then the A750_STATUS state variable is set to A716.

3.3.3.2 A750 Determination

When the VDR mode determination state is BOP and the VDR sends a MODE_SET.confirm message to the PRIMARY CMU, then the value of the A750_STATUS state variable switches to A750.

The MODE_SET.confirm message is a BOP message sent by the VDR to the CMU in response to a MODE_SET.request message. Its transmission indicates that the VDR has successfully transitioned to the ARINC 750 Data Mode of operation. The format of this message is described in Section 5.3.2.6.

In order for the MODE_SET.confirm message to be transmitted, four events should have previously occurred:

a. The VDR should have declared a CMU to be PRIMARY (described in Section 3.3.2.1.3 Primary CMU Determination Algorithm).

b. The VDR should have annunciated this declaration by setting the Primary CMU bits in its (VDR) broadcast ARINC 429 Label 270 word (described in Section 3.3.2.1.4 Primary CMU Notification).

c. The VDR should have declared the CMU to be BIT_ORIENTED (per Section 3.3.2).

d. The VDR should have received a valid MODE_SET.request message from the PRIMARY CMU. c-3

3.3.4 Mode Determination State Table

The VDR should be in a certain state depending on the state variables previously described. Table A8-17 defines the next state as a function of the current state and changes in the state variables VD_STATUS, CMU_STATUS, and A750_STATUS. The ENTRY STATE column shows the current state and the contents of the three state variables at that state. The INPUT → NEW STATE column shows the next state to be entered as a function of a change of one of the state variables to the indicated value. For example, while in state S4, the state variables have the values:

CMU_STATUS = PRIMARY,
A750_STATUS = A716, and
VD_STATUS = DATA.

While in state S4, if the CMU_STATUS variable changes to NULL, the next state is S2; if it changes to BOP the next state is S6; if the VD_STATUS changes to VOICE, the next state is S3.

NOTE: When commanded, the VDR should transition from voice to data even if the CMU is not transmitting a valid ARINC 429 tuning word on its low speed tuning interface. This allows the VDR to wait for a MODE_SET request from the CMU and thus transition correctly to the ‘750 data protocol null’ state.

3.3.5 State Transition Time

The VDR should complete the determination of and the transition to the next state of Table A8-17 within one second of the input conditions for the next state becoming satisfied.

3.0 MODES OF OPERATION

3.4 CMU 750 Data Mode Support Determination

When the VDR enters data mode it assumes 716 Data mode as shown in Table A8-17 until it receives a command from the CMU; see Section 5.3.2.5. The CMU should send a MODE_SET.request primitive to the VDR in order to switch the VDR from 716 Data mode to 750 Data mode.

c-3

3.5 750 Data Mode Protocol Management

The air-ground protocol negotiation process provides the means by which multiple air-ground protocols may be managed between the CMU and the VDR. This process occurs only upon command by the CMU and is performed by exchange of ARINC 429 BOP messages. The details of this process are outlined in Section 5.0.

3.6 CMU ARINC 429 Broadcast

The VDR, in all modes of operation, periodically transmits to the CMU the ARINC 429 words specified in Section 5.5.

4.0 INTERFACES AND PROTOCOLS TO THE GROUND SYSTEM

4.1 Introduction

When the VDR is operating in 716 Voice mode, it operates as a standard double sideband AM voice transceiver as described in ARINC Characteristic 716, "Airborne VHF Communication Transceiver".

When the VDR is operating in 716 Data mode, it operates as a standard double sideband AM data transceiver as described in ARINC Characteristic 716, "Airborne VHF Communication Transceiver".

When the VDR is operating in the Mode A submode of the 750 Data mode, it communicates to the ground, in a balanced mode, via protocols described in Section 4 of ARINC Specification 618, "Air-Ground Character-Oriented Protocol Specification" (or in Section 4 of ARINC Characteristic 724B, "Aircraft Communications Addressing and Reporting System (ACARS)". c-3

COMMENTARY

ARINC Characteristics 724 and 724B reference ARINC Specification 618 for the definition of the interface between any VHF radio and the MU.

When the VDR is operating in the VDL Mode 2 submode of the 750 Data mode, it communicates to the ground, in a balanced mode, via protocols defined in ARINC Specification 631, VHF Digital Link Implementation Provisions". c-3

This chapter describes the direct interface to the VHF communications medium.

COMMENTARY

The parenthetical comment after some of the section titles limit the text to that particular emission.

4.2 Transmitter and Modulator Control

4.2.1 RF Power Output

The transmitter carrier power output measured into a 50 ohm resistive load should be 15 watts minimum and 30 watts maximum on any operating frequency when not in a 716-compatible mode. c-1

COMMENTARY

The specification of 15 watts assumes a maximum cable loss to the antenna of 5.5 dB, thus providing 4.2 watts into the antenna. c-1

4.2.2 Radio Transmitter Duty Cycle

The VDR should be capable of a long-term duty cycle of 20%. Further, the transmitter should be capable of the following full-power sequence of operations:

ON- 30 seconds
OFF- 1 second
ON- 30 seconds
OFF- 239 seconds

See ARINC Specification 631 for information about maximum data transmission duration.

COMMENTARY

The ON time values are chosen to be within the maximum continuous transmission times allowed by RTCA Document DO-207 (35 seconds), to a total transmit time of 1 minute. During a voice transmission, the OFF time is the approximate time required to release the transmitter key and re-key the transmitter following the time-out.

4.2.3 Transmitter RF Power Control

4.2.3.1 RF Output Power Level Regulation (D8PSK)

c-1 In any 20 millisecond period after the transmitter power ramp up time, the variation in the transmitter power should be constant within 1 dB. This section assumes that the transmitter operates into a load with a constant VSWR not to exceed 2:1.

4.2.3.2 RF Output Power Protection

The transmitter should not be damaged when operating into any passive load.

4.2.3.3 Radio Transmitter Keying Protection

There are two maximum transmit timeout modes, one for voice and one for data.

c-1 When the VDR is operating in the Voice mode, the length of transmission is monitored in order to be compliant with RTCA document DO-207. When an excessive length transmission is detected the transmission is automatically terminated. In this circumstance, an exceedance bit is reported in the BITE status word and subsequent transmissions are enabled only after de-activation of the voice mode PTT discrete.

COMMENTARY

Manufacturers are reminded that maximum transmit time detection should be implemented as close as possible to circuitry delivering energy to the RF antenna and be independent of digital control supporting modulation hardware. This may include any or all of the following components: VSWR detector, current to the PA, and temperature of the PA.

c-1 The voice mode maximum transmission cutoff enable function may be inhibited through an analog discrete (MP2A) as described in Attachment 4.

COMMENTARY

The voice mode maximum transmission cutoff enable function was included, to be compliant with RTCA DO-207 and proposed TSO C-128, to terminate a continuous transmission after a maximum of 35 seconds.

c-1

When the VDR is operating in the Data mode, the length of transmission is monitored. When an excessive length transmission is detected transmit keying is terminated unilaterally and permanently. Control electronics are assumed to be in a failure state and should be placed in a halted condition.

COMMENTARY

c-1 Although not required by RTCA DO-207, the data mode maximum transmission cutoff enable function is included to terminate a continuous transmission after a maximum of 35 seconds.

4.2.4 Tuning

c-1 The radio should be capable of tuning to its assigned channel within 100 msec of the receipt of the last bit of the command on the appropriate ARINC 429 input.

The VDR accepts frequency information from two sources: a radio control panel and a MU/CMU. If the VDR is operating in 716 Voice or 716 Data mode, the VDR accepts tuning information over the low speed ARINC 429 bus from a frequency control source. This means of frequency tuning is identical to that of an ARINC Characteristic 716 VHF transceiver as defined in ARINC Characteristic 716, Section 3.2. When operating in 750 Data mode, the VDR accepts tuning information

c-1 across the high speed ARINC 429 bus. The formats for the high speed ARINC 429 frequency data are defined in Section 5.

4.0 INTERFACES AND PROTOCOLS TO THE GROUND SYSTEM

4.2.5 Modulation Definition for Analog Voice

Analog voice transmissions, compatible with ARINC Characteristic 716, is included in the VDR for backwards compatibility. Radio characteristics can be found in ARINC Characteristic 716.

4.2.6 Modulation Definition for MSK

The MSK mode provides for analog and digital data transmissions using AM-MSK, as defined in ARINC Specification 618.

4.2.6.1 Training Sequence (MSK)

The training sequence comprising of Pre-Key and a bit ambiguity resolution segment, as defined in ARINC Specification 618, should be sent before each transmission on the VHF frequency. The transmitter ramp-up allowance for prekey is 2 msec.

4.2.7 Modulation Definition for D8PSK

The VDR should implement the Differential Eight Phase Shift Keyed (D8PSK) modulation as defined in the International Civil Aviation Organization (ICAO) Standards and Recommended Practices (SARPs) for VHF Digital Link (VDL), as well as in Section 3.2.1 and Appendix F of RTCA/DO-224 Change No.1 "Signal-in-Space Minimum Aviation System Performance Standards (MASPS) Advanced VHF Digital Data Communication Including Capability with Digital Voice Technique". c-1 c-3

4.2.8 Permissible Transmitter Variations

Since modulator implementations may differ widely, modulator and transmitter requirements are specified against an ideal model. This section lists the permitted variations from ideal.

4.2.8.1 Frequency Accuracy

The transmitter carrier frequency accuracy should be within ±5 ppm.

COMMENTARY

This specification assumes that the ground station transmitter frequency stability is ±2 ppm.

4.2.8.2 Adjacent Channel Emissions (D8PSK)

Attachment 6, Signal in Space Masks, contains Table A6-1 Spectral Mask of Transmitter for D8PSK, and Table A6-2, Tolerance on the Phase Mask of Transmitter for D8PSK. The amount of power from a transmitter under all operating conditions when measured over the 25 kHz channel bandwidth of the first adjacent channel should not exceed 0 dBm. c-1

The amount of power from a transmitter under all operating conditions when measured over the 25 kHz channel bandwidth centered on the second adjacent channel should be less than - 28 dBm. The amount of power from a transmitter under all operating conditions when measured over the 25 kHz channel bandwidth centered on the fourth adjacent channel should be less than - 38 dBm and it should decrease at the rate of no less than 5 dB per octave to at least - 53 dBm. c-3 c-4

The amount of power from a transmitter under all operating conditions when measured over a 16 kHz channel bandwidth centered on the first adjacent channel should not exceed - 18 dBm. c-1 c-3

COMMENTARY

It is the objective of the FAA to achieve an adjacent channel frequency assignment criteria as close as possible to the present 0.6 nm, and to have no frequency assignment constraints on second adjacent channels and beyond. For additional information on Emission of Radio Frequency Energy refer to RTCA DO-160C, Section 21. c-1

4.2.8.3 Transmitter Phase and Amplitude Balance (D8PSK)

c-1

Referring to the Differential Eight Phase Shift Key (D8PSK) transmitter implementation, the rms Error Vector Magnitude (EVM) of the transmitted D8PSK symbols, when averaged over 100 symbols, should be less than 6%.

COMMENTARY

c-3

The rms EVM is a measure of the amplitude mismatch and phase error between the in-phase and quadrature components of the D8PSK modulated VHF carrier.

4.2.8.4 Transmitter Data Clock Stability

The VDR transmitter data modulation rate should be within ±50 ppm (parts per million) of its nominal data rate.

4.2.8.5 Transmitter Frequency/Phase Performance During Training Sequence (D8PSK)

c-2

The total frequency change during the transmission of the 16 symbol unique sequence should be less than 10 Hz. After transmission of the unique sequence, the phase acceleration should be less than 150 Hz/sec.

4.2.8.6 Transmitter Spurious Radiation

c-3

Any emissions on a harmonic of the transmit carrier frequency which is below 1000 MHz or above 1626 MHz should be less than -18 dBm. Emissions on a harmonic of the transmit carrier frequency which is between 1000 MHz and 1626 MHz should be less than –60 dBm. Any spurious emissions within the frequency band of 117 to 138 MHz, should comply with the specifications in Section 4.2.8.2. Any other spurious emissions at frequencies above 1000 MHz should be less than 60 dBm/1 MHz. Spurious emissions at frequencies between 138 MHz and 1000 MHz should be less than -36 dBm/100 Hz. Spurious emissions at frequencies between 30 MHz and 117 MHz should be less than -36 dBm/100 kHz. Spurious emissions at frequencies between 150 kHz and 30 MHz should be less than -36 dBm/10 kHz. Spurious emissions at frequencies between 9 kHz and 150 kHz should be less than -36 dBm/1 kHz."

COMMENTARY

c-3

The specification for spurious radiation is stated in terms of absolute power level rather than amount of attenuation by virtue of several historical agreements reached as a result of interference on harmonics of aeronautical mobile frequencies. The absolute level of -18 dBm for harmonics is based on 60 dB attenuation of the harmonics in a 15 watt transmitter and is compatible with FCC requirements. This has been determined to be a maximum allowable level for operation.

For this reason equipment manufacturers should regard the figures specified in this paragraph as "barely acceptable minima", and aim to do better in their LRUs.

4.2.8.7 D8PSK Modulation In-band Spectrum Characteristics

c-3

Ideally, the in-band spectrum of the transmitted D8PSK signal should have a Raised Cosine shape with spectrum roll-off constant equal to 0.6 (see Section 3.2.1.2.5 in RTCA/DO-224 Change No. 1). The allowable deviations from this ideal spectrum should be as specified in Table A6-1 in Attachment 6.

4.3 Receiver and Demodulator Control

4.3.1 Sensitivity and Dynamic Range

c-3

For a VDR operating in D8PSK mode, the uncorrected Bit Error Rate output of the D8PSK demodulator should be equal to or less than 10^{-3} for a signal with a power level into a 50 ohm resistive load of -98 dBm to -7dBm.

For a VDR operating in MSK mode, the Bit Error Rate output of the MSK demodulator should be equal to or less than 10^{-3} for a signal with a power level into a 50 ohm resistive load of -98 dBm to -7 dBm.

4.0 INTERFACES AND PROTOCOLS TO THE GROUND SYSTEM

4.3.2 Burnout Protection

The unit should not suffer permanent damage when subjected to a signal of +20 dBm or less.

4.3.3 Selectivity

For D8PSK, the receiver IF selectivity mask should be the same as used for ARINC 716 voice or data mode operation. The data demodulator selectivity mask should be designed to minimize the BER. c-1

4.3.4 Noise Immunity

The receiver/demodulator should be capable of successfully demodulating received signals in the noisy RF environment in which an aircraft normally operates. As such, this section provides design guidance to manufacturers to enable them to meet the desires of their airline customers.

COMMENTARY

It should be noted that there is a potential for comm-to-comm interference using multiple radios assigned to neighboring channels.

4.3.4.1 Desensitization and Interference Rejection

COMMENTARY

Circuitry should be included for the prevention, insofar as practicable, of receiver desensitization due to pulse-type interference. As the magnitude and character of the pulse interference levels expected in a typical installation in the future is not known, system performance specifications would be meaningless, and therefore this section is included as commentary. However, RF pulses of the following characteristics are prototypical of what can be expected.

Width of Pulse	10 ±2 microseconds
Repetition Rate	1000 ±100 pps
Waveform	Rise and Decay time each less than 1 microsecond

4.3.4.2 Adjacent Channel Signal Rejection c-3

The receiving function should provide the specified error rate with a minimum desired of -87 dBm applied at the input to the receiver and with a maximum undesired signal level on the first adjacent channel 44 dB higher than the desired signal. The specified error rate should also be met with a minimum desired signal of -87 dBm applied at the input to the receiver and with a maximum undesired signal level on the second adjacent channel 50 dB higher than the desired signal. The specified error rate should also be met with a minimum desired signal of -87 dBm applied at the input to the receiver and with a maximum undesired signal level on the fourth adjacent channel, or any other assignable channel farther away, 60 dB higher than the desired signal." c-1

COMMENTARY c-3

The adjacent channel undesired signals may be DSB-AM, DSB-AM MSK or D8PSK signals. Note, however that when the undesired signal on the first adjacent channel is a D8PSK signal with emission characteristics per Section 4.2.8.2, the specified adjacent channel rejection cannot be met given the desired signal-to-co-channel interference performance requirement specified in Section 4.2.4.4. Therefore, the EUROCAE MOPS test procedures recommend using an FM signal with in-band spectrum shaping approximating that of the D8PSK modulated carrier with Raised Cosine spectrum and with adjacent channel emissions much lower than those specified in Section 4.2.8.2.

c-3 4.3.4.3 Out-of-Band Interference Rejection Immunity Performance

c-1 The receiving function should provide the specified error rate with a minimum desired signal level of -87 dBm applied at the
c-3 receiver input and with one out of band signal, in the frequency range 108 to 117.9 MHz or 137.5 to 156 MHz, having a level at the receiver input of minus 33 dBm.

COMMENTARY

c-1

In areas where adjacent higher band signal interference exceeds this specification, a higher immunity requirement may be needed.

The receiving function should provide the specified error rate with a minimum desired signal level of -87 dBm applied at the receiver input and with one VHF FM broadcast signal, in the frequency range 87.5 to 107.9 MHz, having a level at the receiver input of minus 5 dBm.

c-3 The receiving function should provide the specified error rate with a minimum desired signal level of -87 dBm applied at the receiver input and with one out of band signal, in the frequency range 50 kHz to 87 MHz or 156.5 to 1215 MHz, having a level at the receiver input of minus 7 dBm.

4.3.4.4 Co-Channel Interference Performance

The receiving function should provide the specified error rate with a minimum desired signal of -87 dBm applied at the input to the receiver and with an undesired co-channel interference signal with level 20 dB lower than the desired signal.

4.3.5 Signal Quality Analysis

The link management function requires knowledge of the stations the aircraft can receive and how well it can receive those stations. Accordingly, frames transmitted by ground stations should be evaluated for signal quality and the signal quality should be passed to the link management function along with the address of the ground station.

The VDR may perform analysis of both the transmitter, the receiver and the channel, measuring such properties as phase distortion, coherence, signal-to-noise measurements, and confidence of demodulation.

COMMENTARY

Manufacturers are advised against using the bit error rate as an SQP metric, as the transition band is too small.

4.3.6 Channel Sense Algorithm

c-1 The VDR should satisfy the channel sense performance as defined in the International Civil Aviation Organization (ICAO) Standards and Recommended Practices (SARPs) for VHF Digital Link (VDL).

COMMENTARY

c-4

Note that the Channel Busy and Channel Idle signal levels specified in the VDL SARPs are referenced at the antenna assuming a dipole antenna and hence they need to be adjusted to a level at the VDR antenna port taking into account typical aircraft antenna and cable losses.

4.4 Transmitter-Receiver Interaction

c-1 The VDR should satisfy the transmitter-receiver interaction performance as defined in the ICAO SARPs for VDL.

5.0 INTERFACE AND PROTOCOLS TO THE CMU

5.1 ARINC Specification 429 Interface Definition

5.1.1 The Physical Layer c-1

The VDR communicates with a CMU across a high-speed physical link as defined in ARINC Specification 429, "Mark 33 Digital Information Transfer System (DITS), Part 3, File Data Transfer Techniques". c-3

5.1.2 Bit Oriented Protocols

Part 3 of ARINC Specification 429 defines Version 1 and Version 3 of the Williamsburg protocol for file data transfer. Both ARINC Specification 429 Bit Oriented Protocol (BOP) and conventional broadcast words are used to transfer information between the VDR and the CMU. Version 3 is used to support VDL Mode 2. Version 1 may be used to support VDR Mode A operation, but Version 3 is preferred if available. The specific version used is negotiated via the ALOHA process described in Part 3 of ARINC Specification 429.

Refer to Section 5.1.3.

Installations that require support of both Williamsburg Versions 1 and 3 in the VDR may need to dynamically switch between Williamsburg versions. This mechanism is supported in the ALOHA mechanism defined in ARINC Specification 429. For example, if the current mode of operation is Mode 2 using Williamsburg Version 3 and the next mode of operation is to be Mode A using Williamsburg Version 1, then the CMU will send an ALO word containing the Version 1 identifier. Upon receipt of the ALO word by the VDR and following the procedures outlined in Section 3.3.2, the VDR's CMU_STATUS state variable will change to PRIMARY and then BOP as the Version 1 is successfully negotiated. The CMU would then send a MODE_SET.request primitive as before to set the new protocol to the Mode A protocol. c-3

5.1.2.1 ARINC Specification 429 BOP Version 1 (Williamsburg Version 1)

For a detailed explanation of the ARINC Specification 429 BOP, as well as definitions of the ARINC Specification 429 BOP word formats, refer to ARINC Specification 429, "Mark 33 Digital Information Transfer System (DITS), Part 3, File Data Transfer Techniques," Section 2.5.

The VDR uses unique timer values for the high speed Version 1 BOP in order to provide the specified performance. The VDR ARINC Specification 429 timer values are shown in Attachment 8, Table A8-16. The CMU uses the standard Version 1 timers, except for the word gap. The VDR and CMU word gap should be 4 to 8 bits. The CMU and VDR should complete the CRC check within 10 milliseconds of receiving the EOT word. c-2 c-3

COMMENTARY

The modified Version 1 timers in the VDR were selected in order to maintain interoperability with standard Version 1. c-2

The following options should be used in a Williamsburg Version 1 implementation of the CMU/VDR interface (options described in ARINC Specification 429, Part 3, Table 10-3a): c-1 c-2

5.0 INTERFACE AND PROTOCOLS TO THE CMU

5.1.2.1 ARINC Specification 429 BOP Version 1 (Williamsburg Version 1) (cont'd)

	Option	Description	Default
c-1	O_1	Half or Full Duplex	Half
	O_2	High or Low Speed Bus	High
	O_3	Automatic CTS When Ready	Yes
c-2	O_4	Accept Automatic CTS	Yes
	O_5	SYS Priority to Resolve-Conflict	CMU
	O_6	Reserved	
	O_7	Reserved	
c-1	O_8	Use of SOLO Word	Yes
c-2	O_9	Reserved	
	O_{10}	Destination Code Required	Yes
c-1	O_{11}	Bit-Protocol Verification (ALO/ALR Protocol Determination)	Yes
c-2	O_{12}	Use Subsystem SAL from ALO word	No

5.1.2.2 ARINC Specification 429 BOP Version 3 (Williamsburg Version 3)

For a detailed explanation of the ARINC Specification 429 BOP, as well as definitions of the ARINC Specification 429 BOP word formats, refer to ARINC Specification 429, "Mark 33 Digital Information Transfer System (DITS), Part 3, File Data Transfer Techniques," Section 3.

The following options should be used in the Version 3 BOP of the CMU/VDR interface (options described in ARINC Specification 429, Part 3, Table 10-3b):

	Option	Description	Default
	O_1	Half of Full Duplex	Full Duplex
	O_2	High or Low Speed Bus	High
	O_3	Automatic CTS When Ready	N/A
c-2	O_4	Accept Automatic CTS	N/A
	O_5	SYS Priority to Resolve-Conflict	N/A
	O_6	Spare	--
	O_7	Spare	--
	O_8	Use of SOLO Word	Yes
	O_9	Reserved	--
	O_{10}	Destination Code RTS/CTS/NCTS/BUSY used	N/A
	O_{11}	Bit-Protocol Verification	Yes
	O_{12}	Use Subsystem SAL from ALO word	No
	O_{13}	Use of information or Command Frames	Command Frame
	O_{14}	Use of Pause Function	No
	O_{15}	Generate 32 bit CRC for information frame	N/A

The CMU-VDR interface uses Command frames and Solo words. Information frames are not used by the CMU-VDR interface.

5.1.2.3 ARINC Specification 429 Flow Control

c-3 The VDR and CMU should respond according to ARINC 429 requests for flow control of the transfer of BOP files. The CMU and VDR may provide a mechanism by which it can request flow control of the transfer of BOP.

No method of controlling the flow of SOLO words is provided.

5.0 INTERFACE AND PROTOCOLS TO THE CMU

The CMU and VDR use two types of files, COMMAND and DATA. A file of type DATA will contain user data intended for peer-to-peer network communications. A file of type COMMAND will contain all other data typically used for CMU to VDR management and Interface Protocol configuration functions. The functional context of the types of files transferred requires that a selective form of flow control be implemented whereby the flow of files of one type is allowed to occur, but the flow of files of another type is not.

Flow control is implemented in different ways for the two versions of the Williamsburg protocol.

5.1.2.3.1 Version 1 Flow Control Mechanism

ARINC 429 flow control for Version 1 is implemented with the protocol words RTS, CTS, NCTS, and BUSY See Section 2.5 of ARINC Specification 429, Part 3. The Destination Code field of the Version 1 Williamsburg protocol word identifies the file type. Files of type COMMAND are identified by a Destination Code of 00_h. Files of type DATA are identified by a Destination Code of 01_h.

5.1.2.3.2 Version 3 Flow Control Mechanism

Flow control by the VDR when using Version 3 is implemented by the use of XON.request and XOFF.request primitives (see Section 5.3.3.2) defined herein. The XON.request and XOFF.request primitives are SOLO words and thus are not subject to flow control procedures.

The Start of File (SOF) word in the Command Frame Data Unit contains a field called the Command Type (CT) field. Files of type COMMAND are identified by a Command Type (CT) Field content corresponding to “Command”.

c-3

Files of type DATA are identified by a CT Field content corresponding to “Data” as defined in Section 3.4.6.3.4 of ARINC Specification 429, Part 3.

The bit definitions of the CT field of the Start of File (SOF) word in the Command Frame Data Unit are as follows:

Bit 24	Bit 23	Meaning
0	0	Command
0	1	Data
1	0	MAC Control
1	1	Reserved

Version 3 of ARINC 429 contains a MAC Control primitive for flow control, but it should not be used because it affects files of all types.

5.1.3 Multiple CMU/VDR Protocol Support

Both ARINC Specification 429 Bit Oriented Protocol (BOP) and conventional broadcast data words are used to transfer information between the VDR and the CMU. Two versions of the ARINC 429 Williamsburg File Data Transfer protocol can be used. Both Williamsburg Version 1 and Version 3 can be used for file transfer when the aircraft is configured to operate in VDR Mode A. Version 3 should be used in all cases when the aircraft is operating VDL Mode 2.

COMMENTARY

> Version 3 of the Williamsburg protocol is necessary to support the throughput of VDL Mode 2. ACARS throughput, being much slower, can be accommodated by Version 1 of the Williamsburg protocol.

The CMU is designed to communicate as part of an air-ground network consisting of many layers of protocols (see ARINC Characteristic 758, and ARINC Specifications 631 and 637). The protocols the CMU uses to communicate with its peers on the ground are referred to as Data Link Protocols, ARINC 631 and ARINC 618 are examples. The CMU and VDR communicate with each other using a local protocol designed to work within the aircraft and support the

5.0 INTERFACE AND PROTOCOLS TO THE CMU

5.1.3 Multiple CMU/VDR Protocol Support (cont'd)

functionality of the air-ground Data Link Protocol. The protocol used between the CMU and VDR is referred to as a CMU/VDR Interface Protocol, or simply Interface Protocol and is defined herein. The CMU/VDR interface is defined so that the CMU can select, control and switch air-ground protocols in real time as conditions require.

COMMENTARY

For example, the CMU may be part of the ATN network which requires that communications with the ground use VDL Mode 2 air-ground Protocol. Then the aircraft flies out of range of the ATN network and the CMU attempts to switch to the ACARS air-ground protocol in order to determine if that service is available. The CMU, via the CMU/VDR interface would command the VDR to switch to Mode A.

Various CMU/VDR configurations may exist in the industry.

a. ACARS VDR operating Mode A only.
b. VDL operating Mode 2 only.
c. Both VDR Mode A and VDL Mode 2 (The mode is selected dynamically by CMU link management software.)

For this third configuration, when the air/ground operation is transferred from VDL Mode 2 to VDR Mode A (or vice versa), the version of ARINC 429 Williamsburg protocol may need to be renegotiated as well.

COMMENTARY

c-3 These provisions are included to address the transition case where the aircraft leaves VDL Mode 2 coverage and falls back on ACARS (VDR Mode A) to maintain air/ground data communications. Some VDR manufacturers may implement Version 3 of the ARINC 429 BOP only. And, some CMUs (presumably ATSUs) will be designed to require ARINC 429 Williamsburg Version 1 connectivity with the VDR when the air/ground link is ACARS (VDR Mode A). The combination of these two units must be avoided if interoperability is to be preserved.

The CMU may have access to multiple VDRs and may configure them differently or the same. The CMU may communicate with more than one radio at a time.

Primitives defined as part of a particular Interface Protocol are uniquely associated with that protocol. Every primitive contains a data field that indicates to which Interface Protocol it belongs. For primitives sent as BOP files, this identifier is called an Extended General Format Identifier (EGFI) and a file that contains an EGFI will be referred to as an Extended BOP File. For primitives sent as SOLO words this identifier is called an Extended Identifier (EID) and a SOLO word that contains an EID will be referred to as an Extended SOLO Word.

5.1.3.1 Extended BOP File Format

An EGFI code identifies the Interface Protocol that created the associated BOP file. Table A8-13 contains a listing of Interface Protocols and their corresponding EGFI codes.

The general format for all Extended BOP files is as follows:

Octet	Definition
1	EGFI
2	Primitive Identifier (PID)
3	Data Field Length MSB
4	Data Field Length LSB
5	Data Field Byte #1

c-1

6	Data Field Byte #2
.	.
.	.
.	.
N+4	Data Field Byte #N

c-1

Whether a BOP file contains an EGFI as the first octet of the file is indicated by the content of the General Format Identifier (GFI) field in the first word of the file. The location of the GFI field is dependent upon whether Williamsburg Version 1 or Version 3 is being used for the file transfer.

5.1.3.1.1 Williamsburg Version 1 GFI

For Williamsburg Version 1 implementations, the GFI field is included as part of the Start Of Transmission (SOT) word which begins all version 1 BOP file transfers. It is predefined in ARINC Specification 429, Part 3, Table 11-6A. A code of "F_h" in the GFI field location indicates that an EGFI occupies the first data octet of the first data word in the file and that the file is an Extended BOP File. c-3

5.1.3.1.2 Williamsburg Version 3 GFI

For Williamsburg Version 3 implementations the GFI field is included as part of the SOF word which begins all Command Frame transfers. It is predefined in ARINC Specification 429, Part 3, Table 11-6A. A code of "F_h" in the GFI field location indicates that an EGFI occupies the first data octet of the first data word in the file and that the file is an Extended BOP File.

5.1.3.2 SOLO Word EID Code

ARINC Specification 429 does not provide an intrinsic mechanism by which SOLO words can be uniquely associated with a particular Interface Protocol. An extension to ARINC Specification 429 is defined herein to provide this capability. c-1

The ID field (see ARINC Specification 429 Table 11-5) identifies SOLO words. A code of "F_h" in the ID field location indicates that an EID occupies bits 21-24 of the SOLO word and that the SOLO word is an Extended SOLO Word. An EID code identifies the Interface Protocol of which the SOLO word is a part. Table A8-13 contains a listing of Interface Protocols and their corresponding EID codes.

The general format for all Extended SOLO words is as follows: c-3

Bit	Definition	Comment
32	Parity	
31-29	"101_b"	(indicates SOLO)
28-25	"F_h"	(indicates Extended SOLO Word)
24-21	EID	(indicates which Interface Protocol)
20-18	Primitive ID	(one of eight primitives)
17-09	9-Bit Data Field	
08-01	SAL	

COMMENTARY

Three bits are provided for identification of a primitive sent using an Extended SOLO word. This provides an Interface Protocol with eight Extended SOLO word primitives. c-2 c-3

5.1.4 Full and Partial Data Word Formats c-1

The CMU and VDR encode the information in octets as defined in ARINC Specification 429. c-3

5.0 INTERFACE AND PROTOCOLS TO THE CMU

c-1 | 5.2 ARINC 750 Data Mode Initialization and Protocol States

c-2 | The VDR is considered to have entered the 750 Data mode once the conditions outlined in Section 3.3.3 Table 3-1 have been met. When in the 750 Data mode, the VDR is expected to respond to command and control messages, and other
c-3 | ARINC Specification 429 BOP initialization procedures. These procedures include the air-ground protocol selection process.

c-1 | A VDR, once it has determined that it is in 750 Data mode, can exist in one of three operational states with respect to the CMU/VDR data mode protocol. The VDR's protocol state can have the values: PROTOCOL_NULL, PROTOCOL_RESET, or PROTOCOL_SET.

c-3 | 5.2.1 PROTOCOL_NULL

c-1 | The Protocol Null state is when the VDR has determined it is in 750 Data mode and a successful selection of an air-ground protocol has not occurred yet. While in this state, the VDR sets the Protocol Status bit to "0" and the Download Request bit to "0" in its Label 270 status word.

c-3 | 5.2.2 PROTOCOL_RESET

c-1 | The Protocol Reset state is when the CMU has selected an air-ground protocol supported by the VDR, but no protocol-specific operational parameters have been set by the CMU. While in this state the VDR sets the Download Request bit to "1" and the Protocol Status bit to "1" in its Label 270 status word.

c-3 | 5.2.3 PROTOCOL_SET

c-1 | The Protocol Set state is when the CMU has selected an air-ground protocol supported by the VDR and provided the protocol-specific operational parameters needed to begin operation. While in this state, the VDR sets the Download Request bit to "0" and the Protocol Status bit to "1" in its Label 270 status word.

c-3 | 5.2.4 Protocol State Diagram

Figure 5-1 below contains the Protocol State Diagram and shows the protocol states that the VDR may have once it has entered the 750 Data mode. The inputs and outputs for the state transitions are the transmission and/or receipt of certain Command and Control primitives.

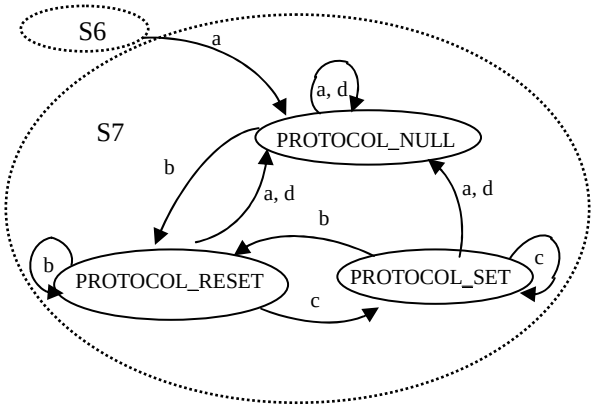


Figure 5-1 - Protocol State Diagram

a. MODE_SET.request received, MODE_SET.confirm sent.

b. PR_SET.request received, PR_SET.confirm sent (non-error).

c. PARAM.request received, PARAM.confirm sent (non-error).

d. PR_SET.request received, PR_SET.confirm sent (error or non-supported protocol).

5.0 INTERFACE AND PROTOCOLS TO THE CMU

It is possible for a CMU to unambiguously determine which of the 750 Data mode protocol states the VDR is in by examining the contents of the Download Request bit and the Protocol Status bit in the VDR's broadcast Label 270 word.

The following table shows the VDR's protocol states as a function of these two bits:

Protocol State	Download Request Bit	Protocol Status Bit
PROTOCOL_NULL	0	0
PROTOCOL_RESET	1	1
PROTOCOL_SET	0	1

c-3

5.3 VDR Control

Since the CMU and VDR may support multiple Interface Protocols, a protocol-independent control mechanism is provided to manage the air-ground protocol selection, BITE data reporting, and other air-ground protocol-independent functions. These functions are managed using VDR Control primitives comprised of conventional (non-extended) BOP files and SOLO words.

5.3.1 VDR Control Message Format

The primitives used for VDR control functions comprise VDR Control (BOP) files and VDR Control SOLO words.

For all VDR Control files, the ARINC 429 GFI field should be set to "2_h". All VDR Control files are of type COMMAND. When ARINC 429 BOP Version 1 is used, then the Destination Code in the 429 RTS word for VDR Control files should be set to "00_h" (to indicate a Command Type file). When ARINC 429 BOP Version 3 is used, then the Command Type field in the 429 SOF word for VDR Control files should be set to "Command". The general format for all VDR Control files is as follows:

Octet	Definition
1	Primitive Identifier
2	Data Field Length MSB
3	Data Field Length LSB
4	Data Field Byte #1
5	Data Field Byte #2
.	.
.	.
.	.
N+3	Data Field Byte #N

c-1

For all VDR Control SOLO words, the SOLO word ID field (bits 28-25), should be set to "2_h". The general format for all VDR Control SOLO words is as follows:

c-3

Bit	Definition
32	Parity
31-29	"101_b" (indicates SOLO)
28-25	"2_h"
24-17	Primitive Identifier (PID)
16-09	8-Bit Data Field
08-01	SAL

c-1

The VDR, regardless of any Interface Protocol it may consider to be active should respond to VDR Control messages.

5.0 INTERFACE AND PROTOCOLS TO THE CMU

5.3.2 Protocol Negotiation

c-1 The VDR Control messages are used to negotiate the air-ground Interface Protocol. The CMU is the controlling entity during the air-ground protocol selection process. The VDR should use the protocol that the CMU requests. To manage the protocol selection process the CMU is provided two primitives, PR_SET.request and PR_QUERY.request.

c-2 The VDR is provided two primitives for responding to the CMU primitives, PR_SET.confirm and PR_QUERY.confirm.

All protocol negotiation primitives are generated using VDR Control messages. A Protocol Identifier Code (PIC) is passed in the primitives to identify an Interface Protocol. Interface Protocols and their corresponding PICs are listed in Attachment 8, Table A8-13.

c-3

5.3.2.1 PR_SET.request Primitive

c-2 The CMU sends the PR_SET.request to the VDR to set the active protocol in the VDR.

Message format

The message consists of a VDR Control SOLO word, formatted as follows:

Bit	Definition	Content
32	Parity	
31-29	"101_b"	
28-25	ID field	2_h
24-17	PID	01_h
16-09	8-Bit Data	Requested PIC (Table A8-13)
08-01	SAL	

c-1

Response

The VDR responds with a PR_SET.confirm message within one second of receipt of the PR_SET.request message.

State

This message is processed in state S7.

New State

c-3

The VDR mode state remains state S7. The protocol determination substate will be either PROTOCOL_RESET or PROTOCOL_NULL, see Section 5.3.2.2.

5.3.2.2 PR_SET.confirm Primitive

c-1 The VDR sends the PR_SET.confirm within one second of its receipt of a PR_SET.request from the CMU.

c-2 If the VDR supports the protocol requested in the PR_SET.request, then it enters the protocol determination substate PROTOCOL_RESET. If the VDR does not support the requested protocol, then it enters the protocol determination substate PROTOCOL_NULL.

5.0 INTERFACE AND PROTOCOLS TO THE CMU

Message Format

The message consists of a VDR Control SOLO word, formatted as follows:

Bit	Definition	Content
32	Parity	
31-29	"101_b"	
28-25	ID field	2_h
24-17	PID	01_h
16-09	8-Bit Data	Confirmed PIC or ERROR protocol code (Table A8-13)
08-01	SAL	

Response

None.

State

This message is transmitted in state S7.

New State

If the data field does not contain the ERROR code, then the resulting state is the PROTOCOL_RESET substate of state S7. If the data field contains the ERROR code, then the resulting state is the PROTOCOL_NULL substate of state S7.

5.3.2.3 PR_QUERY.request Primitive

The CMU issues the PR_QUERY.request message to request the VDR to send a list of supported protocols.

Message Format

The message consists of a VDR Control SOLO word, formatted as follows:

Bit	Definition	Content
32	Parity	
31-29	"101_b"	
28-25	ID field	2_h
24-17	PID	02_h
16-09	8-Bit Data	don't care
08-01	SAL	

Response

The VDR should respond with a PR_QUERY.confirm message within one second of receipt of the PR_QUERY.request message.

State

This message is processed in state S7.

New State

The resulting state is unchanged.

c-3 5.3.2.4 PR_QUERY.confirm Primitive

The PR_QUERY.confirm primitive is sent by the VDR within one second of the receipt of a PR_QUERY.request and contains a list of the VDR's supported protocols.

c-1

Message Format

c-3 This message consists of a VDR Control file of type COMMAND. The file should contain the following:

c-1

Octet	Definition	Range
1	PR_QUERY.confirm	02_h
2	Data field length MSB	0-255
3	Data field length LSB	0-255
4	PIC #1	Table A8-13
5	PIC #2	Table A8-13
.	.	.
.	.	.
N+3	PIC #N	Table A8-13

Response

None.

State

This message is transmitted in state S7.

c-3 **New State**

The resulting state is unchanged.

5.3.2.5 MODE_SET.request Primitive

The CMU issues the MODE_SET. request message to set the VDR to the ARINC 750 radio mode.

Message Format

The message consists of a VDR Control SOLO word, formatted as follows:

c-2

Bit	Definition	Content
32	parity	
31-29	101_b	
28-25	ID	02_h
24-17	PID	05_h
16-09	8-Bit Data	don't care
08-01	SAL	

Response

The VDR responds with a MODE_SET.confirm message and enters the "Protocol Null" protocol determination substate of state S7.

c-3 **State**

This message is processed while in the S6 or S7 state. If the VDR is in any other state then it will ignore this message.

5.0 INTERFACE AND PROTOCOLS TO THE CMU

New State

The resulting state is unchanged.

c-3

5.3.2.6 MODE_SET.confirm Primitive

The VDR sends the MODE_SET.confirm message within one second of receipt of a MODE_SET.request message.

Message Format

The message consists of a VDR Control SOLO word, formatted as follows:

Bit	Definition	Content
32	parity	
31-29	101_b	
28-25	ID	02_h
24-17	PID	05_h
16-09	8-Bit Data	don't care
08-01	SAL	

c-2

Response

None

State

This message is transmitted while in the S6 or S7 state.

New State

The resulting state is the PROTOCOL_NULL substate of state S7.

Note: The MODE_SET.request to MODE_SET.confirm handshake results in the VDR transitioning to ARINC 750 Data Mode, state S7. The MODE_SET.confirm message is shown to be valid in states S6 or S7. The transition to the S7 state is implied to occur after the successful sending of the MODE_SET.confirm message.

c-3

5.3.3 Flow Control Primitives

As mentioned in Section 5.1.2.3.2, two primitives are provided with which flow control can be requested by the VDR or CMU.

5.3.3.1 XOFF.request Primitive

The VDR sends the XOFF.request message to request that the CMU send no further BOP files of the type specified in the Type Field.

5.3.3.1 XOFF.request Primitive (cont'd)

Message Format

The message consists of a VDR Control SOLO word, formatted as follows:

Bit	Definition	Content
32	parity	
31-29	101_b	
28-25	ID	02_h
24-17	PID	06_h
16-09	Type Field (8-bits)	00_h = Command 01_h = Data
08-01	SAL	

Response

None.

State

This message is transmitted while in the S5, S6 or S7 state.

New State

The resulting state is unchanged.

5.3.3.2 XON.request Primitive

The VDR sends the XON.request message to request that the CMU freely send BOP files of the type specified in the Type Field.

Message Format

The message consists of a VDR Control SOLO word, formatted as follows:

c-3

Bit	Definition	Content
32	parity	
31-29	101_b	
28-25	ID	02_h
24-17	PID	07_h
16-09	Type Field (8-bits)	00_h = Command 01_h = Data
08-01	SAL	

Response

None

State

This message is transmitted while in the S5, S6 or S7 state.

New State

The resulting state is unchanged.

5.0 INTERFACE AND PROTOCOLS TO THE CMU

5.3.4 BITE Data

c-3

Upon request the VDR conveys a limited amount of BITE data to the CMU. The purpose of sending BITE information to the CMU is to report the relative health of the VDR for installations which do not include a Central Fault Display System (CFDS). The CMU BITE information is meant to be a subset of the information made available to the CFDS. The VDR should only inform the CMU of its present health state. There is no requirement for the VDR/CMU interface to support fault recording and the variety of CFDS menu modes supported for the CFDS. It is not the intent of this function to be compliant with ARINC Report 604 or 624.

The following table defines the different types of BITE data parameters which the VDR may send to the CMU. c-1

BITE Boolean
VSWR
SW Part Numbers

All BITE data parameters comprise multiple bytes arranged in a common format, are sent in one BOP file, and conform to the general format shown in Section 5.3.1 Command and Control Message Format.

5.3.4.1 VDR_BITE.request Primitive c-3

The CMU issues the VDR_BITE.request message to request the VDR to send a list of current BITE data.

Message Format

The message consists of a VDR Control SOLO word, formatted as follows:

c-1

Bit	Definition	Content
32	Parity	
31-29	“101_b”	
28-25	ID field	2_h
24-17	PID	03_h
16-09	8-Bit Data	don’t care
08-01	SAL	

Response

The VDR responds with a VDR_BITE.confirm message within one second of receipt of the VDR_BITE.request message.

State

This message is processed in state S7 and may also be processed in the S5 and S6 states.

c-3

New State

The resulting state is unchanged.

5.3.4.2 VDR_BITE.confirm Primitive

c-1 The VDR sends the VDR_BITE.confirm message which contains all of the available BITE information.

Message Format

c-3 This message consists of a VDR Control file whose type is COMMAND. The file should contain BITE Boolean, VSWR, and software part numbers formatted as follows:

Octet	Definition	Range
1	VDR_BITE.confirm	03_h
2	Data field length MSB	0-255
3	Data field length LSB	0-255
4	Bite Booleans MSB	$0\text{-}FF_h$
5	Bite Booleans LSB	$0\text{-}FF_h$
6	VSWR	$10_h\text{-}FF_h$
7	N, number of part numbers contained in the file.	
8	M, number of ISO-5 characters per part number.	
9	PN1, char 1	
10	PN1, char 2	
c-1 .	.	
.	.	
8+M	PN1, char M	
9+M	PN2, char 1	
10+M	PN2, char 2	
.	.	
.	.	
8+2M	PN2, char M	
.	.	
.	.	
8+NM	PNN, char M	

BITE Booleans

The BITE Booleans should be formatted as follows:

MSB bit discretes

Bit	Description	Content
8	VDR failure	1 = failed
7	Antenna failure	1 = failed
6	DFS bus #1 status	1 = inactive or not examined
c-2 5	DFS bus #2 status	1 = inactive or not examined
4	CMC 1 bus activity bit	1 = inactive
3	CMC 2 bus activity bit	1 = inactive
2	Bit 4 valid	1 = invalid
1	Bit 3 valid	1 = invalid

5.0 INTERFACE AND PROTOCOLS TO THE CMU

COMMENTARY

Certain hardware implementations may not have the capability to simultaneously examine DFS bus #1 and DFS bus #2. For the DFS buses, a value of "1" for bits 5 or 6 will indicate that the corresponding bus is either not active or is not being examined. Similarly, the hardware may lack the ability to simultaneously examine CMC1 bus and CMC 2 bus. If the value reported for CMC1 bus activity in bit 4 is valid (bus is being examined), then bit 2 will indicate "valid". Similarly, the content of bit 1 validates the content of bit 3. c-3

LSB bit discretes c-2

LSB bit discrete is reserved for future use and should be set to 00_h until defined otherwise.

VSWR

The VSWR byte provides a means of encoding a VSWR of 1.0:1 to 15.0:1 with a 0.0625 step size. The valid range for this byte is from 10_h to FF_h.

Software Part Numbers c-1

The software part numbers are encoded in octets 9 through 8 + N * M. Each octet contains a character of the part number as an ISO-5 character. The VDR's software part numbers should be encoded using ISO-5 characters. The VDR should transmit the software part number in an order that sends the most significant digit first, least significant digit last. For example, the "6" should be the first character transmitted in the following 10 character software part number: 6 5 3 9 8 3 1 0 0 1. Part numbers should be 24 characters or fewer. The number of part numbers should be limited to eight. c-3

Response c-1

None.

State

This message is transmitted in state S7. This message may also be transmitted in the states S5 and S6. c-3

New State

The resulting state is unchanged.

5.3.5 Error Messages c-2

If either the VDR or CMU experiences an error in VDR Control communications, the unit experiencing the error should notify its counterpart of the error by sending an ERROR.indication message.

Message Format

The message consists of a VDR Control SOLO word, formatted as follows: c-1

Bit	Definition	Content
32	Parity	
31-29	"101_b"	
28-25	ID field	2_h
24-17	PID	00_h
16-09	Error Code	PID of offending primitive or "FF_h" for unspecified error.
08-01	SAL	

5.0 INTERFACE AND PROTOCOLS TO THE CMU

5.3.5 Error Messages (cont'd)

c-1 **Response**

None.

State

c-3 This message is valid in states S5, S6 and S7.

New State

The resulting state is unchanged.

5.4 Reserved

5.5 Periodic Data

The VDR and CMU transmit periodically certain ARINC Specification 429 broadcast words. Periodic data is communicated using ARINC Specification 429 broadcast words.

The VDR should periodically transmit the following ARINC Specification 429 words to the CMU:

Label	Description	Rate
172	VDR System Address Label	1/sec
270	VDR Real-time status	1/sec
377	VDR Equipment ID	1/sec

c-1

The VDR should expect to periodically receive the following list of ARINC Specification 429 words from the CMU.

Label	Description	Rate
172	CMU System Address Label	1/sec
270	CMU Real-time status	1/sec

5.5.1 VDR's System Address Label Word (172)

c-3 The purpose of the transmitted ARINC 429 Label 172 word is to inform the CMU of the VDR's SAL and supported air-ground protocols. The format of the Label 172 word is shown in Table A8-7. The SAL field (bits 16-9), defined in Table A8-10, is set as a function of the transceiver's SDI strapping. The air-ground protocol field (bits 17-24) is set as a function of the air-ground protocols supported by the VDR. See Table A8-7. If bits 17-24 are all zero, then this will be understood to mean that the only VDL mode supported by the VDR is mode A. The PAD field (bits 25-29) is reserved for future growth and should be set to 0.

5.5.2 VDR's Status Word (270)

c-1 The transmitted ARINC 429 Label 270 word is used to inform the CMU of real-time status data. The format of the Label 270 word is shown in Table A8-8. The SDI codes (bits 9, 10), should be set in accordance with the SDI strapping of the
c-3 transceiver as defined in Table A8-12. The PAD bits are reserved for future growth and should be set to "0". The settings for
c-1 the SSM Field (bits 30, 31), are defined in Table A8-11.

5.5.2.1 Primary CMU Field

As defined in Section 3.3.2.1.4 Primary CMU Notification, the Primary CMU Field (bits 15, 16), are used to indicate which CMU the VDR considers to be PRIMARY and should be set to the SDI code of the PRIMARY CMU. If neither CMU is declared to be PRIMARY, then both bits in the field should be set to "1". c-1

5.5.2.2 Protocol Status Bit

The VDR sets the Protocol Status bit (bit 14) in its Label 270 word to a "1" whenever it is in either the PROTOCOL_RESET or PROTOCOL_SET protocol determination substates of state S7. The VDR sets the bit to a "0" at all other times.

5.5.2.3 Download Request Bit

The VDR sets the Download request bit (bit 11), in its Label 270 status word, to a "1" whenever it is in the determination substate PROTOCOL_RESET of state S7. The VDR sets the bit to a "0" at all other times. c-2 c-1

5.5.2.4 VDR Status Bit

The VDR Status bit (bit 18), is used to convey information about the operational health of the VDR. Anytime the VDR considers itself to be in a fault state, this bit should be set to a "1". Otherwise, this bit should be set to a "0". c-2

5.5.2.5 Transmission Time-out Warning Bit

The Transmission Time-out Warning bit (bit 13), should be set to a "1" if less than five seconds remain until the time-out function disables the transmitter or if the time-out function has disabled the transmitter. Otherwise, this bit should be set to a "0". c-1

5.5.2.6 Voice/Data Status Bit

The Voice/Data status bit (bit 17), should be set to a "1" if the transceiver is operating in the 716 Voice mode, and set to a "0" if it is operating in the 716 Data mode or 750 Data mode. c-2

5.5.2.7 750/716 Mode

The 750/716 Mode bit (bit 19) is used to indicate whether the VDR is operating in the 716 Mode or the 750 Mode. c-3

0 = 716 Mode, voice or data
1 = 750 Mode c-2

5.5.2.8 VDR State

The VDR state field, bits 21-24, is used to indicate the current state of the VDR as defined in Table A8-17.

5.5.2.9 Active Air-Ground Protocol

The Active Air-ground Protocol field, bits 25-27, is used to indicate which air-ground protocol is active when the VDR is in the 750 data mode. These bits are set to 0 when the VDR is in the 716 mode (bit 19=0). See Table A8-8. c-3

5.5.3 Transmitted Equipment Identification Word

The ARINC 429 Label 377 word is used to transmit the VDR's equipment identification code to the CMU. The format of the Label 377 word is shown in Table A8-9. The SDI codes (bits 9, 10), should be set in accordance with the SDI strapping of the transceiver as defined in Table A8-12. The Equipment Class field (bits 11-22), is set to "016_h" which identifies the LRU as a "VHF Transceiver". The PAD Field (bits 23-29), should be set to "0". The SSM code should be set to "Normal" as defined in Attachment 8, Table A8-11. c-1 c-2

5.0 INTERFACE AND PROTOCOLS TO THE CMU

5.5.4 Received System Address Label Word

The VDR should receive an ARINC 429 Label 172 data word from the CMU over the high speed ARINC Specification 429 interface. The ARINC 429 Label 172 data word contains the SAL of the CMU. The format of the received ARINC 429 Label 172 word is defined in ARINC Characteristic 758 “Communications Management Unit (CMU) Mark-2”.

c-1

5.5.5 Received Status Word

The VDR should receive an ARINC 429 Label 270 word from the CMU over the high speed ARINC Specification 429 interface. The ARINC 429 Label 270 data word contains information on whether the CMU is “active” or in “standby” mode.

Bit 20 is defined to be the Active/Standby bit.

c-2

The VDR considers the CMU active and available for ARINC 750 protocol operations only if bit 20 is set to “1”. The format of the received ARINC 429 Label 270 word is defined in ARINC Characteristic 758 “Communications Management Unit (CMU) Mark 2”.

c-1

6.0 PROVISIONS FOR AUTOMATIC TEST EQUIPMENT (ATE)

6.1 General

To enable Automatic Test Equipment (ATE) to be used in the bench maintenance, internal circuit functions not available at the unit service connector and considered by the equipment manufacturer necessary for automatic test purposes may be brought to pins on an auxiliary connector of a type selected by the equipment manufacturer. This connector should be fitted with only that number of contacts needed to support the ATE functions. The connector should be provided with a protective cover suitable to protect these contacts 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.

6.1.1 ATE Testing

c-1 The VDR should be designed to be testable using support equipment that complies with ARINC Specification 608A, "Design Guidance for Avionics Test Equipment".

7.0 PROVISIONS FOR BUILT-IN TEST EQUIPMENT (BITE)

7.1 Introduction

The VDR should contain BITE capabilities in accordance with ARINC Report 624, "Design Guidance for Onboard Maintenance System (OMS)", and Report 604, "Guidance for Design and Use of Built-In Test Equipment."

COMMENTARY

The guidance in ARINC Report 624 regarding the BITE capability for detection and isolation of internal and external VDR faults or failures generally supersedes that in ARINC Report 604. Also, the general philosophy, basic guidance, and certain specific recommendations are described for the OMS in ARINC Report 624, and for the Centralized Fault Display System (CFDS) in ARINC Report 604.

The VDR BITE should be capable of detecting and annunciating a minimum of 95% of the faults or failures which can occur within the VDR and as many faults as possible associated with the VHF antenna, coaxial cable, and interfaces with the CMU or MU.

COMMENTARY

Whether the VSWR of the antenna and its associated cabling should be measured and judged "GOOD" has been a subject of considerable discussion in the past. The antenna cabling loss is specified as not more than 5.5 dB. 5.5 dB yields a VSWR of not more than 1.9:1 regardless of the antenna VSWR. Therefore, measuring the VSWR at the connector of the radio at best only determines whether or not the antenna feed line is connected and not severely damaged near the transceiver. Under no circumstances should an antenna and its associated cabling be judged "BAD" if acceptable communications can be performed.

The VDR BITE should operate continuously during flight. Monitoring of the results should be automatic. The BITE should automatically test, detect, isolate, and record both intermittent and steady state faults.

The BITE should indicate its condition and any faulty inputs upon activation of the self-test routine. In addition, BITE should display faults which have been detected during in-flight monitoring.

COMMENTARY

An example of this would be an internal loop back test which would demodulate and monitor each frame transmitted, in order to verify the correct operation of the transmitter and receiver.

No failure occurring within the BITE subsystem should interfere with the normal operation of the VDR.

COMMENTARY

Sufficient margins should be used in choosing BITE parameters to preclude nuisance warnings. Discrepancies in VDR operation caused by power bus transients, received noise, EMI, servicing interference, abnormal accelerations, turbulence, etc. should not be recorded as faults.

7.2 BITE Interfaces

The VDR should facilitate control and annunciation of the BITE information via the following interfaces:

a. OMS/CFDS Interfaces
b. MU/CMU Interfaces
c. VDR Front Panel

7.0 PROVISIONS FOR BUILT-IN TEST EQUIPMENT (BITE)

COMMENTARY

The VDR is intended to be compatible with newer aircraft which have either an OMS or CFDS, as well as older aircraft which have no centralized maintenance system. In order to ensure interchangeability of the VDR across the entire range of installations, it should be capable of supporting BITE on the various interfaces.

On the OMS/CFDS interfaces and the MU/CMU interfaces, the VDR should provide a listing of BITE options in menu format for operator selection. By menu selection, the operator should be capable of requesting fault status (current and previous), initiating self tests and requesting detailed failure information for diagnostics. The philosophy expressed in ARINC Reports 604 and 624 is that avionic units such as the VDR should provide an interactive, "user friendly" aid to maintenance.

The ARINC 600 program pins MP11C and MP14A, should be wired as described in Table A8-15 to indicate whether the VDR is connected to an Airbus, Boeing, or McDonnell-Douglas type CFDS. | c-3

7.2.1 OMS Interfaces

The VDR should facilitate BITE control and fault reporting capability, including interfaces with single or dual Central Maintenance Computer (CMC) units in accordance with ARINC Report 624. Attachment 8, Table 8-1 describes the list of BITE codes which should be used for VDR fault reporting. | c-1

7.2.2 Character-Oriented CFDS Interfaces

The VDR should facilitate BITE control and readout, including interfaces with single or dual Centralized Fault Display Interface Units (CFDIUs), in accordance with the character-oriented fault reporting protocol described in ARINC Report 604.

7.2.3 Bit-Oriented CFDS Interfaces

The VDR should facilitate BITE control and readout, including interfaces with single or dual CFDIUs, in accordance with the bit-oriented fault reporting protocol described in ARINC Report 604. Command and Fault summary words should be ir accordance with Attachment 8, Tables 8-2 and 8-3. | c-1

7.2.4 MU/CMU BITE Interfaces

The VDR should facilitate BITE control and readout via the single or dual interfaces with the MU or CMU. Protocols for exchange of BITE data on these interfaces should be in accordance with the bit-oriented CFDIU protocol described in ARINC Report 604. Command and Fault summary words should be in accordance with Attachment 8, Tables 8-2 and 8-3.

7.3 BITE Presentation

BITE information provided on the data buses for the OMS/CFDS and CMU/MU is to be presented to maintenance personnel on the display contained within the applicable system. Additionally, the VDR should present System/LRU fault status on its front panel in order to facilitate the use of BITE for local troubleshooting in the electronics equipment bay and for installations without a compatible OMS/CFDS or MU/CMU.

COMMENTARY

Airlines desire that BITE information be presented to line maintenance personnel using easily understandable text - not coded! - and using an alpha-numeric display or equivalent technique. The airlines do not want the maintenance personnel to be burdened with carrying a library of code translations, and desire BITE fault analysis capability equal to or surpassing that realized with shop Automatic Test Equipment.

7.0 PROVISIONS FOR BUILT-IN TEST EQUIPMENT (BITE)

7.4 Fault Monitor

The results of in-flight or ground operations of BITE should be stored in a non-volatile monitor memory. The size of the memory should be sufficient to retain detected faults during the previous ten flight legs. The data in the monitor memory should include flight leg identification and fault description.

The contents of the monitor memory should be retrievable by BITE operation or by shop maintenance equipment. Refer to ARINC Report 624 for further guidance on fault recording.

The VDR should send BITE fault data to the OMS/CFDS and MU/CMU on the applicable Data Bus.

COMMENTARY

The airlines have expressed an interest in having BITE data from as many as 64 previous flight legs available in memory.

A question which should be considered by the equipment designer is, "What is the scope/purpose of BITE"? It appears from the unconfirmed failure data that is available from repair shop operations, that there is merit in considering storage of data which identifies the Shop Replaceable Unit (SRU). BITE should be used to detect and isolate faults to the LRU level.

7.5 Self-Test Initiation

At the time of equipment turn-on, a power-up self-test should be initiated automatically as described in ARINC Reports 604 and 624. In addition, the VDR should provide self-test capability for troubleshooting and installation verification. The initiation of the applicable test sequences should be possible from the control point(s) for the OMS, CFDS, MU, or CMU.

COMMENTARY

It is desirable that the power-up self-test be completed in less that 15 seconds.

As an aid to shop maintenance and local trouble-shooting on the aircraft, a mechanism should be provided on the VDR front panel for initiation and annunciation of a unit/system self-test results. The self-test routine should start with a test which verifies the correct operation of all elements of the annunciating mechanism. If the self-test routine detects a fault, the appropriate fault should be annunciated. If no fault is found, the contents of the intermittent fault memory should be reviewed; if an occurrence of a fault on one of the four earlier flight legs is detected, the appropriate fault should be annunciated. If no faults are detected, and none were recorded during the four earlier flight legs, a "normal" status should be annunciated. Fault annunciations should continue until the self-test control is activated a second time or a "time-out" period of approximately ten minutes expires.

COMMENTARY

Selection of four as the number of flight legs (for which intermittent fault memory should be examined for the line maintenance BITE function) was made in the belief that it could be reduced as confidence in the BITE was built up. Manufacturers are urged to make this number easily alterable in their BITE implementation.

7.6 Monitor Memory Output

The BITE Monitor Memory output should consist of the following:

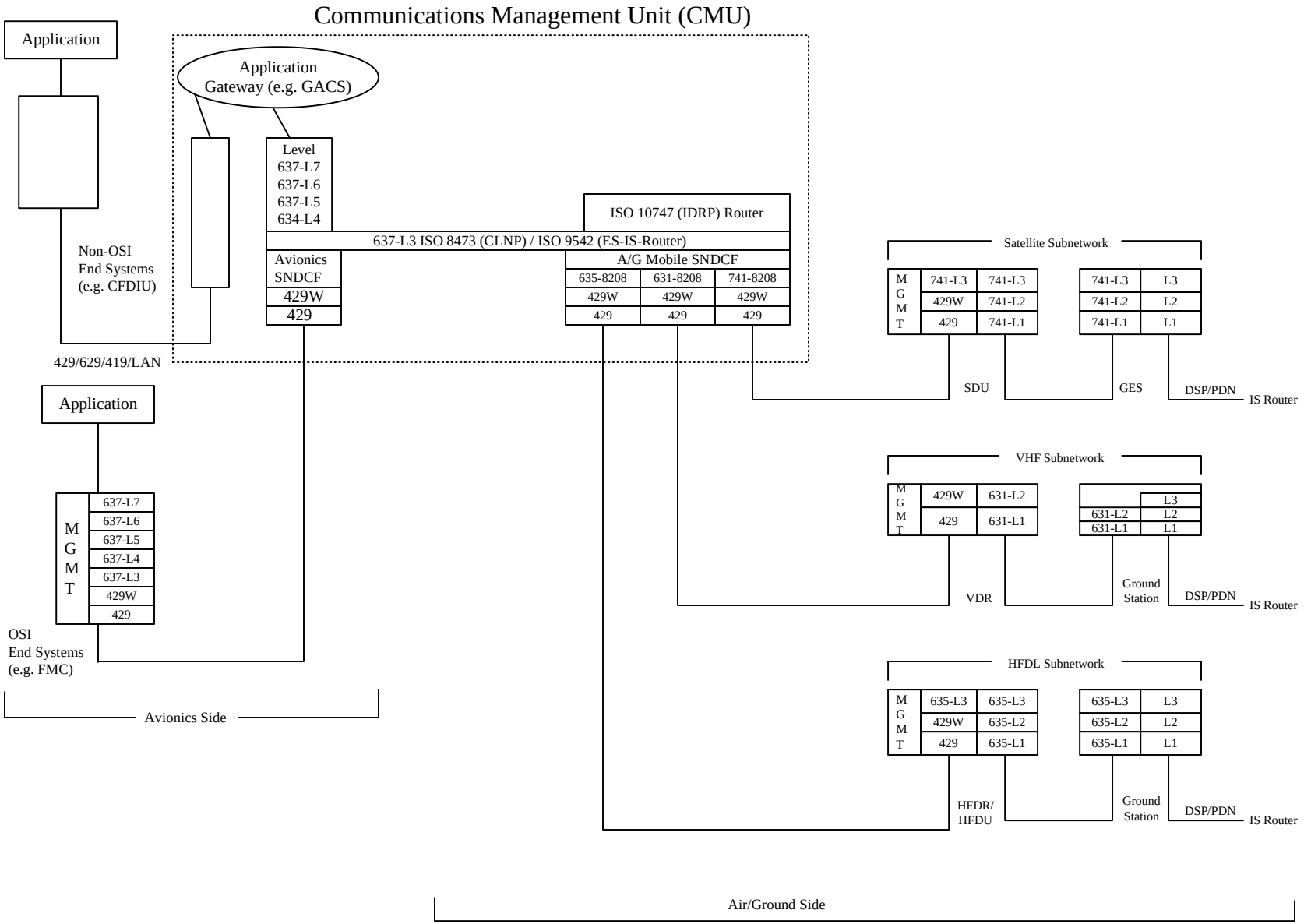
a. An output on the applicable ARINC 429 Data bus to the OMS/CFDS or MU/CMU when so requested, as described in ARINC Reports 624 and 604 using the format described therein.

b. An output to the VDR front panel annunciator, indicating the status of the VDR, antenna, coaxial cable, and interfaces. An English language presentation is preferred over coded messages.

7.0 PROVISIONS FOR BUILT-IN TEST EQUIPMENT (BITE)

c. An output of undefined format which should be made available for shop read-out at the ATE reserved pins of the upper connector located on the VDR.

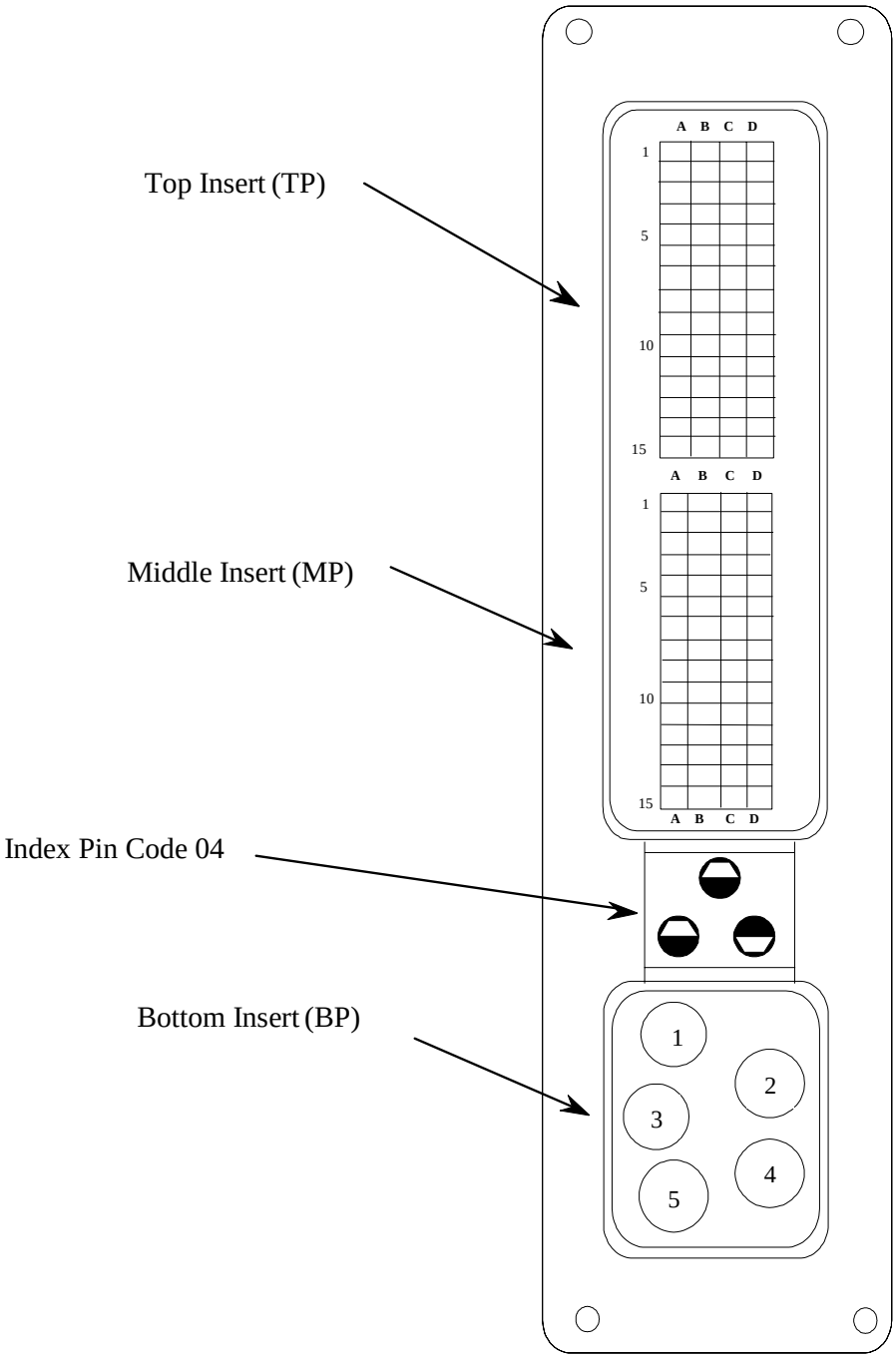
The monitor memory should be capable of being reset in order that stored faults are not carried over once an LRU replacement or repair has been effected. The reset should be initiated only by shop maintenance.



NOTES:

1. This figure appears in the following ARINC standards: 631, 635, 637, 750 and 753. Due to non-synchronous update of these standards, differences in this figure between standards may arise. In all cases, the figure with the most recent date (see lower left hand corner) should have precedence.

ATTACHMENT 2
VDR CONNECTOR POSITIONING



Rear View

ATTACHMENT 3
STANDARD INTERWIRING

FUNCTION	VDR	CMU#1	CMU#2	OMS	DL	OTHER	NOTES
Future Spare	TP1A						
Future Spare	TP1B						
Future Spare	TP1C						
Future Spare	TP1D						
Future Spare	TP2A						
Future Spare	TP2B						
Future Spare	TP2C						
Future Spare	TP2D						
Future Spare	TP3A						
Future Spare	TP3B						
Future Spare	TP3C						
Future Spare	TP3D						
Future Spare	TP4A						
Future Spare	TP4B						
Future Spare	TP4C						
Future Spare	TP4D						
Reserved for ATE	TP5A						
Reserved for ATE	TP5B						
Reserved for ATE	TP5C						
Reserved for ATE	TP5D						
Reserved for ATE	TP6A						
Reserved for ATE	TP6B						
Reserved for ATE	TP6C						
Reserved for ATE	TP6D						
Reserved for ATE	TP7A						
Reserved for ATE	TP7B						
Reserved for ATE	TP7C						
Reserved for ATE	TP7D						
Future Spare	TP8A						
Future Spare	TP8B						
Future Spare	TP8C						
Future Spare	TP8D						
Future Spare	TP9A						
Future Spare	TP9B						
Future Spare	TP9C						
Future Spare	TP9D						
Future Spare	TP10A						
Future Spare	TP10B						
Future Spare	TP10C						
Future Spare	TP10D						
Future Spare	TP11A						
Future Spare	TP11B						
Future Spare	TP11C						
Future Spare	TP11D						
Future Spare	TP12A						
Future Spare	TP12B						
Future Spare	TP12C						
Future Spare	TP12D						
Future Spare	TP13A						
Future Spare	TP13B						
Future Spare	TP13C						
Future Spare	TP13D						

ATTACHMENT 3
STANDARD INTERWIRING

FUNCTION		VDR	CMU#1	CMU#2	OMS	DL	OTHER	NOTES
Future Spare		TP14A						
Future Spare		TP14B						
Future Spare		TP14C						
Future Spare		TP14D						
Future Spare		TP15A						
Future Spare		TP15B						
Future Spare		TP15C						
Future Spare		TP15D						
Mic Input	Hi	MP1A	o				o	1,A
	Lo	MP1B	o				o	1,A
	PTT	MP1C	o				o	1,A
Key Event		MP1D	o				o	1,A
Max Trans Cutoff		MP2A	o				o	4,K
Mic Input (Ground)		MP2B	o				o	1
Data Loader Input	A	MP2C	o				o	4,O
	B	MP2D	o				o	4
Optional	Hi	MP3A	o				o	1,B
(Remote Squelch)	ARM	MP3B	o				o	1,B
Squelch	Lo	MP3C	o				o	1,B
dc Ground		MP3D	o				o	2
Self Test Discrete		MP4A	o				o	1
Audio Ground		MP4B	o				o	1
Data Loader Output	A	MP4C						4,0
	B	MP4D						4
Data Link	Hi	MP5A	o				o	1,C
Data Input	Lo	MP5B	o				o	1,C
Reserved for 716 Compatibility		MP5C	o				o	
8.33 kHz Program for 716 Compatibility		MP5D						
Data from OMS/CFDS	A	MP6A	o		o			2,P
#1 Input Port A	B	MP6B	o		o			2
Data from OMS/CFDS	A	MP6C	o		o			4,P
#2 Input Port B	B	MP6D	o		o			4
Frequency/Function Select	A	MP7A	o				o	1,P
Data I/P Port B	B	MP7B	o				o	1
Voice Data Select		MP7C	o				o	1,D
Data Key Line		MP7D	o				o	1,E
Antenna Monitor Program		MP8A	o		o		o	1
Data Loader Enable		MP8B						4,N
Reserved for 716 Compatability		MP8C	o				o	1
Data Keyline Return		MP8D	o				o	1
SDI Code Input		MP9A						2,F
SDI Code Input		MP9B						2,F
Ground		MP9C						2
Reserved for AGC		MP9D	o				o	1
Program Common		MP10A	o				o	1
Future Spare		MP10B						
Data to both CMUs	A	MP10C	o	o		o		4,O
Output Port	B	MP10D	o	o		o		4

c-1

ATTACHMENT 3
STANDARD INTERWIRING

	FUNCTION		VDR	CMU#1	CMU#2	OMS	DL	OTHER	NOTES
	Frequency/Function Select	A	MP11A	o				o	1,P
	Input Port A	B	MP11B	o				o	1
c-3	Maintenance System ID		MP11C	o				o	
	Data Select Discrete		MP11D	o				o	2,G
	Data from CMU #1	A	MP12A	o	o				4,O
	Input Port A	B	MP12B	o	o				4
	Data from CMU #2	A	MP12C	o	o				4,O
	Input Port B	B	MP12D	o	o				4
	SELCAL Audio and	Hi	MP13A	o				o	1,I
	Data Output	Lo	MP13B	o				o	1,I
	Squelch Disable		MP13C	o				o	1,J
	Squelch Disable Return		MP13D	o				o	1,J
c-3	Maintenance System ID		MP14A						
	Ground/Air Discrete		MP14B	o				o	2,H
	Data to OMS/CFDS	A	MP14C	o		o			2,P
	Output Port	B	MP14D	o		o			2
	Audio/Sidetone	Hi	MP15A						1,L
	Output	Lo	MP15B						1,L
	Muting		MP15C						1,M
	Muting Return		MP15D						1,M
	Antenna RF Input		BP1	o				o	2
	Power Input +27.5 Vdc		BP2	o				o	2,N
	Spare		BP3						
	Power Input Ground		BP4	o				o	2
	Not Used		BP5						

ATTACHMENT 4
NOTES APPLICABLE TO STANDARD INTERWIRING

1. Applicable to ARINC 716 VHF COM compatible operations only.

2. Applicable to both ARINC 716 VHF COM and ARINC 750 VDR operations. Functions are identical.

3. Applicable to both ARINC 716 VHF COM and ARINC 750 VDR operations. The new VDR functions are different from VHF modes.

4. Applicable to ARINC 750 VDR operations only.

   A. Microphone Input (MP1A, B, C, D)

      Standard four wire microphone interwiring as described in Attachment 6 of ARINC Characteristic 716-7. The microphone should be keyed when MP1C is grounded.

   B. Optional Remote Squelch (MP3A, B, C)

      To accommodate an optional remote squelch adjustment if so required or provided.

   C. Data Link Input (MP5A, B)

      Analog 2400 bps ACARS data input to the VHF 716 COMM. The interface is defined in ARINC Specification 618.

   D. Voice/Data Select (MP7C)

      When in ARINC 716-compatible modes, then the VDR is in Mode 0 when pin MP7C is grounded and in Voice when pin MP7C is open. c-4

   E. Data Key Line (MP7D)

      When in Mode 0, the transmitter should be keyed when pin MP7D is grounded and should be unkeyed when pin MP7D is open. c-4

   F. SDI Code Input (MP9A, B)

      An analog discrete pair prewired at the rear connector to identify specific VHF radio location in the aircraft.

   G. Data Select Discrete (MP11D)

      Used to enable either Frequency/Function Select Data I/P Port A or B. Port A should be selected when pin MP11D is grounded, and port B should be selected when pin MP11D is open.

   H. Ground/Air Discrete (MP14B)

      This discrete is used for BITE functionality. Pin MP14B is grounded to indicate the aircraft is airborne, and is open to indicate the aircraft is on the ground. c-3

   I. SELCAL Audio & Data Output (MP13A, B)

      An analog output to provide 2400 bps data to the ACARS MU. May also be used for SELCAL provisions.

   J. Squelch Disable/Return (MP13C, D)

      An analog discrete to provide squelch override or disable capability. The squelch should be disabled when pin MP13C is grounded, and enabled when pin MP13C is open.

   K. Maximum Transmission Cutoff Enable (MP2A)

      An analog discrete which determines whether the maximum transmission time cutoff feature is implemented. Discrete is open to enable the cutoff feature; if the discrete is grounded, then the cutoff feature is disabled.

   L. Audio/Sidetone Output (MP15A, B)

      An analog output for either receiver audio during RCV, or sidetone audio during voice transmit modes.

ATTACHMENT 4
NOTES APPLICABLE TO STANDARD INTERWIRING

M. Muting/Return (MP15C, D)

An optional two wire analog discrete to provide a switch closure internal to the VHF COMM for external system muting applications during transmit modes. Muting should be enabled when pin MP15C is grounded, and disabled when pin MP15C is open.

N. Power Input (BP2)

One 10 amp circuit breaker should be provided in the standard installation.

O. High Speed ARINC 429 Bus

P. Low Speed ARINC 429 Bus

ATTACHMENT 5
ENVIRONMENTAL CONDITIONS FOR AIRBORNE EQUIPMENT
RTCA/DO-160C

The following RTCA/DO-160C categories apply to the environmental specification of the ARINC 750 VHF Data Radio.

Environment	UNIT LOCATION			
	DO-160C Section	Rack Mounted	Internal Airframe Mounted	External Airframe Mounted
Temperature and Altitude	4	A1	A1	D2
Temperature Variation	5	C	C	A
Humidity	6	A	A	A
Operational Shocks and Crash Safety	7	Shock	Shock	Shock
Vibration	8	B	B	C
Explosion Proofness	9	X	X	E
Water Proofness	10	X	X	W
Fluids Susceptibility	11	X	X	H
Sand and Dust	12	X	X	D
Fungus Resistance	13	X	X	F
Salt Spray	14	X	X	S
Magnetic Effect	15	X	X	X
Power Input	16	A	A	A
Voltage Spike	17	A	A	A
Audio Frequency Conducted Susceptibility - Power Inputs	18	Z	Z	Z
Induced Signal Susceptibility	19	A	A	A
Radio Frequency Susceptibility (Radiated and Conducted)	20	U	V	W
Emission of Radio Frequency Energy	21	A	A	A
Lightning Induced Transient Susceptibility	22	A2C2	A3C3	A4C4
Lightning Direct Effects	23	-	-	-
Icing	24	X	X	A

ATTACHMENT 6
SIGNAL IN SPACE MASK

c-1

Table A6-1 - Spectral Mask of Transmitter for D8PSK

Lower Bound		Upper Bound	
Frequency	Attenuation	Frequency	Attenuation
0	-0.25	0	0.25
1700	-0.25	2500	0.25
3000	-1	3900	-1
3900	-3	4900	-3
4800	-6	5800	-6
5350	-10	6650	-10
6310	-20	7910	-20
6680	-30	8680	-30

Frequency is specified in Hz deviation from the channel center (on both sides), and the attenuation is specified in dBc.

ATTACHMENT 7
EXAMPLE SYMBOL ENCODING

This attachment was deleted by Supplement 3.

ATTACHMENT 8
VDR TABLES AND FIGURES

Table A8-1 - CFDS Fault Identification Codes

Fault Code ID	Nomenclature	Meanings
1	Power Input Recovery	Power interrupt has occurred in the last 3 seconds
2	Left CFDS Activity Fail	No data received from left CFDS
3	Left CFDS Signal Fail	Left CFDS data is invalid
4	Right CFDS Activity Fail	No data received from right CFDS
5	Right CFDS Signal Fail	Right CFDS data is invalid
6	BITE Test Inhibit	Initiated test is inhibited
7	VDR Failure	VDR is in failure
8	VHF Antenna/Coax Failure	VHF antenna or coax is in failure
9	MU/CMU Input-1 Failure	No data received from MU/CMU Input-1
10	MU/CMU Input-2 Failure	No data received from MU/CMU Input-2

Note: Fault ID Codes 1 thru 5 are assigned to generic faults, and Code 6 is assigned to BITE Test Inhibit, based on guidance material in ARINC Report 624.

c-1

Staff Note: This table, derived from draft material in Avionics PUB 91-174/FCM-55, may require changes based on work in progress on ARINC Report 624 in the FCM Subcommittee.

ATTACHMENT 8
VDR TABLES AND FIGURES

Table A8-2 - Bit-Oriented CFDS BITE Command Summary Word Input to VDR

Bit No.	Function	Bit Status	
		1	0
1 2			
3 4 5	Label 227 (Octal)		
6 7 8			
9 10	SDI		
11 12	Pad		
13 14 15 16 17 18 19 20 21 22 23 24	Equipment ID - 016 (Hex)		
25 26 27 28 29 30 31	(See Functional Select Table A7.1 in ARINC Report 604.)		
32	Parity (odd)		

c-2

Note: In the event of a conflict between the material in this Attachment and ARINC Report 604, "Guidance for Design and Use of Built-In Test Equipment (BITE)", this Attachment should take precedence.

ATTACHMENT 8
VDR TABLES AND FIGURES

c-1 **Table A8-3 - Bit-Oriented CFDS BITE Fault Summary Word Output from VDR**

Bit No.	Function	Bit Status	
		1	0
1	Label (350) (Octal)		
2			
3			
4			
5			
6			
7			
8			
9	SDI		
10			
11	VDR Status	Failed	OK
12	Antenna/Coax Status	Failed	OK
13	CFDIU Input Bus 1	Inactive	Active
14	DFS Bus Selection	Port A	Port B
15	Selected DFS Input Bus	Inactive	Active
16	CFDIU Input Bus 2	Inactive	Active
17	CMU/MU Input Bus 1	Inactive	Active
18	CMU/MU Input Bus 2	Inactive	Active
19			
20			
21			
22			
23			
24			
25			
26			
27	8.33 kHz Tuning Capable	Capable	Not Capable
28	BITE Test Inhibit	Inhibit	Enable
29	Command Word Acknowledge	ACK	NAK
30	SSM		
31			
32	Parity (Odd)		

c-3

Note: In the event of a conflict between the material in this Attachment and ARINC Report 604, “Guidance for Design and Use of Built-In Test Equipment (BITE)”, this Attachment should take precedence.

ATTACHMENT 8
VDR TABLES AND FIGURES

Table A8-4 - VDR Mode Command

Bit	Function	Comments
1-8	Label 276	
9-10	SDI (Set to 00)	
11	VHF 1 Voice/Data Command	0 = Voice, 1 = Data
12	VHF 2 Voice/Data Command	0 = Voice, 1 = Data
13	VHF 3 Voice/Data Command	0 = Voice, 1 = Data
14-29	Reserved (Set to 0)	
30-31	SSM	
32	Parity (Odd)	

c-2

Table A8-5 - Reserved

Table A8-6 - Reserved

Table A8-7 - VDR System Address Label (SAL) Word

c-1

Bit	Function	Comments	
1-8	Label 172 (octal)		
9-16	SAL	SDI	SAL
		0	250 octal
		1	251 octal
		2	252 octal
		3	253 octal
17	VDL Mode A, BOP Version 1	1 = not supported, 0 = supported	
18	VDL Mode A, BOP Version 3	0 = not supported, 1 = supported	
19	VDL Mode 2	0 = not supported, 1 = supported	
20	Reserved for VDL future mode	0 = not supported, 1 = supported	
21	Reserved for VDL future mode	0 = not supported, 1 = supported	
22	Reserved for VDL future mode	0 = not supported, 1 = supported	
23	Reserved for VDL future mode	0 = not supported, 1 = supported	
24	VDL Mode 2 Supplement 4 SQP	0 = not supported, 1 = supported	
25-29	Pad	Set to zero	
30-31	SSM		
32	Parity (odd)		

c-4
c-3
c-4
c-3
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c-4
c-3

Note: If bits 17-23 are all zero then the VDR may or may not support Mode A using BOP Version 1 because this feature was introduced after the initial implementation of Mode A.

c-3

ATTACHMENT 8
VDR TABLES AND FIGURES

Table A8-8 - VDR Status Word

	Bit	Function	Comments
	1-8	Label 270 (octal)	
	9-10	SDI	
c-1	11	Download Request Bit	1 = Reset state 0 = Initialized
c-2	12	Spare	
c-1	13	Transmission Time-out warning bit	Set to "1" if less than 5 seconds until time-out (or timed out) Set to "0" at all other times.
	14	Protocol Status bit	1 = Protocol active 0 = Protocol inactive
	15-16	Primary CMU	16 15 Description 0 0 Single CMU 0 1 Left CMU 1 0 Right CMU 1 1 Undefined (bits 15 & 16 map to bits 9 & 10 in the CMU's Label 270 word)
	17	Voice/Data Status bit	Voice = 1
	18	VDR Status bit	Fault = 1
	19	750/716 Mode	0 = 716 Mode 1 = 750 Mode
	20	PAD	Set to zero
c-4	21-24	VDR State (Table A8-17 and Figure A8-1)	24 23 22 21 Description 0 0 0 1 State S1 (1_h) 0 0 1 0 State S2 (2_h) 0 0 1 1 State S3 (3_h) 0 1 0 0 State S4 (4_h) 0 1 0 1 State S5 (5_h) 0 1 1 0 State S6 (6_h) 0 1 1 1 State S7 (7_h)
c-3	25-27	Active CMU/VDR Interface Protocol	27 26 25 Description 0 0 0 Init State, Mode A or 716 mode (aka Mode 0) 0 0 1 Mode A 0 1 0 Mode 2 0 1 1 Reserved for VDL future mode 1 0 0 Reserved for VDL future mode 1 0 1 mode indicated by bit 22 of VDR Label 172 1 1 0 mode indicated by bit 23 of VDR Label 172 1 1 1 mode indicated by bit 24 of VDR Label 172
	28-29	PAD	Set to zero
	30-31	SSM	
	32	Parity (odd)	

c-1

Table A8-9 - VDR Equipment ID Word

Bit	Function	Comments
1-8	Label 377 (octal)	
9-10	SDI	
c-1 11-22	Equipment Class	016_h
23-29	PAD	zero
c-1 30-31	SSM Code	Normal (00_h)
32	Parity (odd)	

ATTACHMENT 8
VDR TABLES AND FIGURES

Table A8-10 - System Address Label Field

SDI Strapping	SAL (octal)	Bit 16	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	
Left	251	1	0	0	1	0	1	0	1	c-1
Right	252	0	1	0	1	0	1	0	1	
Center	253	1	1	0	1	0	1	0	1	

Table A8-11 - Sign Status Matrix Setting

SSM Setting	Bit 31	Bit 30
Normal	0	0
NCD	0	1
Functional Test	1	0
Failure Warning	1	1

Table A8-12 - SDI Field

Installation Position	Bit 10	Bit 9
N/A	0	0
Left	0	1
Right	1	0
Center	1	1

Table A8-13 - Protocol ID, EGFI and EID codes

Protocol	Protocol ID code	EGFI code	EID code	
ASIP	$F1_h$	$F1_h$	1_h	c-1
ACARSIP	$F2_h$	$F2_h$	2_h	c-3
ERROR	FF_h	n/a	n/a	c-1

Note: The error Protocol ID code is returned in a PR_SET.confirm message when the VDR does not support a protocol requested by the CMU in a PR_SET.request message.

ATTACHMENT 8
VDR TABLES AND FIGURES

Table A8-14 - [C]MU/VDR Command and Control Primitives

	Command and Control Message	Primitive	Sender	Type	PID
	Error indication	ERROR.indication	either	SOLO	00_h
	Protocol set request	PR_SET.request	[C]MU	SOLO	01_h
	Protocol set confirm	PR_SET.confirm	VDR	SOLO	01_h
c-1	Protocol query request	PR_QUERY.request	[C]MU	SOLO	02_h
	Protocol query confirm	PR_QUERY.confirm	VDR	File	02_h
	BITE request	VDR_BITE.request	[C]MU	SOLO	03_h
	BITE confirm	VDR_BITE.confirm	VDR	File	03_h
c-2	Mode set request	MODE_SET.request	[C]MU	SOLO	05_h
	Mode set confirm	MODE_SET.confirm	VDR	SOLO	05_h
c-4	X-off request	XOFF request	VDR	SOLO	06_h
	X-on request	XON request	VDR	SOLO	07_h

Table A8-15 - Maintenance System Identification

c-3

MP11C	MP14A	CFDS Type
Ground	Ground	Airbus CFDS
Ground	Open	Boeing CFDS
Open	Ground	McDonnell-Douglas CFDS
Open	Open	Undefined

c-4 Note: MP11C and MP14A should exclusively be used for the purpose of selecting CFDS functionality.

ATTACHMENT 8
VDR TABLES AND FIGURES

Table A8-16 - Variables of High Speed Bit-Oriented Protocol - Version 1

TIME	DESCRIPTION	MIN VALUE	MAX VALUE	TIMER OR DESIGN GOAL FOR SOURCE OR SINK
T_1	CTS/NCTS Send Time	0 ms	55 ms	Goal for Sink
T_2	RTS Repeat Time After Receipt of NCTS	100 ms	140 ms	Timer for Source
T_3	Busy Send Time	0 ms	100 ms	Goal for Sink
T_4	RTS Repeat Time After Receipt of Busy	1.0 sec	1.2 sec	Timer for Source
T_5	RTS Repeat Time If No Response	150 ms	200 ms	Timer for Source
T_6	Time of Random Timer to Resolve RTS Conflicts	50 ms	500 ms	Goal for Source
T_7	Increment of Time T_6	10 ms	100 ms	Goal for Source
T_8	ACK/NAK/SYN Send Time	0 ms	55 ms	Goal for Sink
T_9	LDU Time-out Following CTS	400 ms	440 ms	Timer for Sink
T_{10}	ACK/NAK Time-out After CTS	600 ms	660 ms	Timer for Source
T_{11}	Loop Back Send Time	0 ms	100 ms	Goal for Sink
T_{12}	ALO Repeat Time if No Response to ALO	200 ms	250 ms	Timer for Source
T_{13}	SOT Send Time After Receipt of CTS	0 ms	55 ms	Goal for Source
T_{14}	Incomplete File Time-out	10 sec	11 sec	Timer for Sink
T_{15}	ALR Send Time	0 ms	180 ms	Goal for Sink
T_{16}	ACK/NAK Time-out After EOT	220 ms	330 ms	Timer for Source

c-2

ATTACHMENT 8
VDR TABLES AND FIGURES

Table A8-17 - VDR State Transition Table

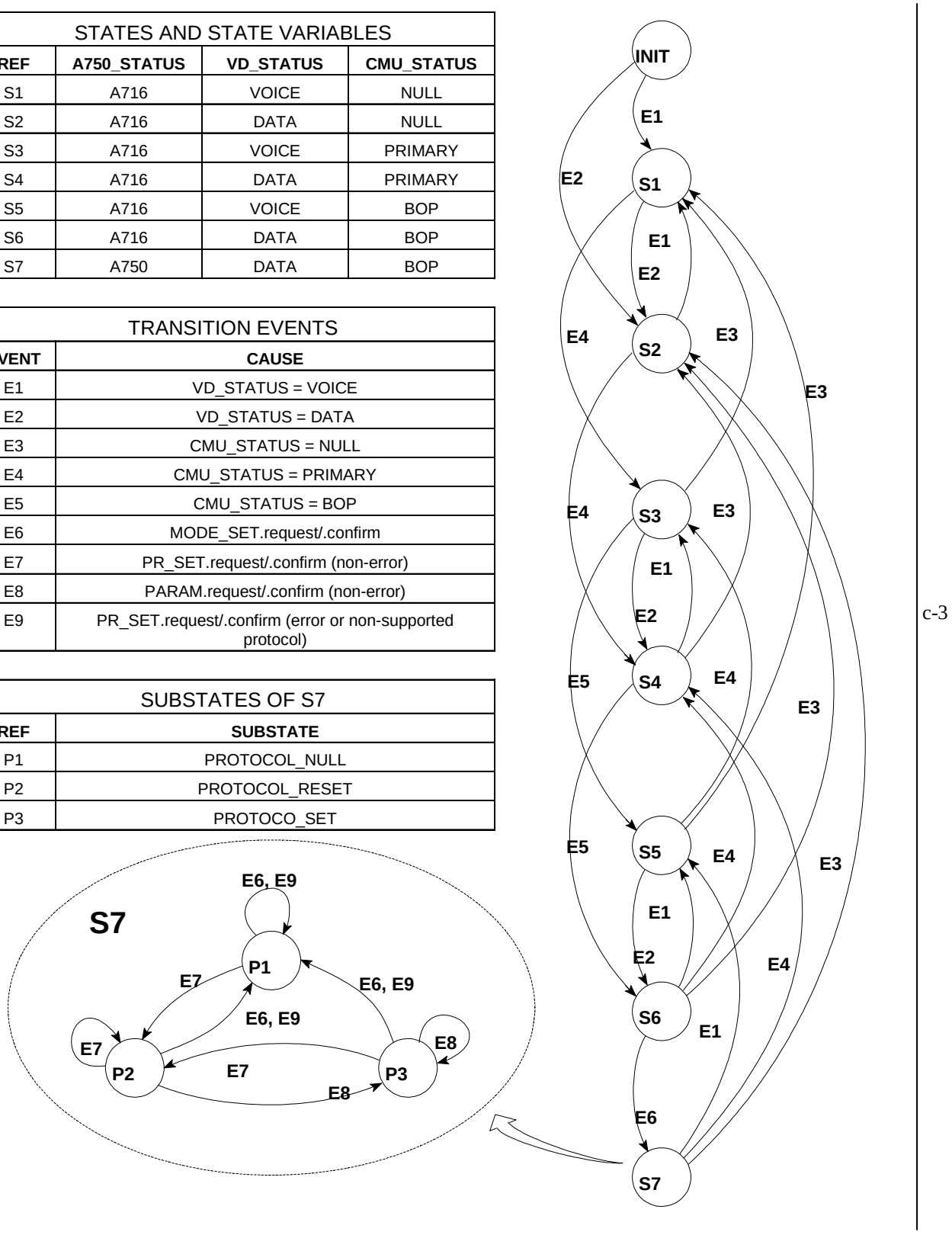
ENTRY STATE		INPUT → NEW STATE						
		CMU_STATUS			A750_STATUS		VD_STATUS	
	State variable contents	NULL	PRI	BOP	A716	A750	VOICE	DATA
S1	CMU_STATUS = NULL A750_STATUS = A716 VD_STATUS = VOICE		S3					S2
S2	CMU_STATUS = NULL A750_STATUS = A716 VD_STATUS = DATA		S4				S1	
S3	CMU_STATUS = PRIMARY A750_STATUS = A716 VD_STATUS = VOICE	S1		S5				S4
S4	CMU_STATUS = PRIMARY A750_STATUS = A716 VD_STATUS = DATA	S2		S6			S3	
S5	CMU_STATUS = BOP A750_STATUS = A716 VD_STATUS = VOICE	S1	S3					S6
S6	CMU_STATUS = BOP A750_STATUS = A716 VD_STATUS = DATA	S2	S4			S7	S5	
S7	CMU_STATUS = BOP A750_STATUS = A750 VD_STATUS = DATA	S2	S4				S5	

ATTACHMENT 8
VDR TABLES AND FIGURES

STATES AND STATE VARIABLES			
REF	**A750_STATUS**	**VD_STATUS**	**CMU_STATUS**
S1	A716	VOICE	NULL
S2	A716	DATA	NULL
S3	A716	VOICE	PRIMARY
S4	A716	DATA	PRIMARY
S5	A716	VOICE	BOP
S6	A716	DATA	BOP
S7	A750	DATA	BOP

TRANSITION EVENTS	
EVENT	**CAUSE**
E1	VD_STATUS = VOICE
E2	VD_STATUS = DATA
E3	CMU_STATUS = NULL
E4	CMU_STATUS = PRIMARY
E5	CMU_STATUS = BOP
E6	MODE_SET.request/.confirm
E7	PR_SET.request/.confirm (non-error)
E8	PARAM.request/.confirm (non-error)
E9	PR_SET.request/.confirm (error or non-supported protocol)

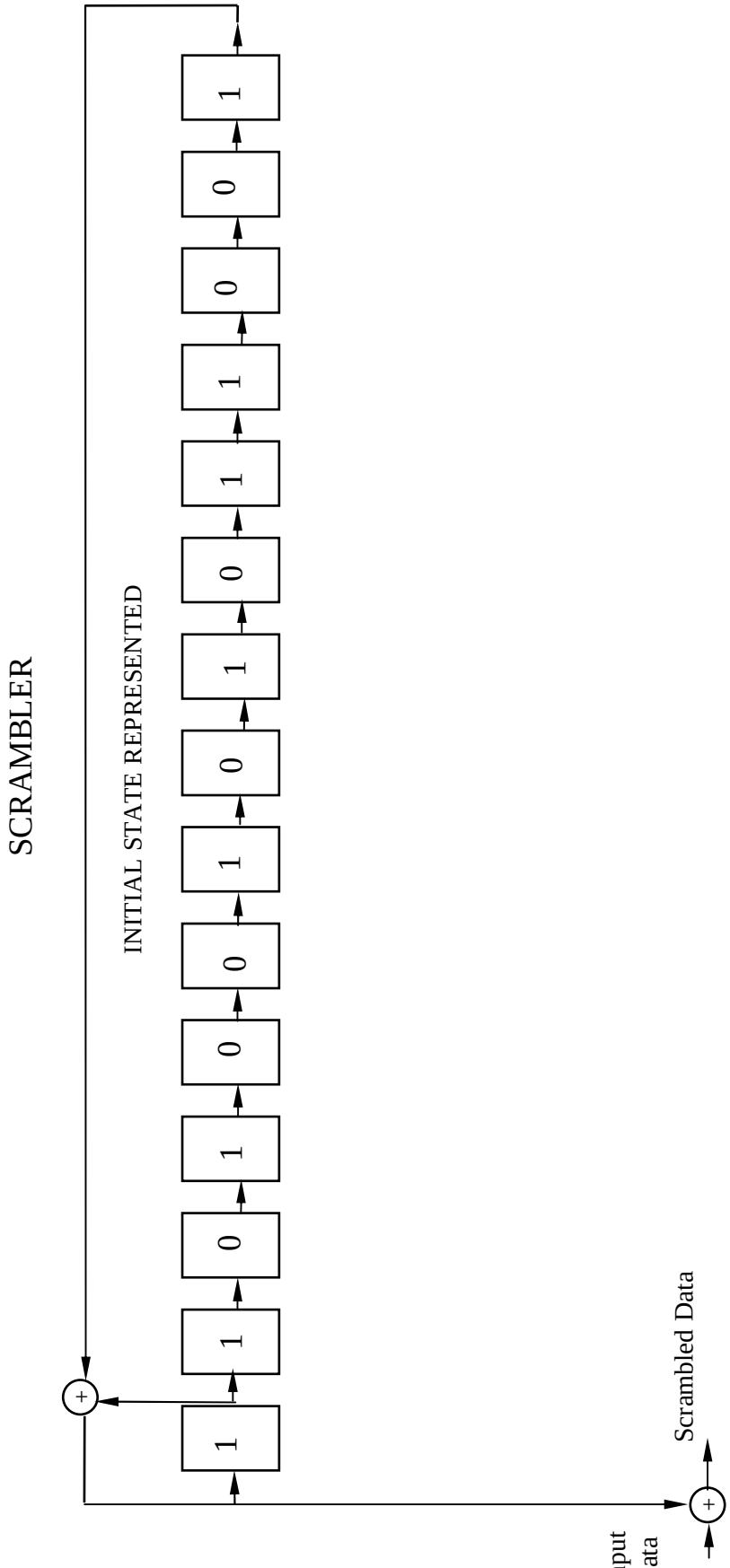
SUBSTATES OF S7	
REF	**SUBSTATE**
P1	PROTOCOL_NULL
P2	PROTOCOL_RESET
P3	PROTOCO_SET



c-3

Figure A8-1 - VDR Mode and Protocol Determination States

ATTACHMENT 9
SCRAMBLER FUNCTIONAL BLOCK



ATTACHMENT 10
AVLC SIMPLE INTERFACE PROTOCOL (ASIP)

c-3

A10.1 Purpose

This attachment to ARINC Characteristic 750 defines the Aviation VHF Link Control (AVLC) Simple Interface Protocol (ASIP). The ASIP is a collection of messages, methods and procedures that may be implemented in both a VHF Data Radio (VDR) and a Communications Management Unit or Management Unit (CMU) to enable the pair to function as an entity in a VDL Mode 2 network.

c-3
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c-3

A10.2 Overview

The defining document that describes the functions, methods and procedures to be implemented by an airborne entity performing VHF Digital Link (VDL) operations is the Standards and Recommended Practices (SARPs) developed by the Aeronautical Mobile Communications Panel (AMCP), "Aeronautical Telecommunications, Annex 10, Volume III – Communications." The protocols and procedures defined in this attachment are an implementation of Section 6.5 of the SARPs, "LINK LAYER PROTOCOLS AND SERVICES", which pertains to packet mode operations.

c-1
c-3

The CMU and the VDR operate together to implement the functionality defined by Section 6.5 of the SARPs. A functional partitioning can be imposed between the VDR and the CMU to implement the SARPs definition. The ASIP defines a split in link layer functionality between the VDR and the CMU subsystems as well as the protocols and procedures necessary to support it.

The VDL link layer can be considered to be divided into three sublayers:

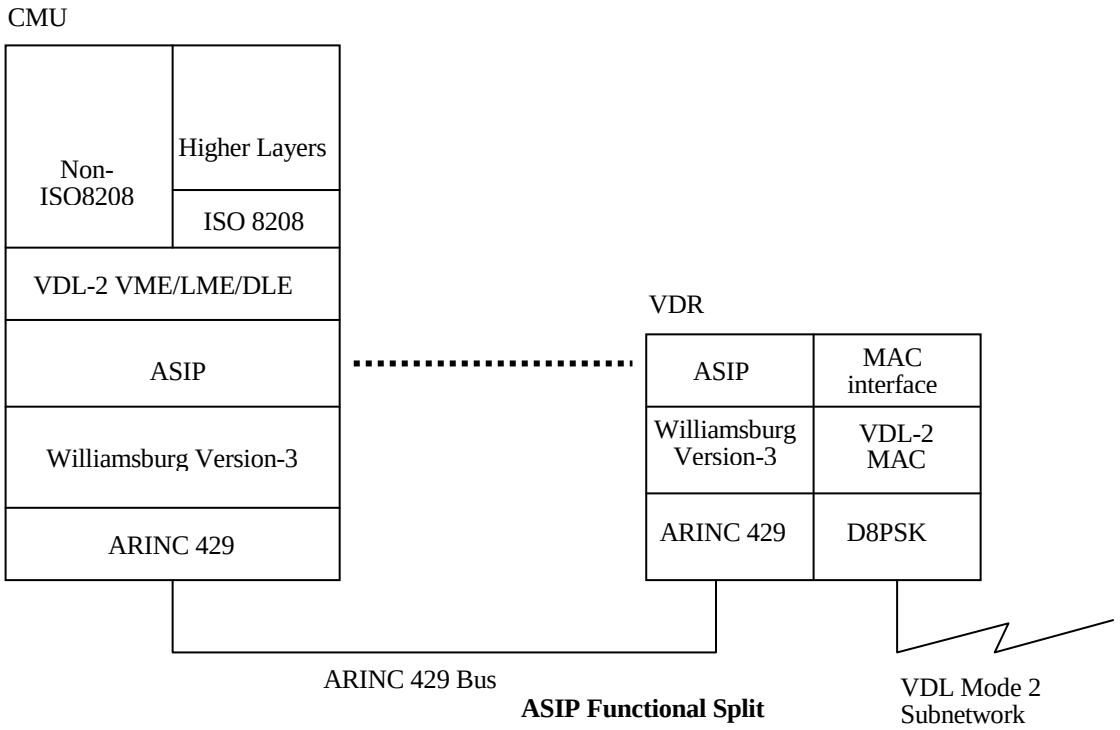
a. A Media Access Control (MAC) sublayer, which uses the Carrier Sense Multiple Access (CSMA) algorithm. This sublayer resides in the VDR.

b. A Data Link Service (DLS) sublayer, which acts as a connection-oriented point-to-point or a connectionless broadcast link over the MAC sublayer. This sublayer resides in both the CMU and VDR.

c. A Link Management Entity (LME) sublayer, which establishes and maintains connections between airborne and ground stations. This sublayer resides in the CMU.

c-1

The functional partitioning defined by the ASIP is partially shown in the following diagram.



ASIP Functional Split

c-3

Note: VDL Mode 2 AVLC protocol includes VME, LME, DLE, and MAC.

ATTACHMENT 10
AVLC SIMPLE INTERFACE PROTOCOL (ASIP)

A10.3 ASIP Protocols and Procedures

c-1

A10.3.1 Overview

c-3 The ASIP CMU/VDR Interface Protocol comprises Extended BOP files and Extended SOLO words as defined in Section 5.1.3.1 and 5.1.3.2, respectively. As defined in Section 5.1.2.3, file primitives are of types COMMAND or DATA.

c-1 A received RF transmission may contain multiple frames. For each frame in the transmission, the VDR removes both flags and bit stuffing information as well as calculates the FCS. If the FCS is good and the frame meets the address screening requirements of Section A10.4.13, then the VDR sends the frame to the CMU using a single primitive. The frame is stripped of any flags, bit stuffing information, and the FCS.

c-4 One of the address-screening criterion is that the frame's destination address should match one of three addresses except for the A/G Bit. Each address will conform to the Destination Address Field of the Generic Frame Format shown in Table A10-
c-3 3. This set of addresses, referred to herein as the Destination Address Set (DAS), is loaded by the CMU using a command primitive. The VDR, prior to its initialization procedure, should contain a null DAS. Consequently, no frames should be passed from the VDR to the CMU until the DAS contains a valid destination address.

c-1 The VDR sends a Signal Quality Parameter (SQP) indication message (SQP.indication) to the CMU for every received transmission from the ground that contains a valid FCS. The SQP indication is used by the LME function, which resides in the CMU. The SQP reporting function is disabled prior to the VDR's initialization and is enabled when the CMU sends operational parameter data to the VDR. The SQP message contains the address of the transmitting station and a parameters corresponding to the signal quality of that transmission.

The VDR periodically sends a Channel Utilization (CU) indication message (CU.indication) to the CMU. This message contains a parameter that indicates the percentage of time that the channel is occupied either by the VDR or by other stations.

c-3 A frame to be sent by the CMU is passed to the VDR devoid of any flag, bit stuffing, or FCS information. The VDR adds this information to the frame prior to transmission. In addition to the frame data, the message from the CMU will contain the sequence number for that frame. After the frame has been removed from the VDR's transmit buffer, the VDR will send a confirmation message to the CMU. This confirmation message will contain an indication of whether the frame was transmitted, the sequence number and the MAC delay for that frame.

The VDR maintains a timer (TM2 timer) whose expiration will indicate that the channel is occupied. When the TM2 timer expires the VDR will send a Channel Congested indication message (CHAN_CONG.indication) to the CMU. Upon expiration of the TM2 timer, the VDR will purge any untransmitted frames.

c-4 If the VDR receives a PARAM.request message, then it will delete all untransmitted frames and send a confirmation message to the CMU for each deleted frame.

c-3 The CMU is provided a primitive with which it may command the VDR to purge all untransmitted frames. For each purged frame, the VDR will send a confirmation message to the CMU.

c-1

A10.3.2 ARINC 429 Interface Definition

c-3 The ASIP should be implemented using only the ARINC 429 Williamsburg Version 3 bit oriented protocol. Williamsburg Version 3 Command Frames should be used for all file transfers.

A10.3.3 BOP File Transfer GFI Code

c-1 The GFI code (contained in the FDU's Start of File (SOF) word) associated with all BOP data files should be set to "F_h", indicating an extended GFI.

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AVLC SIMPLE INTERFACE PROTOCOL (ASIP)

A10.3.4 BOP File Transfer Command Type Code c-1

The Command Type Code (contained in bits 23 - 24) of the Command Frame SOF word, should be set according to the following values: c-3

Command primitives	0_h
Data transfer primitives	1_h

Only the UNITDATA.request and UNITDATA.indication primitives are currently defined to have a Command type code of 1_h. All remaining primitives are command primitives and as such have a Command type code of 0_h.

A10.3.5 General File Format

c-1

The format of all BOP file transfers conforms to a common format for data transfer and is shown in ARINC Characteristic 750, Section 5.1.3.1, BOP File Transfer Extended GFI Code.

A10.4 Procedures

A10.4.1 Initialization

ARINC Characteristic 750, Section 5.0, defines the CMU to VDR interface as providing support for multiple interface protocols. It defines the initialization procedure to be performed in order to bring the interface to a functional state upon reset or power up. As part of initialization, the VDR determines the status of any CMU on the ARINC 429 bus and negotiates the Williamsburg version to be used. As defined in the procedures of Section 3.3 and per Table A8-17 , the VDR determines the correct operating mode. The procedures in Section 5.2 define 750 Data mode initialization. c-3

A10.4.2 VDR Periodic Reporting

The VDR periodically sends broadcast words to the CMU to convey status information as defined in ARINC Characteristic 750, Section 5.5.

A10.4.3 CMU Periodic Reporting

c-1

The CMU periodically sends broadcast words to the VDR to convey status information as defined in ARINC Characteristic 750, Section 5.5.

A10.4.4 VDR Error Message

If the VDR experiences a protocol error during its operation with the CMU, it should send a VDR_ERROR.indication message. This message may be used to indicate that the VDR has received a message out of sequence, that the message is unrecognized, or that the message format is in error.

c-3

A10.4.5 CMU Error Message

If the CMU experiences a protocol error during its operation with the VDR, it should send a CMU_ERROR.indication message. This message may be used to indicate that the CMU has received a message out of sequence, that the message is unrecognized, or that the message format is in error. c-4 c-3

A10.4.6 VDR Operating Parameter Data

c-1

If the VDR receives a PARAM.request message from the active CMU, it transmits a PARAM.confirm to the CMU within 1 second of the reception. The PARAM.request message is used to set all operating parameters for the VDR, including operating frequency, mode, persistence, M1, TM1, and TM2. The VDR, upon sending a PARAM.confirm message, transitions to the PROTOCOL_SET protocol substate. c-3 c-4 c-1

ATTACHMENT 10
AVLC SIMPLE INTERFACE PROTOCOL (ASIP)

A10.4.6 VDR Operating Parameter Data (cont'd)

COMMENTARY

c-1

The only primitive available to the CMU to query the VDR for a list of its operational parameters is the PARAM.request primitive. Since the VDR responds with a PARAM.confirm to every instance of a PARAM.request, the content of the PARAM.confirm message can be used by the CMU to indicate error conditions or unsupported parameters in the VDR.

c-3

In the event that the VDR cannot set the operating parameters to the values requested by the CMU in a PARAM.request message, it should not declare an error event. Instead, the VDR should continue to function normally using the values it reported in the PARAM.confirm message it sent to the CMU. The CMU should make a determination if the mismatch in the contents of the PARAM.request and the PARAM.confirm messages is sufficient to warrant either a VDR reset or a failure declaration.

c-1 A10.4.7 Signal Quality Parameter Reporting

c-3 The VDR should send an SQP.indication message to the CMU for every transmission from a ground station it receives. This
c-4 message should be sent within 1 second of receipt; however, it should only be sent if any frame in the transmission is
c-1 received with a valid FCS. SQP reporting is enabled only while the VDR is in the PROTOCOL_SET substate.

The SQP.indication message should contain the second SQP value only if the CMU and VDR are supporting the new SQP scale. The VDR indicates in its Label 172 (bit 24) if the new SQP scale is supported. The CMU indicates in its Label 172 (bit 18) if the new SQP scale is supported.

c-4

The SQP values should be determined from the RF signal strength using the following two formulas. The first formula is the original and the second formula was added by supplement 4. The VDR should calculate both values.

Original SQP formula:

if (PdBm ≤ -98), then SQP = 0.

c-3 if (-98 < PdBm < -27), then SQP = INT(((100+PdBm)/5) + 0.5)

if (P ≥ -27) then SQP = 15

The supplement 4 SQP value should be determined from the RF signal strength using the following formula:

if (PdBm < -98) then SQP = 0.

c-4

if (-98 = ≤ PdBm = ≤ -68) then SQP is determined by the table below

if (PdBm > -68) then SQP = 15

ATTACHMENT 10
AVLC SIMPLE INTERFACE PROTOCOL (ASIP)

SQP Value	Power Range (dBm)	Comments
0	< -98	uplinks received at sensitivity threshold or below
1	-98 ≤ PdBm < -97	
2	-97 ≤ PdBm < -96	
3	-96 ≤ PdBm < -95	
4	-95 ≤ PdBm < -94	
5	-94 ≤ PdBm < -93	
6	-93 ≤ PdBm < -92	
7	-92 ≤ PdBm < -90	
8	-90 ≤ PdBm < -88	
9	-88 ≤ PdBm < -86	
10	-86 ≤ PdBm < -84	
11	-84 ≤ PdBm < -82	
12	-82 ≤ PdBm < -80	
13	-80 ≤ PdBm < -74	
14	-74 ≤ PdBm ≤ -68	
15	> -68	uplinks received from ground stations within 6 to 20 nmiles

COMMENTARY

c-4

Note that when an aircraft is flying at a constant altitude, the signal-strength vs range is not proportional to distance squared. Only when the aircraft is climbing away from a ground station or descending towards a ground station at a constant elevation angle can we assume that the range from the ground station doubles or halves for every 6 dB change in signal strength.

The above table breaks the signals close to the sensitivity threshold of the radio (-92 to -98 dBm) into 1 dB bins corresponding to 12 to 25 nautical mile bins if the aircraft is climbing or descending. Note that it is possible to receive short messages error-free at signal levels around or below the sensitivity threshold. So SQP values of 0-3 indicate marginal signals and SQP values of 12-15 (-80 dBm or greater, ranges of less than 25-50 nmiles) indicate practically error free transmission of messages of maximum length. SQPs between 3 and 11 indicate usable signals with the higher the number, the more reliable the link.

The accuracy of the SQP readings, regardless of scale used, should be ± 7 dB. Note that the absolute accuracy depends on the temperature at which the receiver is operating and it varies from unit to unit. Readings taken at steady-state temperature and on the same unit should exhibit a monotonic increase in SQP as the received signal strength increases.

The SQP.indication message should contain both SQP values, the four octets that consist of the Source Address Field of the Generic Frame Format (Table A10-3), and the VHF frequency in use at the time that the uplink was received.

A10.4.8 Address Request

c-1

In order to receive any incoming frames, the CMU should send an ADDR.request message to the VDR containing up to three addresses setting the contents of the DAS. An address will consist of the four octets designated as the Destination Address Field of the Generic Frame Format in Table A10-3.

c-3

The ADDR.request message is sent by the CMU to the VDR to set the content of the DAS or to request a report contain the content of the DAS.

c-1

The VDR's DAS should be able to contain three addresses. Since any address sent via this message will replace the DAS's content in its entirety, the CMU can set the DAS to NULL by sending a NULL address list with the control octet value of 01_h (set).

ATTACHMENT 10
AVLC SIMPLE INTERFACE PROTOCOL (ASIP)

A10.4.8 Address Request (cont'd)

c-1 c-4 The CMU can request a copy of the existing DAS by sending an ADDR.request message with a control octet value of 00_h. The DAS's content in the VDR is not modified by an ADDR.request message with a control octet value of 00_h. The VDR responds with an ADDR.confirm message containing all of the currently loaded addresses.

The three addresses loaded by the CMU into the VDR will typically be set such that a frame will be sent to the CMU if its Destination Address Field matches one of the following:

c-3
a. the aircraft's ICAO assigned 24-bit address with an associated 3-bit type field indicating "Aircraft,"
b. the "all ones"address with an associated 3-bit type field indicating "Aircraft,"
c. the "all ones" address with an associated 3-bit type field indicating "All stations broadcast."

Address type field encoding is shown in Table A10-4.

c-1 A10.4.9 Address Response

c-3 The VDR should send the CMU an ADDR.confirm message containing a list of all currently loaded addresses. The VDR sends this message in response to any ADDR.request message from the CMU.

c-1 A10.4.10 Channel Utilization Parameter

c-3 The VDR should send the CMU an indication of the percentage of the time that the channel is busy. The CU parameter should be sent to the CMU in a CU.indication message at 1-second intervals.

c-1 c-4 CU is calculated in the VDR by determining the percentage of time that the channel is occupied during a 1 second reporting interval. The VDR should sample the channel at 1 millisecond intervals or more often. CU can range in value from 0 to 100, with 100 corresponding to a channel that is 100 percent occupied. The channel is considered occupied if either the VDR is transmitting or the VDL Mode 2 receiver Channel Sense Function (see Section 4.3.6) indicates that the channel is busy at the time the sample is taken.

COMMENTARY

CU is used by the frame layer for calculating frame lifetimes. An algorithm for calculating CU has not been simulated or tested as of this version. As such, it is not known at this time what the effects of the dynamics of a time-varying CU have on the network performance. It is hoped that by having the VDR frequently report the CU data that any future changes can be accommodated within the CMU and not require a VDR modification.

c-1 A10.4.11 Downlink Message Handling

To send a message to the ground, the CMU will send the VDR a UNITDATA.request message. The content of the data portion of this message is dependent on the type of frame to be sent, (INFO, RR, SREJ, etc.), and will contain all information necessary to compose one frame consistent with its type except the flag, bit stuffing, and FCS information. Prior to each frame's transmission, the VDR will calculate the FCS, append the FCS information, and perform both bit stuffing and flag delineation.

Under normal circumstances, the maximum time from receipt of the UNITDATA.request to the start of the frame's rf transmission will vary depending on channel occupancy and p-persistence value; nevertheless, for the special condition of a clear channel and P = 1, the VDR should start the frame's transmission with Tdown milliseconds.

c-4 Tdown = 65 +35*ceil (message_length_in_bytes/255) ms, where ceil(x) rounds to the nearest integer greater than or equal to x, and where message_length_in_bytes is measured after the message header.

Tdown is measured from the end of the last bit of the UNITDATA.request ARINC 429 transmission to the start of the downlink transmission.

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The UNITDATA.request message also contains a sequence number used to explicitly correlate UNITDATA.request messages and UNITDATA.confirm messages. It is the responsibility of the CMU to correctly assign sequence numbers. The CMU should manage the sequence number assignment to ensure that each frame in the VDR transmit buffer has a unique value. It is recommended (but not required) that the sequence number assignment monotonically increase without gaps then wrap around to 1.

COMMENTARY

c-1

The VDR may check the sequence numbers for uniqueness and report duplicates using the VDR_ERROR.indication primitive.

A10.4.12 Uplink Message Handling

If a valid received frame meets the address screening requirements of Section A10.4.13, then the VDR should send the CMU a UNITDATA.indication message within Tup milliseconds.

Tup = 65 + 35* ceil (message_length_in_bytes/255) ms, where ceil(x) rounds to the nearest integer greater than or equal to x, and where message_length_in_bytes is measured after the message header. The Tup time applies only to an rf message that contains one frame. Tup is measured from the end of the last symbol of the received rf message at the receiver input, to the start of the first bit of the UNITDATA.indication transmission to the CMU. c-4

The content of the data portion of this message is dependent on the type of frame received (INFO, RR, SREJ, etc.). The UNITDATA.indication message should contain all the information necessary to compose the frame consistent with its type except the flag, bit stuffing, and FCS information, as the VDR strips these from the frame prior to sending the UNITDATA.indication to the CMU. c-1

A10.4.13 Address Screening

A received frame should contain source and destination address fields. Before a received frame can be sent to the CMU, its destination address field should match one of the three addresses stored in the "DAS except the A/G bit." c-4

Table A10-3 shows a generic frame format. Table A10-4 shows the Address Type Field encoding.

A10.4.14 Error Handling and Recovery

The CMU, through examination of the PARAM.confirm message or by other indications, may determine that the VDR is in an unknown state.

The CMU can return the VDR to a known ARINC 750 Data mode state (PROTOCOL NULL substate of state S7) when the VDR is in state S6 or S7 by sending a MODE_SET.request message (Section 5.3.2.5). When the MODE_SET.request message is received and the VDR state is S6 or S7, then the VDR should transition to the PROTOCOL_NULL substate. When the MODE_SET.request message is received and the VDR state is not S6 or S7 then the VDR should ignore it. See Section 5.3.2.5. c-1

The CMU can return the VDR to a known ARINC 750 Data mode state (PROTOCOL RESET substate of state S7) when the VDR is in state S7 by sending a PR_SET.request message (Section 5.3.2.1). The VDR should transition to the PROTOCOL_RESET substate when the PR_SET.request message containing a supported protocol is received and the VDR state is S7. The VDR should transition to the PROTOCOL_NULL substate when the PR_SET.request message containing an unsupported protocol is received and the VDR state is S7. See Section 5.3.2.1 and Figure A8-1. c-3

The MODE_SET.request and PR_SET.request messages are sent using the command and control mechanism defined in Section 5.0. c-1

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A10.4.14 Error Handling and Recovery (cont'd)

c-1 Either the VDR or the CMU can send a VDR_ERROR.indication or CMU_ERROR.indication message, respectively as the result of various protocol specific error conditions that may occur. The content of the error message provides an error code as well as an octet for an error data field. If the error occurred as the result of processing a received primitive, (due to bad data length, for example) the error data field should contain the PID of the offending primitive (as currently defined).

A10.4.15 VDR Buffer Management and Flow Control

For each air-to-ground virtual connection the number of un-acknowledged transmitted frames is limited to the window size for that link. If the CMU were to send this number of frames to the VDR for transmission and if the RF channel were busy, the VDR would have to buffer these frames until they could be transmitted. If the CMU had more than one air-to-ground virtual connection active and if the channel were busy, then the VDR would have to buffer a window size number of frames for each virtual connection. It is recognized that a VDR implementation may not provide sufficient buffer capability to accommodate this number of untransmitted frames.

To manage this possibility the VDR is provided the flow control primitives, XON.request/ XOFF.request defined in Section 5.3.3 herein, with which it may request flow control of FDUs sent by the CMU. The VDR will send an XOFF.request message to the CMU to request that the CMU send no FDUs of the type specified in the Type Field of the XOFF.request message.

Due to the possibility of delay in the reception and subsequent processing of the XOFF.request message by the CMU, after the VDR has sent an XOFF.request message to the CMU, the VDR should be able to receive and process at least one additional FDU of the type specified in the Type Field in the XOFF.request message.

If the VDR cannot process an FDU received from the CMU, then the VDR should send the CMU a VDR_ERROR.indication with the error code set to buffer overflow. See Table A10.2.

c-3

COMMENTARY

No specific flow control mechanism is defined for transfers from VDR to CMU. It is assumed that the CMU provides sufficient capabilities to absorb the uplink traffic. It should be noted that a ground station may send several frames to the same aircraft within one uplink transmission. The VDR will have to wait for complete reception of the uplink string of bits in order to properly decode it. The multiple associated Unitadata indication and SQP indication FDUs will thus have to be sent in burst to the CMU, as described in Figure A10-11. The VDR should provide sufficient buffering capabilities to properly transfer these frames to the CMU while receiving a new uplink from the ground. Implementors should note that ARINC Specification 631 allows up to 7 frames to be transmitted per VDL link within one single CSMA access to the same aircraft.

A10.4.16 VDR Transmit Buffer Purging

If the VDR's transmit buffer contains untransmitted frames and the VDR receives a PURGE.request or PARAM.request message, then the VDR will clear the transmit buffer of all untransmitted frames. For each untransmitted frame the VDR will send a UNITDATA.confirm whose Transmit Status field will be set to 01_h indicating that the frame was discarded (Section A10.5.12).

A10.4.17 Vendor Reserved Primitives

A set of sixteen primitives are reserved and may be assigned by a manufacturer for purposes outside the scope of this
c-4 definition**.** Some of the primitives have been set aside per vendor requests for specific functions unique to those vendors. These reserved primitive ID values should only be used by the vendor that they are assigned to, see Section A10.5.15. These
c-3 purposes may include, but are not limited to debugging and special test modes. These Extended BOP file primitives of undefined type (COMMAND or DATA), include the ID codes $F0_h$ through FF_h.

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COMMENTARY

Vendors should be aware of the possible adverse effect of unlimited transmission of vendor reserved primitives on CMU/VDR system performance. Some system integrators/airframe manufacturers may require that the transmission of vendor reserved primitives be disabled. c-4

A10.5 Primitives

The following primitives are defined:

Parameter Name	Subsection
UNITDATA.request	A10.5.2
UNITDATA.indication	A10.5.7
UNITDATA.confirm	A10.5.12
PARAM.request	A10.5.1
PARAM.confirm	A10.5.6
VDR_ERROR.indication	A10.5.9
CMU_ERROR.indication	A10.5.4
CU.indication	A10.5.11
SQP.indication	A10.5.10
ADDR.request	A10.5.3
ADDR.confirm	A10.5.8
CHAN CONG.indication	A10.5.13
PURGE.request	A10.5.14

c-3

The primitives that are transferred between VDR and CMU are used for all command and data transfer. Primitives are of three generic types:

REQUEST — The REQUEST primitive is passed between the VDR and CMU when a response may be required. Primitives of this type have the form XXX.request.

CONFIRM — The CONFIRM primitive is passed between the VDR and CMU in response to a previous REQUEST primitive. Primitives of this type have the form XXX.confirm. c-1

INDICATION — The INDICATION primitive is passed between the VDR and the CMU to convey unsolicited information such as user data or error messages. Primitives of this type have the form XXX.indication.

The general format of all messages exchanged using the Extended BOP file transfer between the CMU and VDR is as defined in Section 5.1.3.1. For primitives composed of Extended SOLO words, the format is as defined in Section 5.1.3.2.

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A10.5.1 Message PARAM.request

The CMU sends the PARAM.request message to set all operating parameters, except addresses, for the VDR, including operating frequency and modulation mode.

Message Format

c-1 The message consists of one Extended BOP file of type COMMAND containing the following:

	Octet	Parameters	Value or Range
	1	EGFI	$F1_h$
	2	Primitive ID	20_h
	3	Data field length MSB	00_h
c-3	4	Data field length LSB	07_h
	5	Frequency MSB	(tens, ones of freq. in MHz) 18 to 36 (12_h to 24_h) for 118 through 136 MHz.
c-1	6	Frequency LSB	(tenths, hundredths of freq. in MHz, ignore 1000ths) 00 to 97 (00_h to 61_h) for xxx.000 through xxx.975 MHz. Example: freq = 121.775 MSB = 21 = 15_h LSB = 77 = $4D_h$ (ignore thousandths place)
c-4	7	TM1 value	0.5 to 125 ms (01_h to FA_h), 0.5 ms step size.
c-3	8	TM2 value	6 to 120 sec (06_h to 78_h), 1 sec stepsize.
	9	M1 MSB	00_h to FF_h. Valid value for M1 is 1 through 65535.
c-4	10	M1 LSB	01_h to FF_h
c-3	11	p-Persistence value	1/256 to 1 (00_h to FF_h), 1/256 step size.

Normal response

c-1 The VDR responds to this message with a PARAM.confirm message containing the VDR's active values for all the above parameters. If as a result of this command, the VDR purges frames from its transmit buffer, then the VDR sends a c-4 UNITDATA.confirm message for each frame as a response to an outstanding unacknowledged UNITDATA.request command previously received from the CMU.

Error response

In the event that the VDR detects an error in the data contained in the message, it sends a VDR_ERROR.indication message. An unsupported parameter value is not an error and should trigger a PARAM.confirm message, not a VDR_ERROR.indication message.

Reasons for failure

c-1 BADDATA - data length invalid or otherwise in error.

State

This message is processed in the PROTOCOL_RESET and PROTOCOL_SET substates of state S7.

New State

The resulting state is unchanged.

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A10.5.2 Message UNITDATA.request c-1

The CMU sends the UNITDATA.request message to send AVLC data to the VDR. This message contains one frame to be transmitted by the VDR in the next available transmission. c-3

Message Format

The message consists of one Extended BOP file of type DATA containing the following:

Octet	Parameters	Value or Range	
1	EGFI	$F1_h$	
2	Primitive ID	21_h	c-1
3	Data field length MSB	MSB (0 to FF_h)	
4	Data field length LSB	LSB (0 to FF_h)	
5	Sequence number	0 to FF_h (0 to 255)	
6	Data field byte #1	All bytes of data to be sent are consecutively ordered.	
7	Data field byte #2		
.	.		
.	.		
.	.		
N+5	Data field byte #N		c-3

Normal response

UNITDATA.confirm containing sequence number when the frame is transmitted or deleted.

Error response

In the event that the VDR detects an error in the data contained in the message, it sends a VDR_ERROR.indication message.

Reasons for failure c-1

BADDATA - data length invalid or otherwise in error.

State

This message is processed in the PROTOCOL_SET substate of state S7.

New State

The resulting state is unchanged.

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AVLC SIMPLE INTERFACE PROTOCOL (ASIP)

A.10.5.3 Message ADDR.request

c-3 The CMU sends the ADDR.request message to manage the addresses used by the VDR for address screening. Depending on the contents, the CMU can either request a report of the addresses or set the addresses in the DAS. Any addresses set using this primitive should completely replace the existing contents of the DAS. Thus, if the CMU wishes to delete the content of the DAS, it can do so by sending a NULL table to the VDR (octets 6 to 17 = 0) with the control octet set to a value of 01_h. If the CMU wishes to request a copy of the DAS, it can do so by sending a NULL table to the VDR (octets 6 to 17 = 0) with the control octet set to a value of 00_h.

c-3 The four octets of each address contained in the ADDR.request message directly correspond to the four octets that make up the Destination Address Field except for the A/G bit of the Generic Frame Format shown in Table A10.3. An example of an ADDR.request message that follows this convention is shown following Table A10-3.

Message Format

The message consists of one Extended BOP file of type COMMAND containing the following:

Octet	Parameters	Value or Range
1	EGFI	$F1_h$
2	Primitive ID	22_h
3	Data field length MSB	00_h
4	Data field length LSB	$0D_h$ accounts for control octet, three addresses.
5	Control octet	00_h = request list of all addresses in DAS. 01_h = set the following addresses.
6	Address 1, octet 1	Bit 8 corresponds to bit 22 of the Station Address.
7	Address 1, octet 2	Bit 8 corresponds to bit 15 of the Station Address.
8	Address 1, octet 3	Bit 8 corresponds to bit 8 of the Station Address.
9	Address 1, octet 4	Bit 8 corresponds to bit 1 of the Station Address.
10	Address 2, octet 1	Bit 8 corresponds to bit 22 of the Station Address.
11	Address 2, octet 2	Bit 8 corresponds to bit 15 of the Station Address.
12	Address 2, octet 3	Bit 8 corresponds to bit 8 of the Station Address.
13	Address 2, octet 4	Bit 8 corresponds to bit 1 of the Station Address.
14	Address 3, octet 1	Bit 8 corresponds to bit 22 of the Station Address.
15	Address 3, octet 2	Bit 8 corresponds to bit 15 of the Station Address.
16	Address 3, octet 3	Bit 8 corresponds to bit 8 of the Station Address.
17	Address 3, octet 4	Bit 8 corresponds to bit 1 of the Station Address.

Normal response

The VDR should respond with a ADDR.confirm message.

Error response

In the event that the VDR detects an error in the data contained in the message it sends a VDR_ERROR.indication message.

Reasons for failure

BADDATA - data length invalid or otherwise in error.

State

This message is processed in the PROTOCOL_RESET and PROTOCOL_SET substates of state S7.

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New State

The resulting state is unchanged.

A10.5.4 Message CMU_ERROR.indication

The CMU sends the CMU_ERROR.indication message to indicate that a protocol error occurred. Protocol errors can include the reception of a message out of sequence for the current state, an unrecognized primitive, or a format error in the message.

Message Format

The message consists of one Extended BOP file of type COMMAND containing the following:

Octet	Parameters	Value or Range
1	EGFI	$F1_h$
2	Primitive ID	23_h
3	Data field length MSB	0
4	Data field length LSB	2
5	Error code	See Table A10-2
6	Error data	See Table A10-2

c-1

Normal response

None.

Error response

In the event that the VDR detects an error in the data contained in the message, it sends a VDR_ERROR.indication message.

Reasons for failure

BADDATA - data length invalid or otherwise in error.

State

This message is processed in the PROTOCOL_RESET and PROTOCOL_SET substates of state S7.

New State

The resulting state is unchanged.

A10.5.5 Reserved c-3

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A10.5.6 Message PARAM.confirm

The VDR sends the PARAM.confirm message in response to a PARAM.request message. It contains the VDR's current operational parameters.

Message Format

The message consists of one Extended BOP file of type COMMAND containing the following:

	Octet	Parameters	Value or Range
c-1	1	EGFI	$F1_h$
	2	Primitive ID	50_h
	3	Data field length MSB	00_h
	4	Data field length LSB	07_h
	5	Frequency MSB	(tens, ones of freq. in MHz) 18 to 36 (12_h to 24_h) for 118 through 136 MHz.
	6	Frequency LSB	(tenths, hundredths of freq. in MHz, ignore 1000ths) 00 to 97 (00_h to 61_h) for xxx.000 through xxx.975 MHz. Example: freq = 121.775 MSB = 21 = 15_h LSB = 77 = $4D_h$ (ignore thousandths place)
c-4	7	TM1 value	0.5 to 125 ms (01_h to FA_h), 0.5 ms step size
c-3	8	TM2 value	6 to 120sec (06_h to 78_h), 1 sec step size.
	9	M1 MSB	00_h to FF_h. Valid value for M1 is 1 through 65535.
c-4	10	M1 LSB	01_h to FF_h
c-3	11	p-Persistence value	1/256 to 1 (00_h to FF_h), 1/256 step size.

Normal response

None.

Error response

In the event that the CMU detects an error in the data contained in the message, it sends a CMU_ERROR.indication message.

c-1 **Reasons for failure**

BADDATA - data length invalid or otherwise in error.

State

This message is processed in the PROTOCOL_RESET and PROTOCOL_SET substates of state S7.

New State

The resulting state is the PROTOCOL_SET substate of S7.

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A10.5.7 Message UNITDATA.indication c-1

The VDR sends the UNITDATA.indication message to send AVLC data to the CMU. c-3

Note: The UNITDATA.indication and associated SQP.indication should be sent in the order shown in Figures A10-4 and A10-11. c-4

Message Format

The message consists of one Extended BOP file of type DATA containing the following:

Octet	Parameters	Value or Range
1	EGFI	$F1_h$
2	Primitive ID	51_h
3	Data field length MSB	MSB (0 to FF_h)
4	Data field length LSB	LSB (0 to FF_h)
5	Frequency MSB	(tens, ones of freq. in MHz) 18 to 36 (12_h to 24_h) for 118 through 136 MHz.
6	Frequency LSB	(tenths, hundredths of freq. in MHz, ignore 1000ths) 00 to 97 (00_h to 61_h) for xxx.000 through xxx.975 MHz. Example: freq = 121.775 MSB = 21 = 15_h LSB = 77 = $4D_h$ (ignore thousandths place)
7	Data field byte #1	All bytes of data to be sent are consecutively ordered.
8	Data field byte #2	
.	.	
.	.	
.	.	
N+6	Data field byte #N	

c-1 c-2 c-3

Normal response

None.

Error response

In the event that the CMU detects an error in the data contained in the message, it sends a CMU_ERROR.indication message. c-1

Reasons for failure

BADDATA - data length invalid or otherwise in error.

State

This message is processed in the PROTOCOL_SET substate of state S7.

New State

The resulting state is unchanged.

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c-1 A10.5.8 Message ADDR.confirm

The VDR sends the ADDR.confirm message in response to an ADDR.request. It contains the content of the DAS.

c-3 The four octets of each address contained in the ADDR.confirm message directly correspond to the four octets that make up the Destination Address Field of the Generic Frame Format shown in Table A10.3. An example of an ADDR.request message that follows this convention is shown following Table A10-3.

Message Format

c-1 The message consists of one Extended BOP file of type COMMAND containing the following:

Octet	Parameters	Value or Range
1	EGFI	$F1_h$
c-2 2	Primitive ID	52_h
c-1 3	Data field length MSB	00_h
4	Data field length LSB	$0C_h$
5	Address 1, octet 1	Bit 8 corresponds to bit 22 of the Station Address.
6	Address 1, octet 2	Bit 8 corresponds to bit 15 of the Station Address.
7	Address 1, octet 3	Bit 8 corresponds to bit 8 of the Station Address.
8	Address 1, octet 4	Bit 8 corresponds to bit 1 of the Station Address.
c-3 9	Address 2, octet 1	Bit 8 corresponds to bit 22 of the Station Address.
10	Address 2, octet 2	Bit 8 corresponds to bit 15 of the Station Address.
11	Address 2, octet 3	Bit 8 corresponds to bit 8 of the Station Address.
12	Address 2, octet 4	Bit 8 corresponds to bit 1 of the Station Address.
13	Address 3, octet 1	Bit 8 corresponds to bit 22 of the Station Address.
14	Address 3, octet 2	Bit 8 corresponds to bit 15 of the Station Address.
15	Address 3, octet 3	Bit 8 corresponds to bit 8 of the Station Address.
16	Address 3, octet 4	Bit 8 corresponds to bit 1 of the Station Address.

Normal response

c-1 None.

Error response

c-3 In the event that the CMU detects an error in the data contained in the message it sends a VDR_ERROR.indication message.

Reasons for failure

BADDATA - data length invalid or otherwise in error.

c-1 **State**

This message is processed in the PROTOCOL_RESET and PROTOCOL_SET substates of state S7.

New State

The resulting state is unchanged.

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A10.5.9 Message VDR_ERROR.indication

The VDR sends the VDR_ERROR.indication message to indicate that a protocol error occurred. Protocol errors can include the reception of a message out of sequence for the current state, an unrecognized primitive, or a format error in the message or VDR transmit buffer overflows (CMU sends frame when buffer is full).

Message Format c-1

The message consists of one Extended BOP file of type COMMAND containing the following:

Octet	Parameters	Value or Range
1	EGFI	$F1_h$
2	Primitive ID	53_h
3	Data field length MSB	00_h c-3
4	Data field length LSB	02_h
5	Error code	See Table A10-2.
6	Error data	See Table A10-2.

Normal response

None.

Error response

In the event that the CMU detects an error in the data contained in the message, it sends a CMU_ERROR.indication message.

Reasons for failure

BADDATA - data length invalid or otherwise in error.

State c-1

This message is processed in the PROTOCOL_RESET and PROTOCOL_SET substates of state S7.

New State

The resulting state is unchanged.

A10.5.10 Message SQP.indication

The VDR sends the SQP.indication, a "quality of service" report message, once per any transmission received from the ground containing a frame whose FCS is good. A ground station transmitted message is indicated by the content of the type field of the source address. The type field in the source address comprises bits 25 through 27 of the Station Address field (as shown in Table A10-3) and should be encoded as indicated in Table A10-4 for the entries in the comment field: "ICAO-administered" and "ICAO-delegated." The SQP.indication message should only be sent while the VDR is in the PROTOCOL_SET state. c-3 c-1

The SQP.indication message contains data that indicates the "quality of service" parameter, the source address of the originating ground station, and the frequency in use when the uplink was received. This information is used by the LME for station hand-off and link control procedures. Octet 5 contains two measurements of SQP using the two scales defined in Section A10.4.7. The lower nibble of octet 5, bits 4-1 contains the original SQP scale. The upper nibble of octet 5, bits 8-5 contains the second SQP scale introduced by supplement 4. c-3 c-4

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A10.5.10 Message SQP.indication (cont'd)

c-4 The SQP.indication message should contain the second SQP value only if the CMU and VDR are supporting the new SQP scale. The VDR indicates in its Label 172 (bit 24) if the new SQP scale is supported. The CMU indicates in its Label 172 (bit 18) if the new SQP scale is supported.

c-3 The four octets of the address contained in the SQP.confirm message directly correspond to the four octets that make up the Source Address Field of a frame in the received transmission as shown in the Generic Frame Format shown in Table A10-3.

c-4 Note: The UNITDATA.indication and associated SQP.indication should be sent in the order shown in Figures A10-4 and A10-11.

Message Format

The message consists of one Extended BOP file of type COMMAND containing the following:

	Octet	Parameters	Value or Range
	1	EGFI	$F1_h$
	2	Primitive ID	54_h
	3	Data field length MSB	00_h
	4	Data field length LSB	07_h
c-4	5	original SQP, lower nibble	0_h to F_h (0 to 15), quality of service indicator,
c-3			0 = poorest quality, 15 = best quality (See A10.4.7)
	5	supplement 4 SQP, upper nibble	0_h to F_h (0 to 15), quality of service indicator,
c-4			0 = poorest quality, 15 = best quality (See A10.4.7)
			note 1
c-1	6	Source address, octet 1	Bit 8 corresponds to bit 22 of the Station Address.
	7	Source address, octet 2	Bit 8 corresponds to bit 15 of the Station Address.
	8	Source address, octet 3	Bit 8 corresponds to bit 8 of the Station Address.
	9	Source address, octet 4	Bit 8 corresponds to bit 1 of the Station Address.
c-3	10	Frequency MSB	(tens, ones of freq. in MHz)
			18 to 36 (12_h to 24_h) for 118 through 136 MHz.
	11	Frequency LSB	(tenths, hundredths of freq. in MHz, ignore 1000ths)
			00 to 97 (00_h to 61_h) for xxx.000 through xxx.975 MHz.
			Example: freq = 121.775
			MSB = 21 = 15_h
			LSB = 77 = $4D_h$ (ignore thousandths place)

c-4 Note 1: the upper nibble is zero in equipment designed prior to Supplement 4.

Normal response

None.

c-1 **Error response**

In the event that the CMU detects an error in the data contained in the message, it sends a CMU_ERROR.indication message.

Reasons for failure

BADDATA - data length invalid or otherwise in error.

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State

This message is processed in the PROTOCOL_SET substate of state S7. c-3

New State

The resulting state is unchanged.

A10.5.11 Message CU.indication

The VDR sends the CU.indication to indicate the CU parameter. A value of 100 (64_h) indicates 100% utilization of the channel. The CU.indication message should only be sent while the VDR is in the PROTOCOL_SET substate. The CU.indication message is transmitted at fixed 1-second intervals. The CU data is calculated according to Section A10.4.10.

Message Format

The message consists of an Extended SOLO word containing the following:

Bit	Definition	Value or Range
32	Parity	
31-29	Word identifier	101_b
28-25	ID	F_h
24-21	Protocol ID	1_h
20-18	Primitive ID	001_b
17-9	CU	0_h to 64_h (0 to 100).
8-1	SAL	

c-1

Normal response

None.

Error response

In the event that the CMU detects an error in the data contained in the message, it sends a CMU_ERROR.indication message.

Reasons for failure

BADDATA - data length invalid or otherwise in error.

State

This message is processed in the PROTOCOL_SET substate of state S7. c-3

New State

The resulting state is unchanged.

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A10.5.12 Message UNITDATA.confirm

The VDR sends the UNITDATA.confirm to indicate the MAC delay for a transmitted frame or that the frame has been cleared from the buffer (due to a frequency change for example). The MAC delay time is measured from the time that the frame is placed in the transmit buffer until transmission event containing that frame terminates. The resolution on the MAC delay value is 2 msec. The sequence number from the UNITDATA.request message is included in the UNITDATA.confirm message so that the CMU can explicitly correlate the request and confirm message. The CMU should ignore the data in the MAC Delay field when the Transmit status is '01'.

COMMENTARY

The maximum MAC delay value that can be represented by the two octets is 2^{16} * 2 msec = 131 secs. This exceeds the maximum TM2 value of 120 secs shown in the SARPs in Table 6-6.

Message Format

The message consists of one Extended BOP file of type COMMAND containing the following:

Octet	Parameters	Value or Range	Note
1	EGFI	$F1_h$	
2	Primitive ID	56_h	
3	Data field length MSB	00_h	
c-3 4	Data field length LSB	04h	
5	Transmit Status	00_h = transmitted, 01_h = discarded	
6	MAC delay MSB	0_h to FF_h (0 to 255)	1
7	MAC delay LSB	0_h to FF_h (0 to 255)	1
8	sequence number	0_h to FF_h (0 to 255)	

Note 1: The CMU should ignore the MAC Delay field when the transmit status is 01_h.

Normal response

None.

Error response

In the event that the CMU detects an error in the data contained in the message, it sends a CMU_ERROR.indication message.

Reasons for failure

BADDATA - data length invalid or otherwise in error.

State

This message is processed in the PROTOCOL_SET substate of state S7.

New State

The resulting state is unchanged.

ATTACHMENT 10
AVLC SIMPLE INTERFACE PROTOCOL (ASIP)

A10.5.13 Message CHAN_CONG.indication

The VDR sends the CHAN_CONG.indication to indicate when the RF channel is congested. RF channel congestion is detected by the expiration of timer TM2. The TM2 timer is started when the frame is placed in the transmit buffer. The TM2 timer is stopped when a transmission event containing that frame occurs.

Message Format

The message consists of an Extended SOLO word containing the following:

Bit	Definition
32	Parity
31-29	"101_b"
28-25	F_h
24-21	1_h
20-18	"000_b" (Primitive ID for CHAN_CONG SOLO word)
17-09	all bits set to zero
08-01	SAL

Parameters c-3

None

Normal response

None.

Error response

None

Reasons for failure

None

State

This message is processed in the PROTOCOL_SET substate of state S7.

New State

The resulting state is unchanged.

ATTACHMENT 10
AVLC SIMPLE INTERFACE PROTOCOL (ASIP)

A10.5.14 Message PURGE.request

The CMU sends the PURGE.request to command the VDR to purge its transmit buffer.

Message Format

The message consists of an Extended SOLO word containing the following:

Bit	Definition
32	Parity
31-29	"101_b"
28-25	F_h
24-21	1_h
20-18	"010_b" (Primitive ID for PURGE.request SOLO word)
17-09	all bits set to zero
08-01	SAL

c-3

Parameters

None

Normal response

If, as a result of this command, the VDR purges frames from its transmit buffer, then the VDR sends a UNITDATA.confirm message for each frame as a response to an outstanding unacknowledged UNITDATA.request command previously received from the CMU.

c-4

Error response

None

Reasons for failure

None

c-3

State

This message is processed in the PROTOCOL_SET substate of state S7.

New State

The resulting state is unchanged.

ATTACHMENT 10
AVLC SIMPLE INTERFACE PROTOCOL (ASIP)

A10.5.15 Vendor Reserved Primitives

Certain primitives are reserved for use by manufacturers for diagnostic, debugging or other purposes. An Extended BOP file primitive whose Primitive ID falls within the range $F0_h$ to FF_h is considered to be a vendor-reserved primitive. The type (COMMAND or DATA) of these reserved primitives is undefined. c-3

Some vendors have expressed a desire for a dedicated Vendor reserved primitive and have been assigned a primitive ID value. Only the vendor that has been assigned that primitive ID value should use it. A vendor that desires to have a primitive ID value assigned should contact the AEEC VDL Subcommittee secretary. The following primitive ID values have been assigned: c-4

$F0_h$ – Honeywell
$F1_h$ – Rockwell Collins

Message Format

The message consists of one Extended BOP file of type COMMAND or DATA containing the following:

Octet	Parameters	Value or Range	Note
1	EGFI	$F1_h$	Indicates ASIP
2	Primitive ID	$F0_h$ to FF_h	Range of vendor primitives
3	Data field length MSB	-	
4	Data field length LSB	-	
5	Data Field Byte #1		
6	Data Field Byte #2		
.	.		
.	.		
N+4	Data Field Byte #N		

c-3

Normal response

None.

Error response

None.

State

This message is ignored by the CMU and VDR.

New State

The resulting state is unchanged. c-4

ATTACHMENT 10
AVLC SIMPLE INTERFACE PROTOCOL (ASIP)

A10.5.15 Vendor Reserved Primitives (cont'd)

Table A10-1 - VDR - CMU Primitives

All primitives are composed of Extended BOP files except as indicated.

	Command/Query Message	Primitive	Sender	Primitive ID	Type
c-1	Operational parameter request	PARAM.request	CMU	20_h	COMMAND
	CMU data transfer request	UNITDATA.request	CMU	21_h	DATA
	Address request	ADDR.request	CMU	22_h	COMMAND
	CMU Error indication	CMU_ERROR.indication	CMU	23_h	COMMAND
	Operational parameter acknowledge.	PARAM.confirm	VDR	50_h	COMMAND
	VDR data transfer indication	UNITDATA.indication	VDR	51_h	DATA
	Address acknowledgment	ADDR.confirm	VDR	52_h	COMMAND
	VDR Error indication	VDR_ERROR.indication	VDR	53_h	COMMAND
	Signal quality indication	SQP.indication	VDR	54_h	COMMAND
c-4	Channel utilization indication	CU.indication (Extended SOLO word)	VDR	001_b	N/A
	Frame transmission confirm	UNITDATA.confirm	VDR	56_h	COMMAND
c-1	Channel congestion indication	CHAN_CONG.indication (Extended SOLO word)	VDR	000_b	N/A
	Purge	PURGE.request (Extended SOLO word)	CMU	010_b	N/A
c-4	Vendor Reserved Primitives	Vendor defined	VDR/CMU	$F0_h$ to FF_h	COMMAND or DATA

Table A10-2 - Error Messages

	Error Condition	Sender	Error Code	Error Data
c-1	Unspecified Error	CMU/VDR	00_h	Don't care
	Unrecognized PID	CMU/VDR	01_h	Offending PID
	BADDATA	CMU/VDR	02_h	Offending PID
c-4	VDR transmit buffer overflow	VDR	03_h	None
c-1	Out of sequence or unexpected primitive	CMU/VDR	04_h	Offending PID

ATTACHMENT 10
AVLC SIMPLE INTERFACE PROTOCOL (ASIP)

Table A10-3 - Generic Frame Format

		Bit Number							
	Octet No.	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**
Flag	-	0	1	1	1	1	1	1	0 (1^{st} transmitted bit in the frame)
Destination Address Field	1	22		24	25		27	A/G	0
	2	15						21	0
	3	8		Station Address				14	0
	4	1						7	0
Source Address Field	5	22		24	25		27	C/R	0
	6	15						21	0
	7	8		Station Address				14	0
	8	1						7	1
Link Control Field	9				P/F				
Information	N-2	User Data							
Frame Check Sequence Number	N-1	9	Most Significant Octet						16
	N	1	Least Significant Octet					7	8
Flag	-	0	1	1	1	1	1	1	0

ADDR.request and ADDR.confirm Encoding Examples

In the examples, the tail number and 24-bit ICAO address are consistent with DO-224 Change 1, Appendix F.

Both the ADDR.request and ADDR.confirm messages contain three addresses. For the first encoded address, the aircraft tail number is N24175 whose 24-bit ICAO address is 0xA23721. The binary representation of this address is shown below. The type field for this address is '001' for bits 27-25 corresponding to the “Aircraft” type field. The A/G bit is set to '1' since the transmitter is on the ground. Since this address is located in the Destination Address Field, the extension bit of each octet, bit 1, is set to '0' for all four octets.

1010 0010 0011 0111 0010 0001

The four octets in the Destination Address Field would be composed as:

octet 1 = 10110010 = $B2_h$
octet 2 = 00010000 = 10_h
octet 3 = 01110110 = 76_h
octet 4 = 10000100 = 84_h

The second address is the “all ones broadcast” address. The hex representation of this address is 0xFFFFFF. The type field of this address is ‘111’ for bits 27-25 corresponding to the “All stations broadcast” type field. The A/G bit is set to ‘1’ since the transmitter is on the ground. The extension bit of each octet, bit 1, is set to ‘0 for all four octets. The four octets in the Destination Address Field would be composed as:

octet 1 = 11111110 = FE_h
octet 2 = 11111110 = FE_h
octet 3 = 11111110 = FE_h
octet 4 = 11111110 = FE_h

ATTACHMENT 10
AVLC SIMPLE INTERFACE PROTOCOL (ASIP)

A10.5.15 Vendor Reserved Primitives (cont'd)

c-4 The third address the "all ones" broadcast address" The hex representation of this address is $FFFFFF_h$. The type field of this address is '001' for bits 27-25 corresponding to the "Aircraft" type field. The A/G bit is set to '1' since the transmitter is on the ground. The extension bit of each octet, bit 1, is set to '0' for all four octets. The four octets in the Destination Address Field would be composed as:

c-3 octet 1 = 11110010 = $F2_h$
octet 2 = 11111110 = FE_h
octet 3 = 11111110 = FE_h
c-4 octet 4 = 11111110 = FE_h

An ADDR.request message containing these addresses and their associated type fields is:

Octet	Parameters	Value
1	EGFI	$F1_h$
2	Primitive ID	22_h
3	Data field length MSB	00_h
4	Data field length LSB	$0D_h$
5	Control octet	01_h
6	Address 1, octet 1	$B2_h$
7	Address 1, octet 2	10_h
8	Address 1, octet 3	76_h
9	Address 1, octet 4	84_h
10	Address 2, octet 1	FE_h
11	Address 2, octet 2	FE_h
12	Address 2, octet 3	FE_h
13	Address 2, octet 4	FE_h
14	Address 3, octet 1	$F2_h$
15	Address 3, octet 2	FE_h
16	Address 3, octet 3	FE_h
c-3 17	Address 3, octet 4	FE_h

An ADDR.confirm message containing this address is:

Octet	Parameters	Value
1	EGFI	$F1_h$
2	Primitive ID	52_h
3	Data field length MSB	00_h
4	Data field length LSB	$0C_h$
5	Address 1, octet 1	$B2_h$
6	Address 1, octet 2	10_h
7	Address 1, octet 3	76_h
8	Address 1, octet 4	84_h
9	Address 2, octet 1	FE_h
10	Address 2, octet 2	FE_h
11	Address 2, octet 3	FE_h
12	Address 2, octet 4	FE_h
13	Address 3, octet 1	$F2_h$
14	Address 3, octet 2	FE_h
15	Address 3, octet 3	FE_h
16	Address 3, octet 4	FE_h

ATTACHMENT 10
AVLC SIMPLE INTERFACE PROTOCOL (ASIP)

Table A10-4 - Address Type Field Encoding

Bit Encoding				
27	**26**	**25**	**Description Type**	**Comments**
0	0	0	Undefined	Future Use
0	0	1	Aircraft	24-bit ICAO address
0	1	0	Undefined	Future Use
0	1	1	Undefined	Future Use
1	0	0	Ground Station	ICAO-administered
1	0	1	Ground Station	ICAO-delegated
1	1	0	Undefined	Future Use
1	1	1	All stations broadcast	All stations

c-1

ATTACHMENT 10
AVLC SIMPLE INTERFACE PROTOCOL (ASIP)

c-3

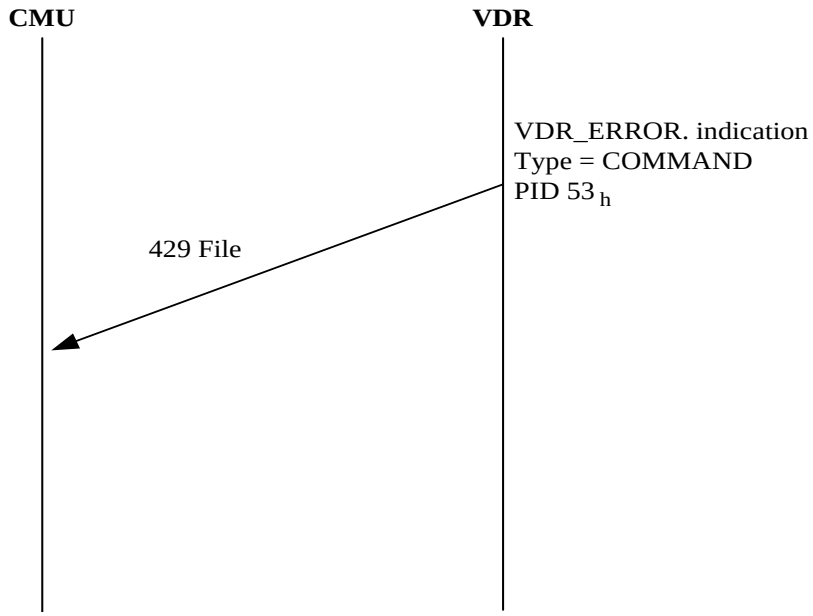


Figure A10-1 VDR Error Message

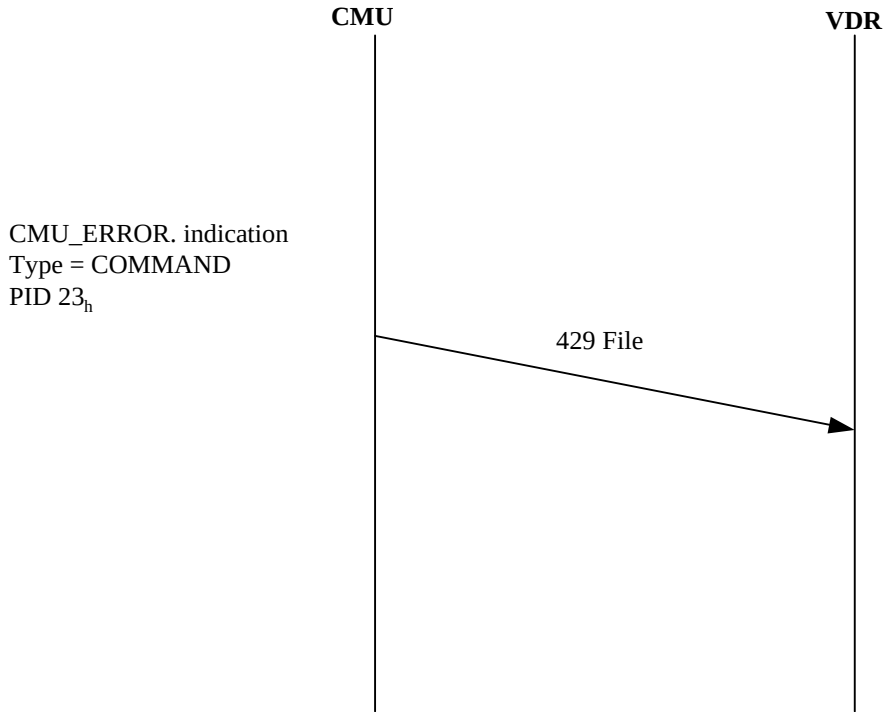


Figure A10-2 CMU Error Message

ATTACHMENT 10
AVLC SIMPLE INTERFACE PROTOCOL (ASIP)

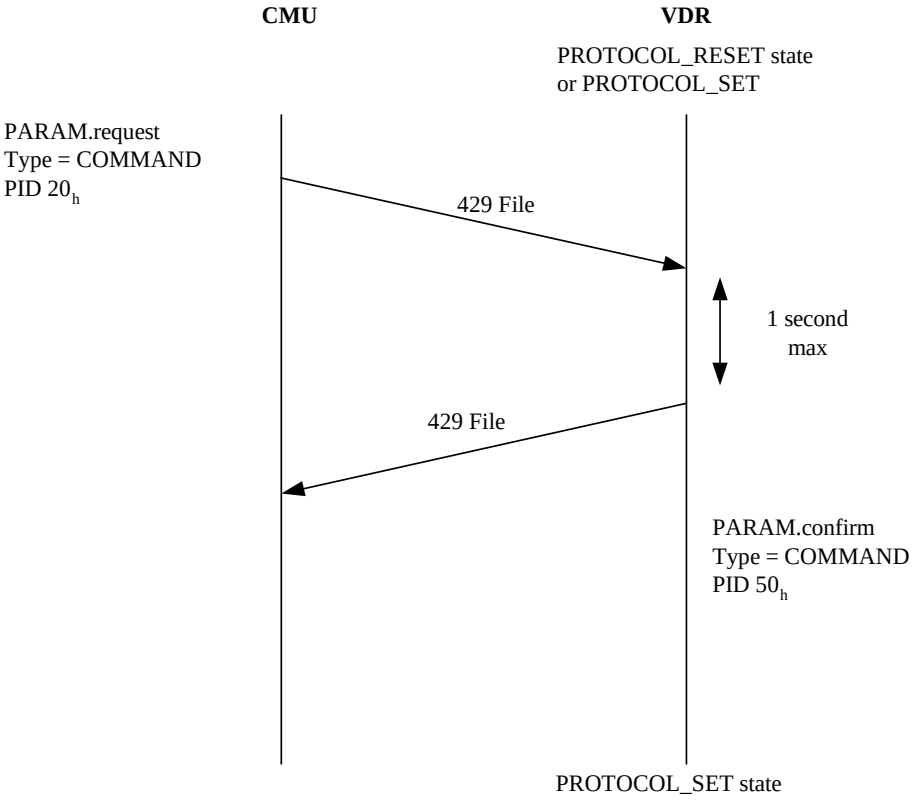


Figure A10-3 VDR Operating Parameter Data

c-3

ATTACHMENT 10
AVLC SIMPLE INTERFACE PROTOCOL (ASIP)

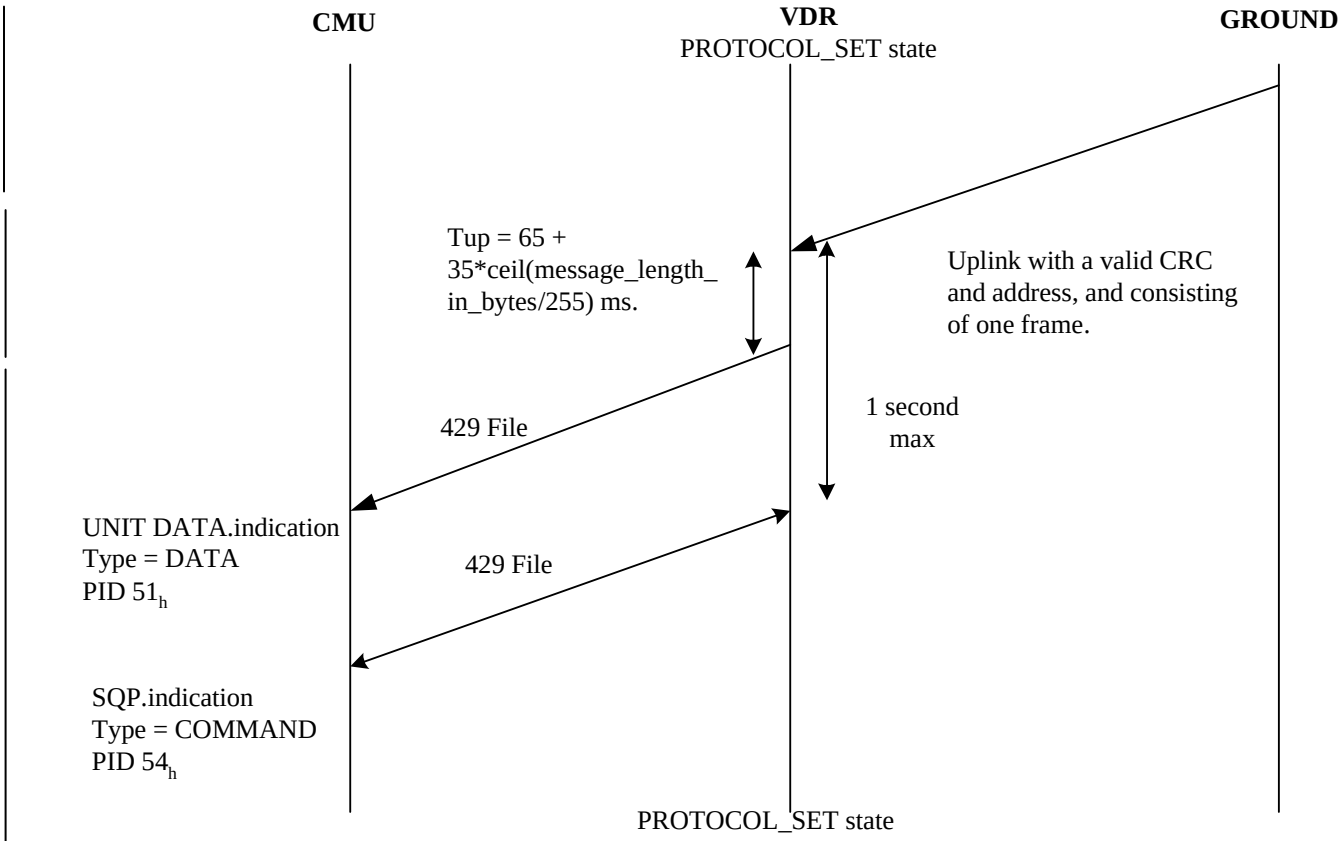


Figure A10-4 Uplink Process Reporting

Note: The UNITDATA.indication and associated SQP.indication should be sent in the order shown.

ATTACHMENT 10
AVLC SIMPLE INTERFACE PROTOCOL (ASIP)

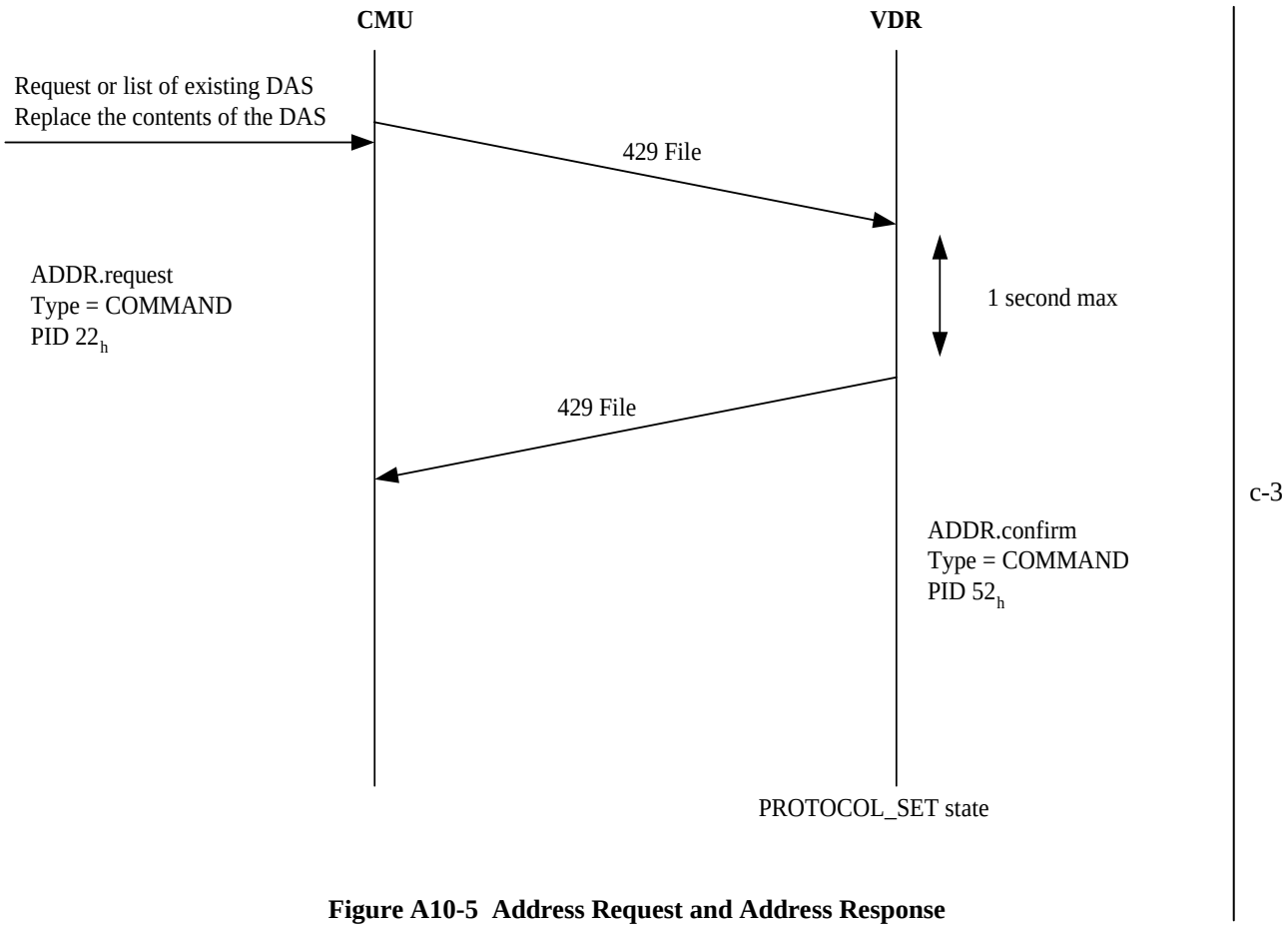


Figure A10-5 Address Request and Address Response

ATTACHMENT 10
AVLC SIMPLE INTERFACE PROTOCOL (ASIP)

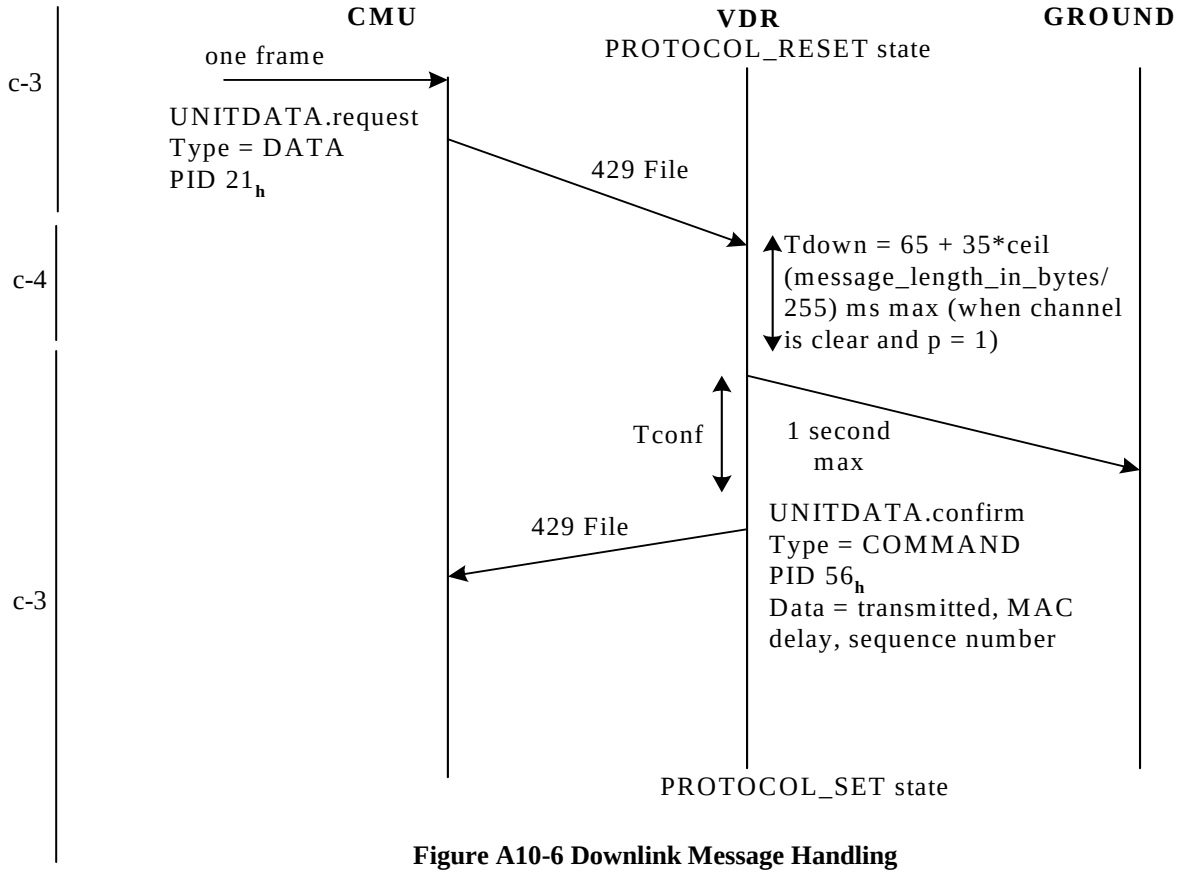


Figure A10-6 Downlink Message Handling

ATTACHMENT 10
AVLC SIMPLE INTERFACE PROTOCOL (ASIP)

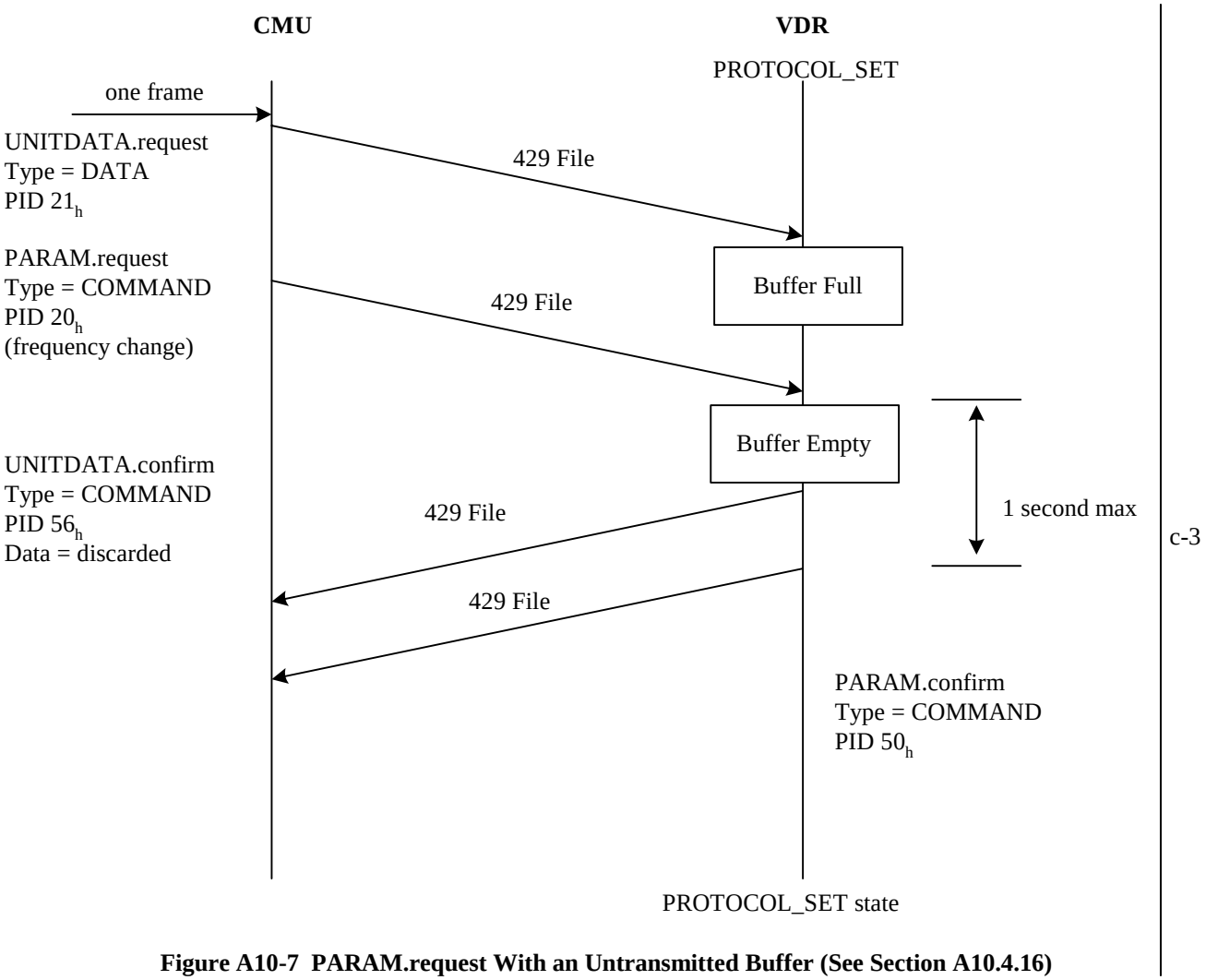
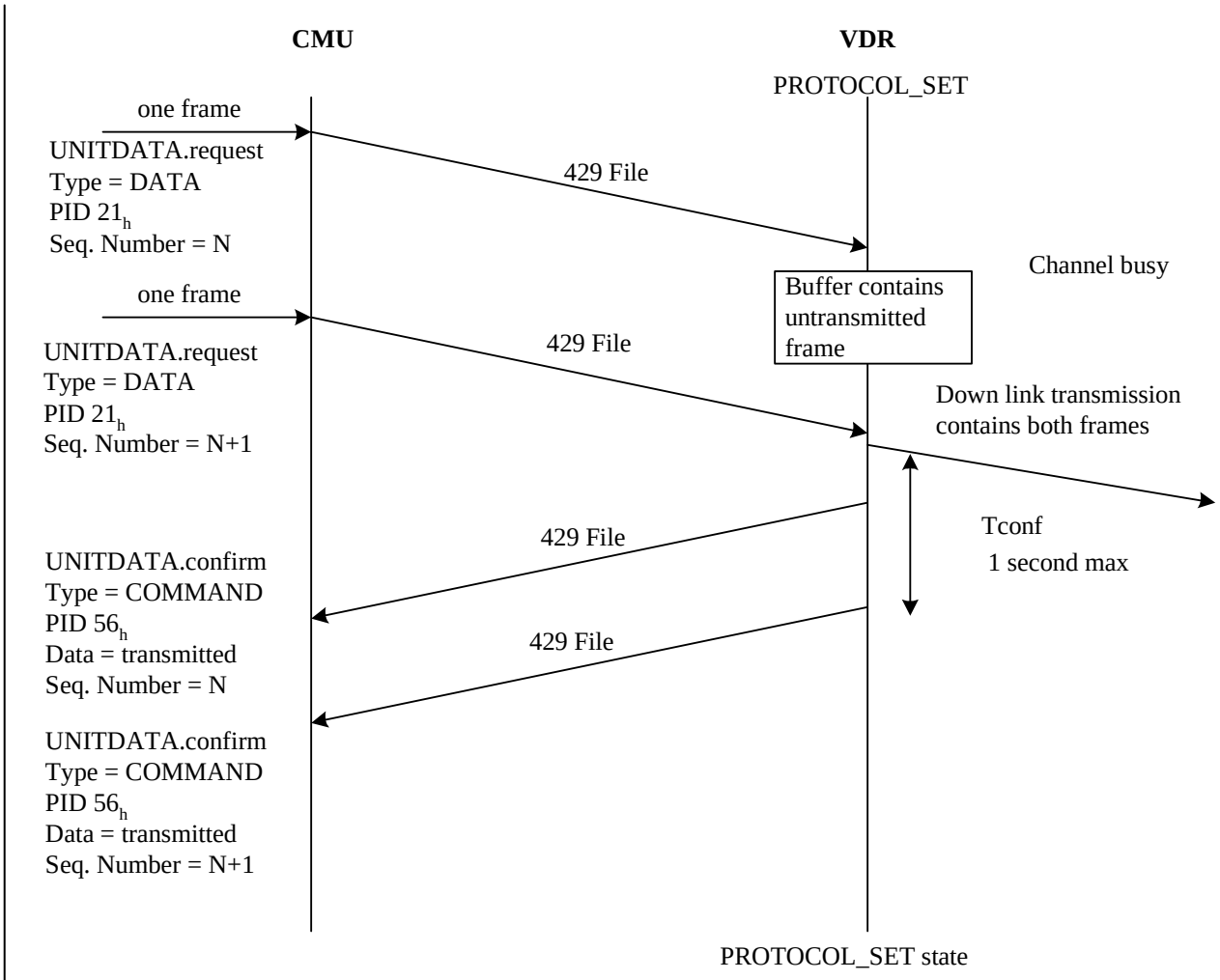


Figure A10-7 PARAM.request With an Untransmitted Buffer (See Section A10.4.16)

ATTACHMENT 10
AVLC SIMPLE INTERFACE PROTOCOL (ASIP)



c-3

Figure A10-8 UNITDATA.request with a Non-empty Buffer

ATTACHMENT 10
AVLC SIMPLE INTERFACE PROTOCOL (ASIP)

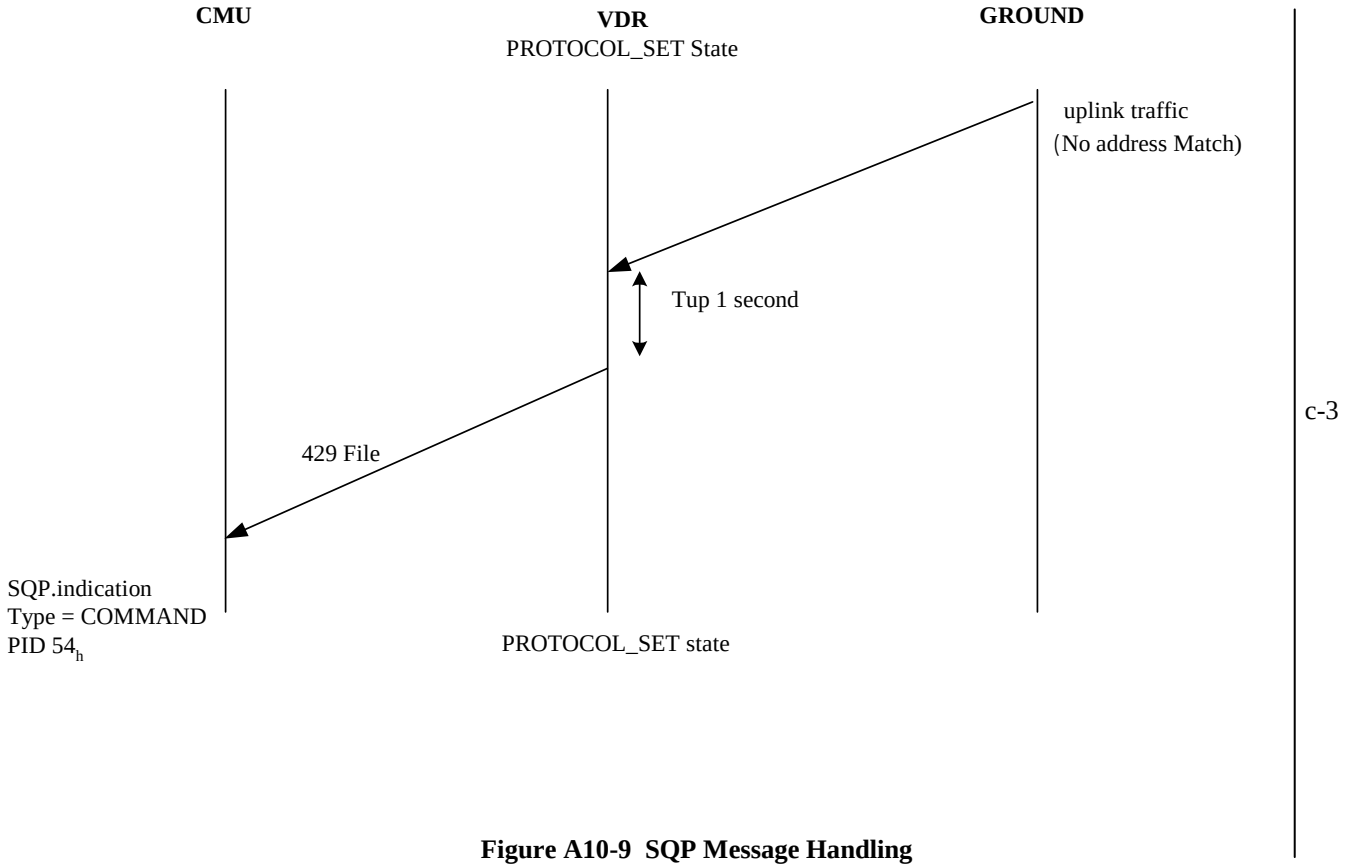


Figure A10-9 SQP Message Handling

ATTACHMENT 10
AVLC SIMPLE INTERFACE PROTOCOL (ASIP)

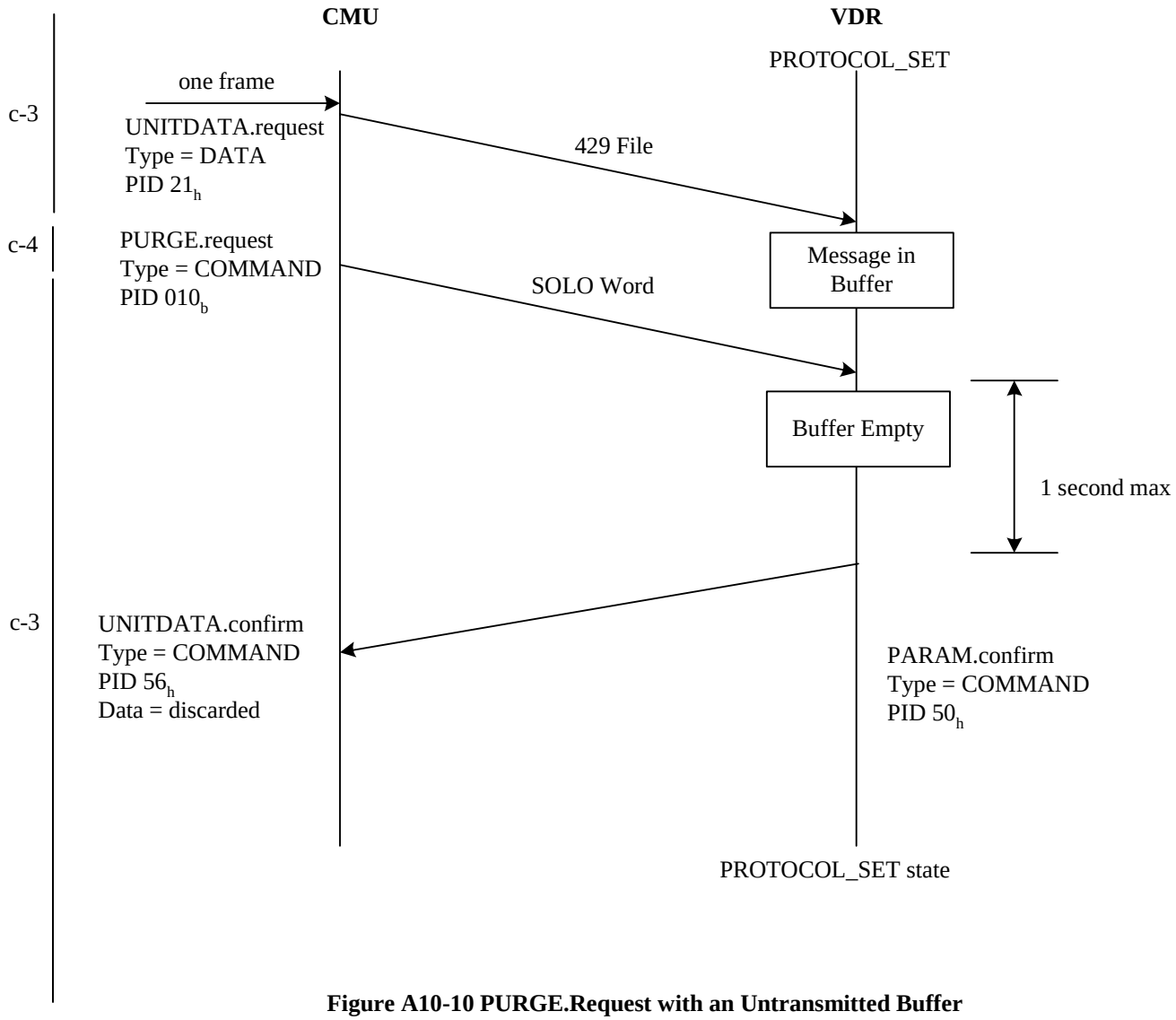
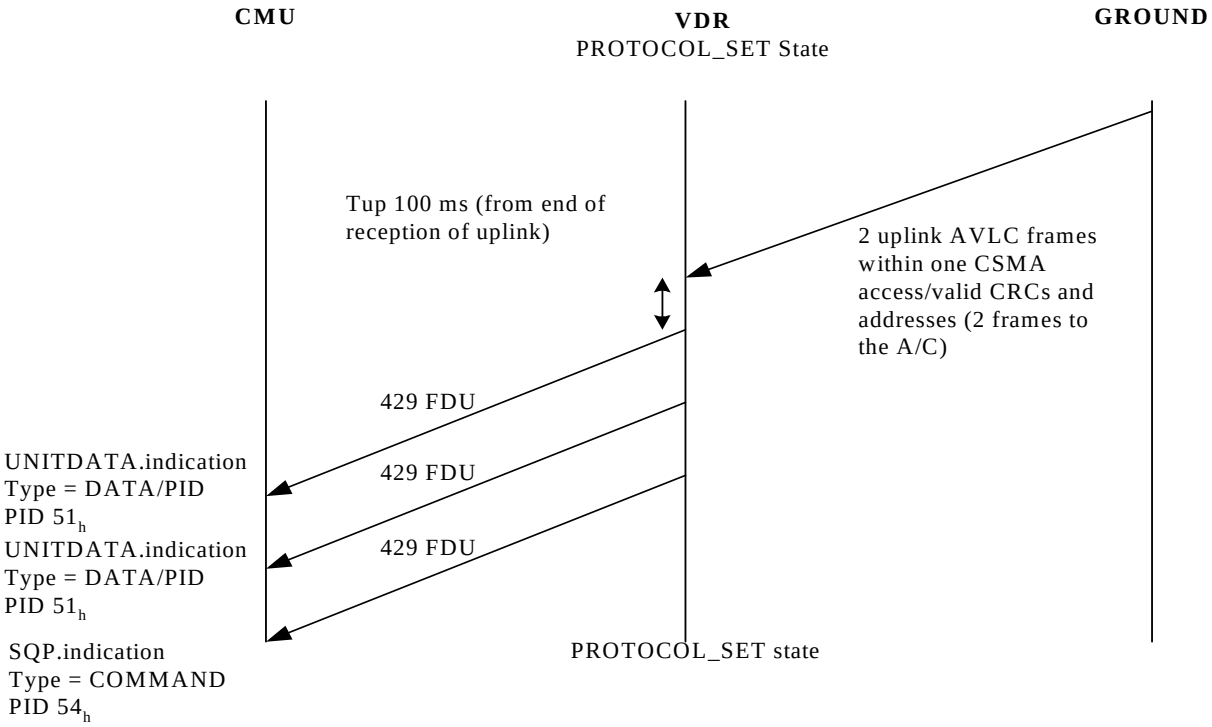


Figure A10-10 PURGE.Request with an Untransmitted Buffer

ATTACHMENT 10
AVLC SIMPLE INTERFACE PROTOCOL (ASIP)



c-3

Figure A10-11 Multiple Frames Uplink Processing

Note: The UNITDATA.indication and associated SQP.indication should be sent in the order shown. c-4

ATTACHMENT 11
ACARS INTERFACE PROTOCOL (ACARSIP)

A11.1 Purpose

This attachment defines the ACARS Interface Protocol (ACARSIP). This protocol is a collection of messages, methods and procedures that may be implemented in both a VHF Data Radio (VDR) and a Communications Management Unit or Management Unit (CMU) to enable the pair to function as an entity in an ACARS network.

A11.2 Functional Overview

ARINC Specification 618 describes the functions, methods and procedures to be implemented by an airborne entity performing VHF ACARS operations. The protocols and procedures defined in this attachment are a particular implementation of VHF operations described in ARINC Specification 618.

The CMU and the VDR operate together to implement the functionality defined by ARINC Specification 618. A functional partitioning can be imposed between the VDR and the CMU to implement ARINC Specification 618's definition. This protocol defines a split in functionality between the VDR and the CMU subsystems and the protocols and procedures to support it.

c-2

The ARINC Specification 618 VHF Protocol has certain functions defined:

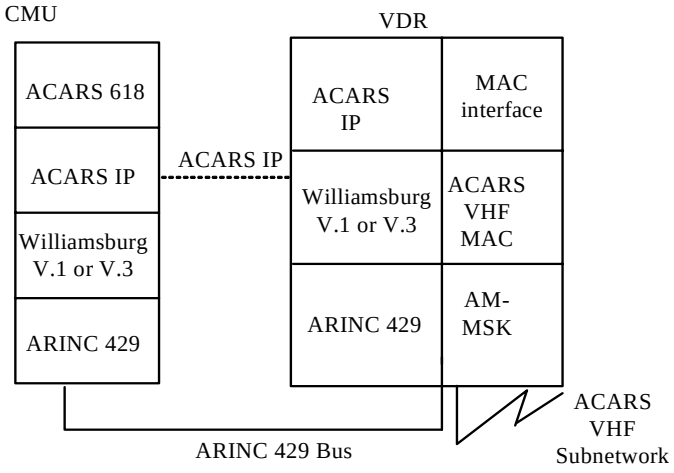
a. The ACARS Physical sub-layer performs modulation and demodulation of the AM-MSK waveform. This functionality resides in the VDR.

b. The ACARS Media Access Control (MAC) sub-layer requires the use of the carrier sense multiple access (CSMA) algorithm. This sub-layer resides in the VDR.

c. The ACARS Link Management sub-layer performs all connection establishment, maintenance functions. This sub-layer resides wholly in the CMU.

d. The ACARS Data Link Service (DLS) sub-layer acts as a connectionless link over the MAC sub-layer. This sub-layer resides in both the CMU and the VDR.

c-3



ACARSIP Functional Split

ATTACHMENT 11
ACARS INTERFACE PROTOCOL (ACARSIP)

A11.2.1 Physical Layer Function

The VDR performs all VHF physical layer functions as defined in ARINC Specification 618, Section 4.0. These include, but are not limited to, modulation and demodulation of the AM-MSK signal and transceiver tuning.

A11.2.2 MAC Layer Function

The VDR performs all VHF MAC layer functions as defined in ARINC Specification 618, Section 4.0. The channel access algorithm is defined to be Non-Persistent CSMA. The maximum pre-key length is 85 msec. c-2

A11.3 Protocols and Procedures

A11.3.1 Protocols Overview

The ACARSIP CMU/VDR Interface Protocol consists of primitives composed only of Extended BOP files and Extended SOLO words as defined in Sections 5.1.3.1 and 5.1.3.2 respectively. As defined in Section 5.1.2.3, file primitives are of types COMMAND or DATA. c-3

A received RF transmission contains only one ACARS block as defined in ARINC Specification 618, Section 2.1. It is preceded by a VHF Preamble (ARINC Specification 618, Section 4.2), and is followed by a BCS Suffix (ARINC Specification 618, Section 4.3). For each demodulated transmission, the VDR calculates the BCS. If the BCS is good and the block meets the address screening requirements of Section A11.4.12, then the VDR sends the block, as defined above, but stripped of the VHF Preamble, to the CMU using a single primitive. c-2

One of the address screening criteria is that the block's address field matches one of a set of (up to) eight valid addresses. This set of addresses, referred herein as the Destination Address Set (DAS), is loaded by the CMU using a command primitive. The VDR, prior to its initialization procedure, contains a null DAS. Consequently, no message blocks are passed from the VDR to the CMU until the DAS contains valid destination addresses.

The VDR sends an SQP information for every received transmission from the ground containing a block with a valid BCS. The SQP information is used by the Link Management function, which resides in the CMU. The SQP reporting function is disabled prior to the VDR's initialization and is enabled when the CMU sends certain operational parameter data to the VDR. The VDR performs SQP reporting with a null DAS. A downlink block to be sent by the CMU is passed to the VDR and contains everything from the <SOH> word through the BCS suffix character. Before transmission of the block, the VDR affixes the VHF Preamble. Upon completion of transmission of the block, the VDR notifies the CMU that the block has been transmitted. c-3 c-2 c-3

The CMU can command the VDR to execute an audit mode. In this mode, the VDR can be commanded to send to the CMU either

a. All received and transmitted blocks, or

b. All transmitted blocks and all received blocks that meet the address screening criteria of Section A11.4.12.

In either case, data is included from the <SOH> to the BCS suffix character**,** regardless of the value of the BCS. c-2

A11.3.2 ARINC SPECIFICATION 429 Interface Definition.

(Defined in ARINC Characteristic 750, Section 5.0).

A11.4 Procedures

Certain procedures should be followed to manage the VDR.

ATTACHMENT 11
ACARS INTERFACE PROTOCOL (ACARSIP)

A11.4.1 VDR Initialization

ARINC Characteristic 750, Section 5.0, defines the CMU to VDR interface as providing support for multiple interface protocols. It defines the initialization procedure that is to be performed in order to bring the interface to a functional state upon reset or power up. The VDR, determines its correct operating mode, whether 716 Voice, 716 Data, or 750 Data, and determines which CMU is to be declared as primary. If in 750 Data mode, it then negotiates the protocol to be used with the CMU. Once this negotiation is successfully completed, normal data mode operations using the negotiated interface protocol can commence.

A11.4.1.1 PROTOCOL_NULL State

After entering 750 Data mode, but before protocol negotiation has succeeded, the VDR should be in the PROTOCOL_NULL state. This is a transitional state in which the VDR communicates with the CMU during the protocol negotiation process using command primitives defined in ARINC Characteristic 750, Section 5.0.

Contents of VDR's transmitted Label 270 status word

Protocol Status bit = "0"
Download Request bit = "0"

A.11.4.1.2 PROTOCOL_RESET State

After a protocol has been successfully negotiated, but before operating parameters have been loaded, the VDR should be in the PROTOCOL_RESET state. All buffers are flushed, and all operating parameters (mode, frequency, etc.) are set to their default values. The DAS is NULL and therefore no uplink messages are passed to the CMU. SQP reporting is disabled.

Contents of VDR's transmitted Label 270 status word:

c-2

Protocol Status bit = "1"
Download Request bit = "1"

A11.4.1.3 PROTOCOL_SET State

Once the PARAM.request message has been received and validated by the VDR, it should be in the PROTOCOL_SET state. SQP reporting is enabled. Uplink messages are only sent once the DAS has been loaded on command by the CMU.

Contents of VDR's transmitted Label 270 status word

Protocol Status bit = "1"
Download Request bit = "0"

A11.4.2 VDR Periodic Reporting

The VDR periodically sends broadcast words to the CMU to convey status information. This is defined in ARINC Characteristic 750, Section 5.0.

A11.4.3 CMU Periodic Reporting

The CMU periodically sends broadcast words to the VDR to convey status information. This is defined in ARINC Characteristic 750, Section 5.0.

ATTACHMENT 11
ACARS INTERFACE PROTOCOL (ACARSIP)

A11.4.4 VDR Error Message

If the VDR experiences a protocol error during its operation with the CMU, it should send a VDR_ERROR.indication message.

A11.4.5 CMU Error Message

If the CMU experiences a non-fatal protocol error during its operation with the VDR, it should send a CMU_ERROR.indication message. c-2

A11.4.6 VDR Operating Parameter Data

If the VDR receives a PARAM.request message from the active CMU, the VDR transmits a PARAM.confirm message to the CMU within 1 second of the reception of the PARAM.request message. The PARAM.request message is used to set all operating parameters for the VDR including operating frequency, modulation, and pre-key. The VDR, upon sending a PARAM.confirm message, transitions to the PROTOCOL_SET protocol state. c-4

COMMENTARY

The only primitive available to the CMU to query the VDR for a list of its operational parameters is the PARAM.request primitive. Since the VDR responds with a PARAM.confirm message to every instance of a PARAM.request message, the content of the PARAM.confirm message can be used by the CMU to indicate error conditions or unsupported parameters in the VDR. For example, if the CMU attempts to set the Modulation format to 2400 bps DSB AM/MSK and the resulting PARAM.confirm message shows the Modulation format to be 31.5 kbps D8PSK, the CMU can infer that the feature is unsupported (or unavailable) in the VDR. c-2 c-4

In the event that the VDR cannot set the operating parameters to the values requested by the CMU in a PARAM.request message, it should not declare an error event, but should continue to function normally using the values it reported in the PARAM.confirm message it sent to the CMU. The CMU should make a determination if the mismatch in the contents of the PARAM.request and the PARAM.confirm messages is sufficient to warrant a VDR reset or failure declaration. c-2

A11.4.7 Signal Quality Parameter Reporting

The VDR should send to the CMU an SQP SOLO word for every received transmission from the ground containing a block with a valid BCS. SQP reporting is enabled only while the VDR is in the PROTOCOL_SET state.

A11.4.8 Address Request

In order for the CMU to receive or transmit any blocks, it sends a message to the VDR to set the contents of the DAS. The ADDR.request message is sent by the CMU to the VDR to set the contents of the DAS.

The VDR's DAS should be able to contain at least eight addresses. Since any addresses sent via this message entirely replaces the DAS's contents, the CMU can set the DAS to NULL by sending a NULL address list. c-2

The CMU should not transmit a block without setting the DAS, because the VDR is not able to forward the acknowledgment to the CMU with a null DAS.

A11.4.9 Address Confirm

The VDR sends an ADDR.confirm message to the CMU containing a list of all currently loaded addresses. The VDR sends this message in response to an ADDR.request message from the CMU within one second of its receipt.

ATTACHMENT 11
ACARS INTERFACE PROTOCOL (ACARSIP)

A11.4.10 Downlink Message Handling

c-2 The CMU sends to the VDR a UNITDATA.request message. The content of the message contains all information necessary to compose one block, and includes everything from the <SOH> character through the BCS Suffix character**,** c-3 including BCS calculation. The VDR affixes the VHF Preamble prior to transmission of the block.

c-2 The VDR queues only one message block for transmission at a time. Within one second of emptying the transmit buffer of this message (as the result of either a successful transmission of the block, overwrite of the block, or a commanded purge), the VDR sends the CMU a UNITDATA.confirm message.

It is possible that channel conditions could delay the VDR's CSMA algorithm from transmitting the message. The VDR persists in trying to transmit the queued message. The CMU is provided two methods to purge the untransmitted message. A PURGE.request message may be issued by the CMU to command the VDR to purge the outstanding message from its buffer. Alternatively, the CMU may send a new UNITDATA.request message, which overwrites the untransmitted message in the VDR's transmit queue. In either case, the VDR indicates which event occurred, either a purge or overwrite, by responding with a UNITDATA.confirm message once the buffer is actually emptied.

A11.4.11 Uplink Message Handling

If a received block has a valid BCS, and meets the address screening requirements of Section A11.4.12, then the VDR sends to the CMU a UNITDATA.indication message within one second of receiving the block. The content of the message contains everything from the <SOH> character through the BCS Suffix character**.** The VDR strips the VHF Preamble from the block prior to sending the UNITDATA.indication message to the CMU.

A11.4.12 Address Screening

Before a received block can be sent to the CMU, it should meet the following:

a. The Uplink/Downlink Block Identifier field should indicate that the block is an uplink block. It should consist of an "A" - "Z" (4/1 - 5/A) or "a" - "z" (6/1 - 7/A) or NUL (0/0) single character.

b. The address field should match one of the addresses previously loaded into the DAS by the CMU. The address should conform to the ISO-5 character encoding scheme and transmission order shown in ARINC Specification 618, Section 2.2.3.

c-2 COMMENTARY

In order for squitter uplink blocks to be sent to the CMU, the squitter all-call address is to be explicitly loaded into the DAS by the CMU.

When audit mode is enabled (per Section A11.4.14) message blocks may be forwarded regardless of the defined address screening.

Table A11-3 shows a generic block format.

A11.4.13 Error Handling and Recovery

The CMU, through examination of the PARAM.confirm message or by other indications, may determine that the VDR is in an unknown state. The CMU can command the VDR to enter the PROTOCOL_RESET state by sending a PR_SET.request message (Section 5.3.2.1). The VDR transitions to the PROTOCOL_RESET state when the PR_SET.request message is received. Either the VDR or the CMU can send an ERROR.indication message as the result of various non-fatal error conditions that may occur. The content of the ERROR.indication message provides an error code as well as an octet for an error data field. If the error occurred as the result of processing a received primitive, due to bad data length for example, the error data field contains the PID of the offending primitive.

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No explicit means is provided the VDR for fatal error recovery since the nature of a fatal error may prevent the VDR from recovering. In the event that the VDR resets itself to either an ARINC 750 Data mode or other mode of operation, the content of the VDR's Label 270 word unambiguously indicates to the CMU its current status and mode of operation.

A11.4.14 Audit Mode

The VDR can perform an audit mode function. In this mode the VDR sends to the CMU either: all received blocks, or all received blocks meeting the address screening requirements of Section A11.4.12, whether the BCS is valid or not. The information is sent to the CMU in an AUDITDATA.indication message and includes all data in the received block from the <SOH> through the BCS suffix characters.

This mode is enabled or disabled upon command by the CMU using an AUDIT.request message. The content of the message indicates which form of the audit mode is requested. Within 1 second of receipt of the message the VDR responds with an AUDIT.confirm message, indicating whether audit mode is enabled or disabled. While audit mode is enabled, the VDR continues to perform normal ACARS data transfers. c-2

A11.4.15 Subnetwork Statistics Data Function

The VDR can perform a subnetwork statistics data gathering function. When this mode is enabled the VDR collects the data identified in ARINC Specification 618, Section 5.10.2, at the period indicated in the request message. The information is sent to the CMU in a STAT.indication message periodically as indicated in the STAT.request message.

This mode is enabled or disabled upon command by the CMU using a STAT.request message. The content of the message indicates the reporting period and whether to enable or disable the reporting. Within one second of receipt of the message the VDR responds with a STAT.confirm message indicating whether the statistics function is enabled or disabled. c-4

A11.5 Primitives

The primitives that are transferred between the VDR and CMU are used for all command and data transfer.

Primitives are of three generic types: c-2

REQUEST	The REQUEST primitive is passed between the VDR and CMU when a response may be required. Primitives of this type have the form XXX.request.
CONFIRM	The CONFIRM primitive is passed between the VDR and CMU in response to a previous REQUEST primitive. Primitives of this type have the form XXX.confirm.
INDICATION	The INDICATION primitive is passed between the VDR and the CMU to convey unsolicited information such as user data or error messages. Primitives of this type have the form XXX.indication.

The general format of all the messages exchanged using the Extended BOP file transfer between the CMU and VDR is as defined in Section 5.1.3.1. For primitives composed of Extended SOLO words, the format is as defined in Section 5.1.3.2. c-3

A11.5.1 Message PARAM.request

The PARAM.request message is sent by the CMU to set all operating parameters for the VDR, including operating frequency and modulation mode. c-2

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ACARS INTERFACE PROTOCOL (ACARSIP)

A11.5.1 Message PARAM.request (cont'd)

Message Format

c-3 The message consists of one Extended BOP file of type COMMAND containing the following:

Octet	Parameters
1	EGFI
2	Primitive ID
3	Data field length MSB
4	Data field length LSB
5	Frequency MSB
6	Frequency LSB
7	Modulation format
8	Pre-key value

Parameters

c-3 EGFI

$F2_h$

Primitive ID field

20_h

Data field length MSB

00_h

Data field length LSB

04_h

Frequency MSB (tens, ones of freq. in MHz)

c-2 18 to 36 (12_h to 24_h) for 118 through 136 MHz.

Frequency LSB (tenths, hundredths of freq. in MHz, ignore 1000ths) 00 to 97 (00_h to 61_h) for xxx.000 through xxx.975 MHz.

Example: freq. = 121.775
MSB = 21 = 15_h
LSB = 77 = $4D_h$
(ignore thousandths place)

Modulation format (only 2400 bps DSB AM/MSK is supported)

c-4 00_h for 2400 bps DSB AM/MSK.

c-2 Pre-key value

c-3 0 to 85 ms, default value of 37 ms (25_h),

c-2 1 ms step size

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COMMENTARY

Pre-key requirements are a summation of the transmitter ramp up time of 2 msec (See Section 4.2.6.1) and the Remote Ground Station (RGS) Automatic Gain Control (AGC) and Synchronization time which is defined to be 35 msec or less per ARINC Specification 618. As a result, the total pre-key default value should be 37 msec.

Normal response

The VDR responds to this message with a PARAM.confirm message containing the VDR's active values for all the above parameters. c-2

Error response

In the event the VDR detects an error in the data contained in the message it sends an VDR_ERROR.indication message.

Reasons for failure

BADDATA - data length invalid or otherwise in error.

State

This message is processed in the PROTOCOL_RESET and PROTOCOL_SET substates of state S7. c-3

New State

The resulting state is unchanged.

A11.5.2 Message UNITDATA.request

The UNITDATA.request message is sent by the CMU to send ACARS data to the VDR. It contains one block to be transmitted by the VDR in the next available transmission. c-2

Message Format

The message consists of one Extended BOP file of type DATA containing the following: c-3

Octet	Parameters	
1	EGFI	c-3
2	Primitive ID	
3	Data field length MSB	c-2
4	Data field length LSB	
5	Data field byte #1	
6	Data field byte #2	
.	.	c-2
.	.	
.	.	
N+4	Data field byte #N	

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ACARS INTERFACE PROTOCOL (ACARSIP)

A11.5.2 Message UNITDATA.request (cont'd)

Parameters

c-3 EGFI
$F2_h$

Primitive ID field
21_h

Data field length MSB
MSB ($0\text{-}FF_h$)

Data field length LSB
LSB ($0\text{-}FF_h$)

Data field bytes
All bytes of data to be sent are consecutively ordered.

Normal response

c-2 The VDR responds with a UNITDATA.confirm message when the block clears its transmit buffer. This can occur as the result of three events:

a. the successful transmission of the block, or
b. the receipt of a PURGE.request message from the CMU.
c. the receipt of a UNITDATA.request message from the CMU that overwrites the existing buffer.

Error response

In the event the VDR detects an error in the data contained in the message, it sends a VDR_ERROR.indication message.

Reasons for failure

BADDATA - data length invalid or otherwise in error.

State

This message is processed in the PROTOCOL_SET substate of state S7.

c-3

New State

The resulting state is unchanged.

A11.5.3 Message ADDR.request

The ADDR.request message is sent by the CMU to manage addresses used by the VDR for address screening. It is used
c-2 by the CMU to set all addresses in the DAS. Any addresses set using this primitive completely replace the existing contents of the DAS.

Thus, if the CMU wishes to delete all entries in the DAS it can do so by sending a NULL table to the VDR with octet 5 set to 00_h.

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ACARS INTERFACE PROTOCOL (ACARSIP)

Message Format

The message consists of one Extended BOP file of type COMMAND containing the following: c-3

Octet	Parameters	
1	EGFI	c-3
2	Primitive ID	
3	Data field length MSB	c-2
4	Data field length LSB	
5	N, number of addresses contained in the file	
6	Address 1, character 1	
7	Address 1, character 2	
8	Address 1, character 3	
9	Address 1, character 4	
10	Address 1, character 5	
11	Address 1, character 6	
12	Address 1, character 7	
13	Address 2, character 1	
14	Address 2, character 2	
15	Address 2, character 3	
.	.	
.	.	
.	.	
N*7+5	Address N, character 7	

Parameters

EGFI c-3

$F2_h$

Primitive ID field

22_h

Data field length MSB

00_h

Data field length LSB c-2

01_h to 39_h

01_h accounts for the address number octet,

39_h accounts for 8*7+1 octets.

N

00_h to 08_h (0 to 8) The number of address contained in the file.

Address

The seven octets of the address compose the ISO-5 characters shown in the seven-unit character coding scheme c-4
in ARINC Specification 618, Section 2.3.3.

Normal response c-2

The VDR responds with a ADDR.confirm message within one second of receipt of the message.

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ACARS INTERFACE PROTOCOL (ACARSIP)

A11.5.3 Message ADDR.request (cont'd)

Error response

c-2 In the event the VDR detects an error in the data contained in the message, it sends VDR_ERROR.indication message.

Reasons for failure

BADDATA - data length invalid or otherwise in error.

State

c-3 This message is processed in the PROTOCOL_RESET and PROTOCOL_SET substates of state S7.

New State

The resulting state is unchanged.

A.11.5.4 Message CMU_ERROR.indication

c-2 The CMU_ERROR.indication message is sent by the CMU to indicate general error conditions.

Message Format

The message consists of one Extended BOP file of type COMMAND containing the following:

c-3

Octet	Parameters
1	EGFI
2	Primitive ID
3	Data field length MSB
c-2 4	Data field length LSB
5	Error code
6	Error data

Parameters

c-3 EGFI
F2h

Primitive ID field
23_h

Data field length MSB
00_h

c-2 Data field length LSB
02_h

Error code
see Table A11-2.

Error data
see Table A11-2.

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ACARS INTERFACE PROTOCOL (ACARSIP)

Normal response

None.

Error response

In the event the VDR detects an error in the data contained in the message, it sends a VDR_ERROR.indication message.

Reasons for failure

BADDATA - data length invalid or otherwise in error.

State

This message is processed in the PROTOCOL_RESET and PROTOCOL_SET substates of state S7.

New State

The resulting state is unchanged.

A11.5.5 Message AUDIT.request

The AUDIT.request message is sent by the CMU to command the VDR to enter or exit audit mode. Two forms of audit mode may be commanded by the CMU: un-screened or screened. When performing the un-screened audit mode the VDR sends all received and transmitted blocks to the CMU. When performing the screened audit mode the VDR sends all transmitted blocks and all received blocks that meet the address screening requirements of Section A11.4.12.

Message Format

The message consists of one Extended BOP file of type COMMAND containing the following:

Octet	Parameters
1	EGFI
2	Primitive ID
3	Data field length MSB
4	Data field length LSB
5	Command

Parameters

EGFI
$F2_h$

Primitive ID field
26_h

Data field length MSB
00_h

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ACARS INTERFACE PROTOCOL (ACARSIP)

A11.5.5 Message AUDIT.request (cont'd)

Data field length LSB
01_h

Command
00_h = disable audit mode.
01_h = enable un-screened audit mode.
02_h = enable screened audit mode.

Normal response

c-2 The VDR responds within one second of receipt with an AUDIT.confirm message.

Error response

In the event the VDR detects an error in the data contained in the message, it sends an VDR_ERROR.indication message.

Reasons for failure

BADDATA - data length invalid or otherwise in error.

State

This message is processed in the PROTOCOL_SET substates of state S7.

c-3

New State

The resulting state is unchanged.

A11.5.6 Message PARAM.confirm

c-2 The PARAM.confirm message is sent by the VDR as the result of a PARAM.request message. It returns information to the CMU about the state of the VDR operation and the contents of its operational parameters.

Message Format

The message consists of one Extended BOP file of type COMMAND containing the following:

c-3

Octet	Parameters
1	EGFI
2	Primitive ID
3	Data field length MSB
4	Data field length LSB
c-2 5	Frequency MSB
6	Frequency LSB
7	Modulation format
8	Pre-key value

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ACARS INTERFACE PROTOCOL (ACARSIP)

Parameters c-3

EGFI
$F2_h$

Primitive ID field
50_h

Data field length MSB
00_h

Data field length LSB
04_h

Frequency MSB (tens, ones of freq. in MHz)
18 to 36 (12_h to 24_h) for 118 through 136 MHz.

Frequency LSB (tenths, hundredths of freq. in MHz, ignore 1000ths)
00 to 97 (00_h to 61_h) for xxx.000 through xxx.975 MHz.

Example: freq. = 121.775
MSB = 21 = 15_h
LSB = 77 = $4D_h$ (ignore thousandths place) c-2

Modulation format
00_h for 2400 bps AM-MSK,
01_h for 31.5 kbps D8PSK.

Pre-key length ms
0 to 85 ms (55_h), 1 ms step size c-4

Normal response

None.

Error response

In the event the CMU detects an error in the data contained in the message, it sends a CMU_ERROR.indication message.

Reasons for failure

BADDATA - data length invalid or otherwise in error.

State

This message is processed in the PROTOCOL_RESET and PROTOCOL_SET substates of state S7. c-3

New State

The resulting state is the PROTOCOL_SET substate of S7.

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ACARS INTERFACE PROTOCOL (ACARSIP)

A11.5.7 Message UNITDATA.indication

c-2

The UNITDATA.indication message is sent by the VDR to send ACARS data to the CMU.

c-4 Note: The UNITDATA.indication and associated SQP.indication should be sent in the order shown in Figure A11-4

c-2 **Message Format**

The message consists of one Extended BOP file of type DATA containing the following:

c-3

Octet	Parameters
1	EGFI
2	Primitive ID
3	Data field length MSB
4	Data field length LSB
5	Data field byte #1, (first character of uplink <SOH>)
6	Data field byte #2
c-2	.
	.
	.
N+4	Data field byte #N, (last character of uplink, BCS suffix Character)

Parameters

c-3 EGFI

$F2_h$

Primitive ID field

51_h

Data field length MSB

MSB (0 to FF_h)

Data field length LSB

LSB (0 to FF_h)

Data field bytes

All bytes of data to be sent are consecutively ordered.

c-2 **Normal response**

None

Error response

In the event the CMU detects an error in the data contained in the message, it sends an CMU_ERROR.indication message.

Reasons for failure

BADDATA - data length invalid or otherwise in error.

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ACARS INTERFACE PROTOCOL (ACARSIP)

State

This message is processed in the PROTOCOL_SET substate of state S7.

New State

The resulting state is unchanged.

11.5.8 Message ADDR.confirm

The ADDR.confirm message is sent by the VDR to indicate the contents of its Destination Address Set. It is sent within one second of the receipt of a ADDR.request message.

Message Format

The message consists of one Extended BOP file of type COMMAND containing the following:

Octet	Parameters
1	EGFI
2	Primitive ID
3	Data field length MSB
4	Data field length LSB
5	N, number of addresses contained in the file
6	Address 1, character 1
7	Address 1, character 2
8	Address 1, character 3
9	Address 1, character 4
10	Address 1, character 5
11	Address 1, character 6
12	Address 1, character 7
13	Address 2, character 1
14	Address 2, character 2
15	Address 2, character 3
.	.
.	.
N*7+5	Address N, character 7

Parameters

EGFI
$F2_h$

Primitive ID field
52_h

Data field length MSB
00_h

Data field length LSB
01_h to 39_h
01_h accounts for the address number octet,
39_h accounts for 8*7+1 octets.

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ACARS INTERFACE PROTOCOL (ACARSIP)

11.5.8 Message ADDR.confirm (cont'd)

N

00_h to 08_h (0 to 8 addresses)

Address

The seven octets of the address compose the ISO-5 characters shown in the seven-unit character coding scheme in ARINC Specification 618, Section 2.3.3.

Normal response

c-2 None.

Error response

In the event the CMU detects an error in the data contained in the message, it sends a CMU_ERROR.indication message.

Reasons for failure

BADDATA - data length invalid or otherwise in error.

State

This message is processed in the PROTOCOL_RESET and PROTOCOL_SET substates of state S7.

c-3

New State

The resulting state is unchanged.

A11.5.9 Message VDR _ ERROR.indication

c-2 The VDR_ERROR.indication message is sent by the VDR to indicate general error conditions.

Message Format

The message consists of one Extended BOP file of type COMMAND containing the following:

c-3

Octet	Parameters
1	EGFI
2	Primitive ID
3	Data field length MSB
4	Data field length LSB
5	Error code
6	Error data

c-2

Parameters

c-3 EGFI

$F2_h$

c-2 Primitive ID field

53_h

Data field length MSB
00_h

Data field length LSB
02_h

Error code
see Table A11-2.

Error data
see Table A11-2.

c-2

Normal response

None.

Error response

In the event the CMU detects an error in the data contained in the message, it sends an CMU_ERROR.indication message.

Reasons for failure

BADDATA - data length invalid or otherwise in error.

State

This message is processed in the PROTOCOL_RESET and PROTOCOL_SET substates of state S7.

c-3

New State

The resulting state is unchanged.

A11.5.10 Message SQP.indication

The SQP.indication message is sent by the VDR and contains a quality of service report for the latest received transmission whose BCS is good. A ground station transmitted message is indicated by the content of the Uplink/Downlink Block Identifier field as defined in ARINC Specification 618, Section 2.3.6. The SQP.indication message should only be sent while the VDR is in the PROTOCOL_SET state.

c-2

The information contained in this message, the lower five bits of the mode character of the message from the transmitting ground station and the SQP of that transmission, can be used by the Link Management function in the CMU for link control procedures.

Note: The UNITDATA.indication and associated SQP.indication should be sent in the order shown in Figure A11-4. c-4

Message Format c-2

The message consists of an Extended SOLO word containing the following: c-3

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A11.5.10 Message SQP.indication (cont'd)

Bit	Definition
32	Parity
31-29	"101_b"
28-25	F_h
24-21	2_h
20-18	"000_b" (Primitive ID for SQP SOLO word)
17-13	Lower five bits of the received Mode Character.
12-09	SQP value (0_h to F_h (0 to 15), quality of service indicator, where 0 = poorest quality, 15 = best quality.)
08-01	SAL

NOTE: Since only uplink messages generate SQP reports, only the lower five bits of the mode character are needed for unambiguous determination of the sender (See ARINC Specification 618, Attachment 6).

Parameters

Mode Character

Lower five bits of the uplink mode character except when mode character is 2, then this field is set to $1F_h$.

SQP Value

Quality of service (signal strength) of uplink. Range 0 to 15 (0 to F_h), where 0 = poorest, 15 = best quality.

The SQP value should be determined from the RF signal strength using the following formula:

if (PdBm ≤ -98), then SQP = 0.

if (-98 < PdBm < -27) then SQP = INT(((100+PdBm)/5) + 0.5)

if (P ≥ -27), then SQP = 15

The signal strength measurement should be accurate to ±7 dB and monotonic.

Normal response

None.

Error response

None.

Reasons for failure

None.

State

This message is processed in the PROTOCOL_SET substate of state S7.

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ACARS INTERFACE PROTOCOL (ACARSIP)

New State c-3

The resulting state is unchanged.

A11.5.11 Message UNITDATA.confirm

The UNITDATA.confirm message is sent by the VDR to indicate that a previously queued block has cleared the transmit buffer. This can occur as the result of three events: c-2

a. the receipt of a PURGE.request message from the CMU.

b. the transmission of the block.

c. the receipt of a UNITDATA.request message from the CMU overwriting the non-transmitted contents of the transmit buffer.

NOTE: If the receipt of a PURGE.request message does not result in the purge of the transmit buffer, then a UNITDATA.confirm message is not sent.

Message Format c-3

The message consists of one Extended BOP file of type COMMAND containing the following:

Octet	Parameters
1	EGFI
2	Primitive ID
3	Data field length MSB
4	Data field length LSB
5	Data field octet

c-2

Parameters

EGFI c-3
$F2_h$

Primitive ID field
55_h

Data field length MSB
00_h

Data field length LSB c-2
01_h

Data field
00_h = Message not sent (purged)
01_h = Message sent
02_h = Transmit buffer overwritten.

Normal response

None

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ACARS INTERFACE PROTOCOL (ACARSIP)

A11.5.11 Message UNITDATA.confirm (cont'd)

NOTE: Else, it sends an ERROR.indication message.

Error response

c-2

In the event the CMU detects an error in the data contained in the message, it sends a CMU_ERROR.indication message.

Reasons for failure

BADDATA - data length invalid or otherwise in error.

State

This message is processed in the PROTOCOL_SET substate of state S7.

c-3

New State

The resulting state is unchanged.

A11.5.12 Message PURGE.request

c-2

The PURGE.request message is sent by the CMU to command the VDR to immediately purge its transmit buffer.

Message Format

The message consists of one Extended BOP file of type COMMAND containing the following:

c-3

Octet	Parameters
1	EGFI
2	Primitive ID
3	Data field length MSB
4	Data field length LSB

c-2

Parameters

c-3 EGFI

$F2_h$

Primitive ID field

25_h

c-2 Data field length MSB

00_h

Data field length LSB

00_h

Normal response

c-3 None.

NOTE: If as a result of this command the VDR purges a block from its transmit buffer, then the VDR sends a UNITDATA.confirm message as a response to an outstanding unacknowledged UNITDATA.request command previously received from the CMU.

Error response c-2

In the event the VDR detects an error in the data contained in the message, it sends a VDR_ERROR.indication message.

Reasons for failure

BADDATA - data length invalid or otherwise in error.

State

This message is processed in the PROTOCOL_SET substate of state S7. c-3

New State

The resulting state is unchanged.

A11.5.13 Message AUDIT.confirm c-2

The AUDIT.confirm message is sent by the VDR to indicate that an error free AUDIT.request message has been received. It is sent within one second of receipt of the AUDIT.request message.

Message Format

The message consists of one Extended BOP file of type COMMAND containing the following: c-3

Octet	Parameters
1	EGFI
2	Primitive ID
3	Data field length MSB
4	Data field length LSB
5	Command

c-2

Parameters

EGFI c-3
$F2_h$

Primitive ID field
56_h

Data field length MSB
00_h

Data field length LSB
01_h

c-2

Command
00_h = audit mode disabled.
01_h = un-screened audit mode enabled.
02_h = screened audit mode enabled.

Normal response

None.

Error response

c-2 In the event the CMU detects an error in the data contained in the message, it sends an CMU_ERROR.indication message.

Reasons for failure

BADDATA - data length invalid or otherwise in error.

State

c-3 This message is processed in the PROTOCOL_SET substate of state S7.

New State

The resulting state is unchanged.

A11.5.14 Message AUDITDATA.indication

c-2 The AUDITDATA.indication message is sent by the VDR to send audit data to the CMU. The data is sent anytime a block is received by the VDR, whether uplink or downlink, and whether the BCS is valid or not.

Message Format

The message consists of one Extended BOP file of type DATA containing the following:

c-3

Octet	Parameters
1	EGFI
2	Primitive ID
3	Data field length MSB
4	Data field length LSB
5	Data field byte #1, (first character of uplink <SOH>)
6	Data field byte #2
c-2 .	.
.	.
.	.
N+4	Data field byte #N, (last character of uplink, BCS suffix Character)

Parameters

c-3 EGFI
$F2_h$

Primitive ID field
c-2 57_h

Data field length MSB
MSB (0 to FF_h)

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ACARS INTERFACE PROTOCOL (ACARSIP)

Data field length LSB
LSB (0 to FF_h)

Data field bytes
All bytes of data to be sent are consecutively ordered.

Normal response

None.

Error response

In the event the CMU detects an error in the data contained in the message, it sends an ERROR.indication message.

Reasons for failure

BADDATA - data length invalid or otherwise in error.

State

This message is processed in the PROTOCOL_SET substate of state S7.

New State

The resulting state is unchanged.

A11.5.15 Message STAT.request

The STAT.request message is sent by the CMU to command the VDR to enable or disable the statistics data reporting. This message is also used to change the reporting interval.

The following reporting mechanisms are identified:

a. Periodic statistic reporting mode: The VDR gathers data for the indicated period. After each period elapses it sends a report containing the data to the CMU using a STAT.indication message.

b. Single statistic reporting mode: The VDR gathers data for the indicated period. After the period elapses it sends a single report containing the data to the CMU using a STAT.indication message.

For both of these modes the VDR will gather data for the period indicated and then send the data to the CMU in a STAT.indication message. If the VDR receives a STAT.request message from the CMU during the data gathering period, then it will abort the data gathering activity (no STAT.indication is sent), and will begin gathering data anew for the mode indicated in the new STAT.request message.

ATTACHMENT 11
ACARS INTERFACE PROTOCOL (ACARSIP)

Message Format

c-2 The message consists of one BOP file general format message block containing the following:

Octet	Parameters
1	EGFI
2	Primitive ID
3	Data field length MSB
4	Data field length LSB
5	Command
6-7	reporting period

Parameters

EGFI

$F2_h$

Primitive ID field

28_h

Data field length MSB

00_h

Data field length LSB

03_h

Command

00_h = disable periodic statistics reporting mode
01_h = enable periodic statistics reporting mode
02_h = change periodic reporting period
03_h = enable a single report for the duration indicated in the reporting period field

Reporting period MSB, LSB

1 to 1440 minutes, resolution minutes

Normal Response

The VDR responds within one second of receipt with a STAT.confirm, message.

Error response

In the event the VDR detects an error in the data contained in the message it sends a VDR_ERROR.indication message.

Reasons for failure

BADDATA - data length invalid, reporting period greater than 1440 minutes or otherwise in error.

State

This message is processed in the PROTOCOL_SET substate of state S7.

ATTACHMENT 11
ACARS INTERFACE PROTOCOL (ACARSIP)

New State

c-3

The resulting state is unchanged.

A11.5.16 Message STAT.confirm

The STAT.confirm message is sent by the VDR to indicate that an error free STAT.request message was received and is being processed. It is sent within one second of receipt of an error free STAT.request message.

Destination Code

c-2

The Destination Code should be set to 00_h

Message Format

The message consists of one BOP file general format message block containing the following:

Octet	Parameters	
1	EGFI	c-3
2	Primitive ID	
3	Data field length MSB	
4	Data field length LSB	
5	Command	c-2
6-7	Reporting period	

Parameters

EGFI
$F2_h$

c-3

Primitive ID field
58_h

Data field length MSB
00_h

Data field length LSB
03_h

Command

c-2

00_h = disable statistics reporting mode
01_h = enable statistics reporting mode
02_h = change reporting period
03_h = enable a single report for the duration indicated in the reporting period field

Reporting period MSB, LSB
1 to 1440 minutes, resolution minutes

c-3

Normal Response

c-2

None.

ATTACHMENT 11
ACARS INTERFACE PROTOCOL (ACARSIP)

A11.5.16 Message STAT.confirm (cont'd)

Error response

c-2 In the event the CMU detects an error in the data contained in the message, it sends a CMU_ERROR.indication message.

Reasons for failure

BADDATA - data length invalid, does not match request or otherwise in error.

State

c-3 This message is processed in the PROTOCOL_SET substate of state S7.

New State

The resulting state is unchanged.

A11.5.17 Message STAT.indication

c-2 The STAT.indication message is sent by the VDR to send statistics data to the CMU. If the STAT.request message commanded periodic data, then the data is sent at the periodic interval indicated. If the STAT.request message commanded a single message, then one STAT.indication message is sent.

Message Format

The message consists of one BOP file general format message block containing the following:

	Octet	Parameters
c-3	1	EGFI
	2	Primitive ID
c-2	3	Data field length MSB
	4	Data field length LSB
c-3	5	Cumulative VHF channel Busy (Tcu), range 0 to 99 (00_h to 63_h).
	6-8	Cumulative MAC delay (Tmac), 000000 to 999999 ms (0000_h to $0F423F_h$)
	9-10	Number of downlink blocks received from surrounding aircraft (D3), 000 to 999 (0000_h to $03E7_h$)
	11-12	Number of incomplete downlink blocks received from surrounding aircraft (ID3), 000 to 999 (0000_h to $03E7_h$)
	13-14	Number of downlink blocks received with bad BCS from surrounding aircraft (BD3), 000 to 999 (0000_h to $03E7_h$)
c-2	15	Number of uplink blocks addressed to aircraft with bad BCS (BU3), 00 to 99 (00_h to 63_h)
	16	Number of incomplete uplink blocks addressed to aircraft (IU3), 00 to 99 (00_h to 63_h)
	17-18	Number of uplink blocks addressed to other aircraft with bad BCS (BU4), 000 to 999 (0000_h to $03E7_h$)
	19-20	Number of incomplete uplink blocks addressed to other aircraft (IU4), 000 to 999 (0000_h to $03E7_h$)
	21	Number of Squitters received with bad BCS (BSQ2), 00 to 99 (00_h to 63_h)
	22	Number of incomplete Squitters received (ISQ2), 00 to 99 (00_h to 63_h)

ATTACHMENT 11
ACARS INTERFACE PROTOCOL (ACARSIP)

Parameters

EGFI
$F2_h$

Primitive ID field
59_h

c-3

Data field length MSB
00_h

Data field length LSB
12_h

Data
Variable, as described herein and in ARINC Specification 618, Section 5.10.2.

Normal Response

None.

c-2

Error response

In the event the CMU detects an error in the data contained in the message, it sends a CMU_ERROR.indication message.

Reasons for failure

BADDATA - data length invalid, or otherwise in error.

State

This message is processed in the PROTOCOL_SET substate of state S7.

New State

The resulting state is unchanged.

c-3

ATTACHMENT 11
ACARS INTERFACE PROTOCOL (ACARSIP)

Table A11-1 VDR - CMU Primitives

All primitives are composed of Extended BOP files except as indicated.

Command/Query message	Primitive	Sender	Primitive ID	Type
Operational parameter request	PARAM.request	CMU	20_h	COMMAND
CMU data transfer request	UNITDATA.request	CMU	21_h	DATA
Address request	ADDR.request	CMU	22_h	COMMAND
CMU Error indication	CMU_ERROR.indication	CMU	23_h	COMMAND
Transmit buffer purge request	PURGE.request	CMU	25_h	COMMAND
Audit mode request	AUDIT.request	CMU	26_h	COMMAND
Statistics mode request	STAT.request	CMU	28_h	COMMAND
Parameter confirmation	PARAM.confirm	VDR	50_h	COMMAND
VDR data transfer indication	UNITDATA.indication	VDR	51_h	DATA
Address confirmation	ADDR.confirm	VDR	52_h	COMMAND
VDR Error indication	VDR_ERROR.indication	VDR	53_h	COMMAND
Signal quality indication	SQP.indication (Extended SOLO word)	VDR	"000"	N/A
CMU data transfer confirmation	UNITDATA.confirm	VDR	55_h	COMMAND
Audit mode confirmation	AUDIT.confirm	VDR	56_h	COMMAND
Audit data transfer indication	AUDITDATA.indication	VDR	57_h	DATA
Statistics mode confirmation	STAT.confirm	VDR	58_h	COMMAND
Statistics data transfer indication	STAT.indication	VDR	59_h	COMMAND

Table A11-2 Error Messages

Error Condition	Sender	Error code	Error data
Unspecified Error	CMU/VDR	00_h	Don't care
Unrecognized Primitive ID	CMU/VDR	01_h	Offending Primitive ID
BADDATA	CMU/VDR	02_h	Offending Primitive ID
Out of Sequence or Unexpected Primitive	CMU/VDR	04_h	Offending Primitive ID

ATTACHMENT 11
ACARS INTERFACE PROTOCOL (ACARSIP)

Table A11-3 Generic Message Block Format

Field Name	Length
Start of Heading	1 char
Mode	1 char
Address	7 char
Technical Acknowledgment	1 char
Label	2 char
Uplink/Downlink Block Identifier	1 char
Start of Text	1 char
Text	220 char Max
Suffix	1 char
Block Check Sequence	16 bits
BCS Suffix Character	1 char

c-2

ATTACHMENT 11
ACARS INTERFACE PROTOCOL (ACARSIP)

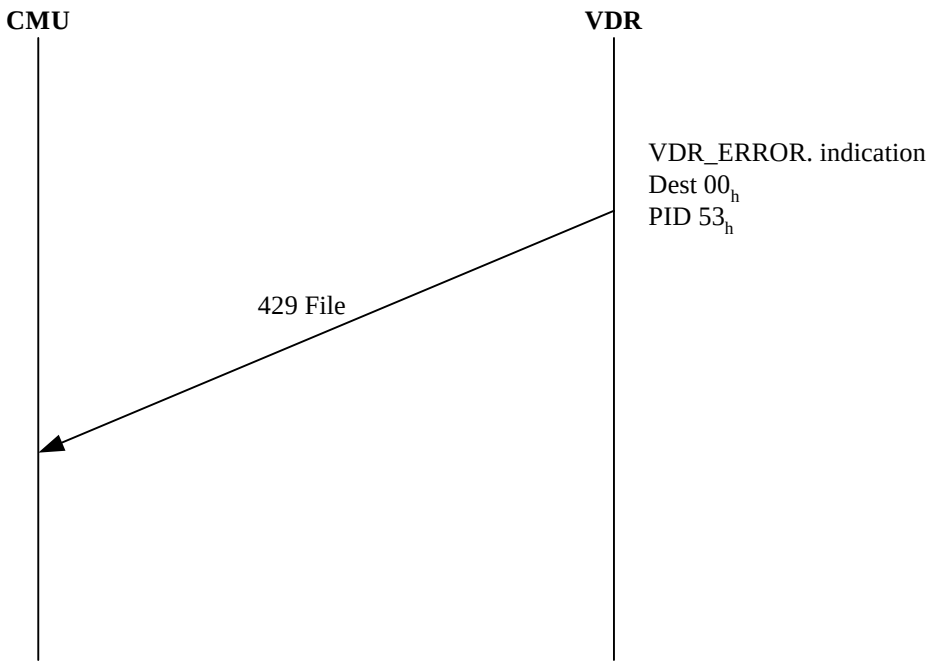


Figure A11-1 VDR Error Message

c-2

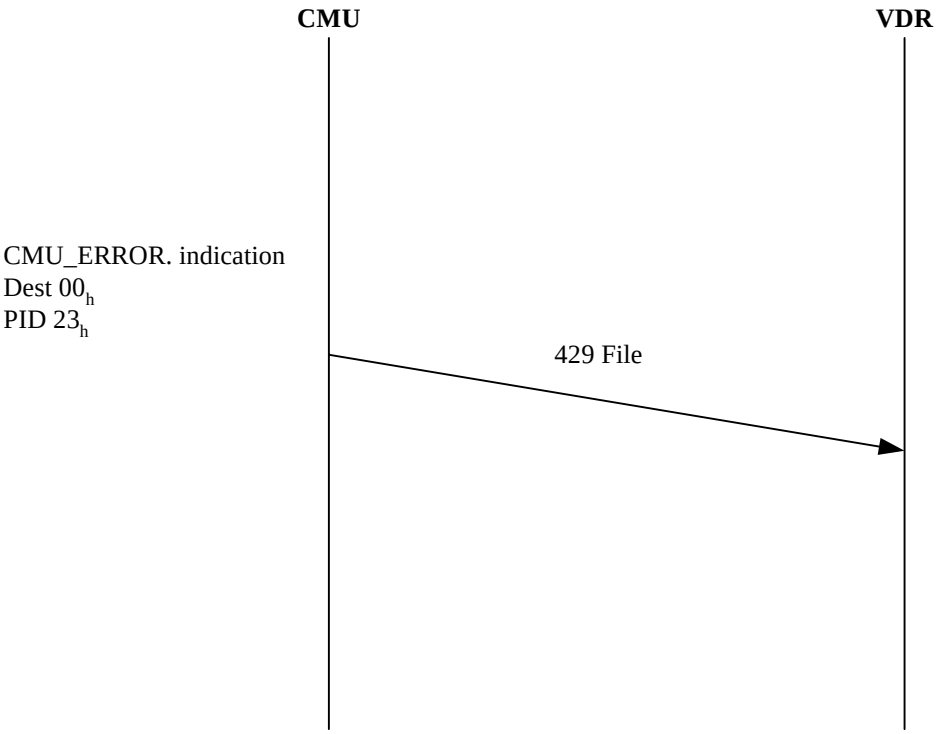
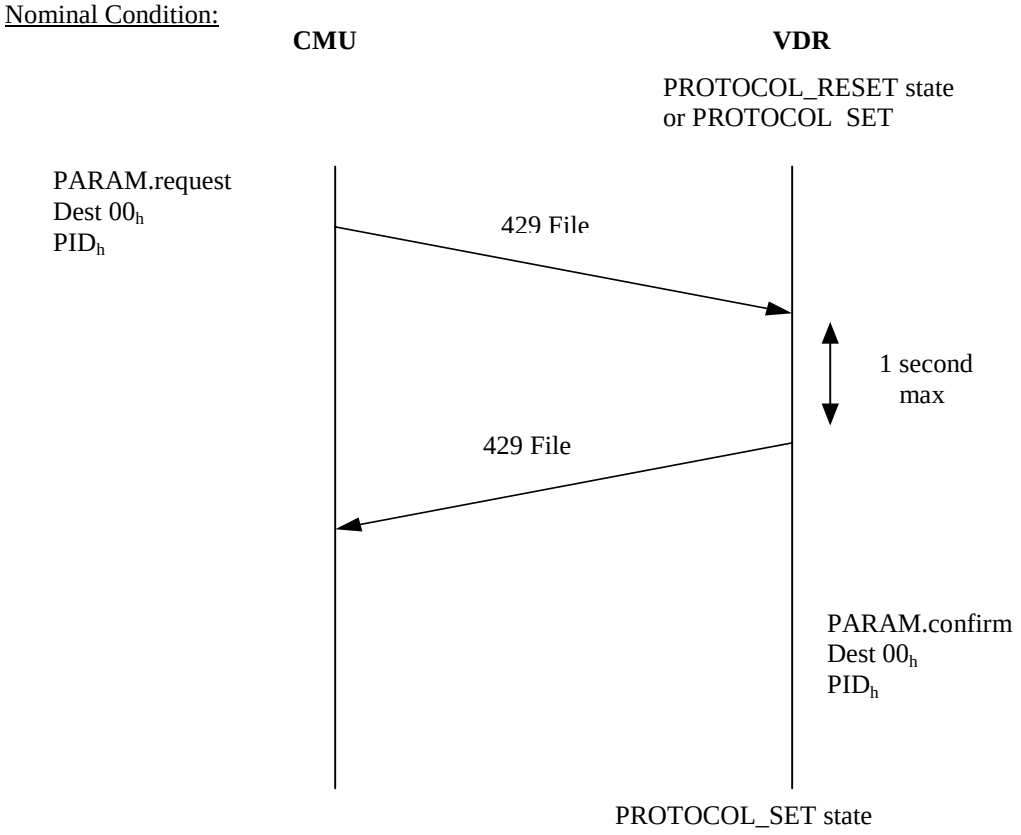


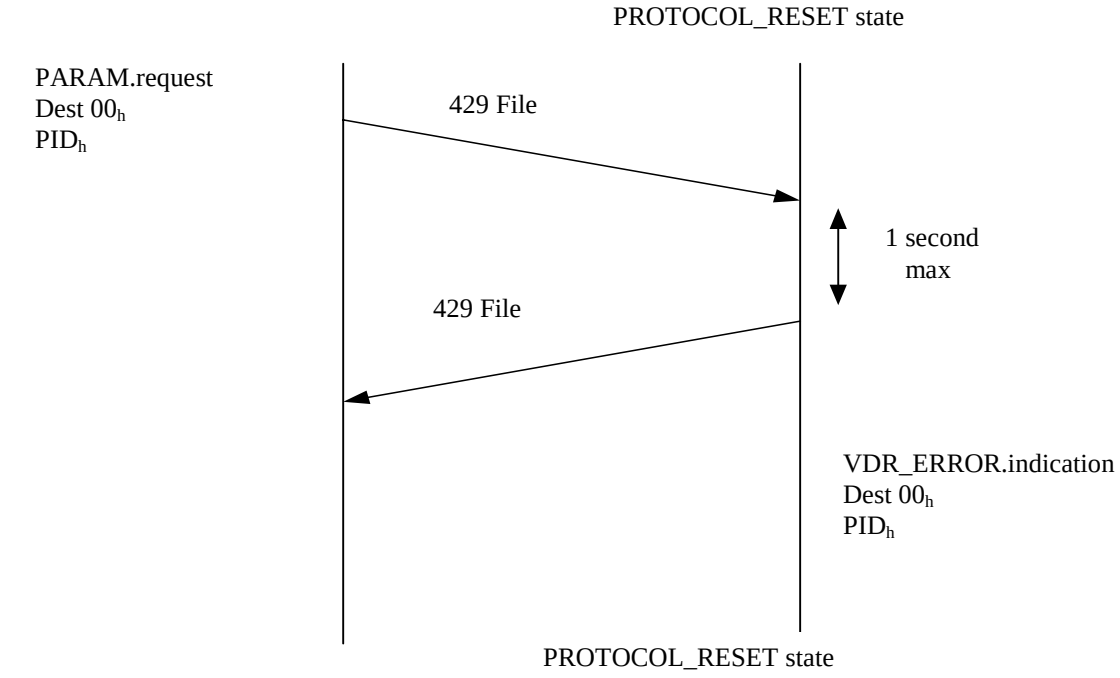
Figure A11-2 CMU Error Message

ATTACHMENT 11
ACARS INTERFACE PROTOCOL (ACARSIP)

Nominal Condition:



Error Condition:



c-2

Figure A11-3 VDR Operating Parameter Data

ATTACHMENT 11
ACARS INTERFACE PROTOCOL (ACARSIP)

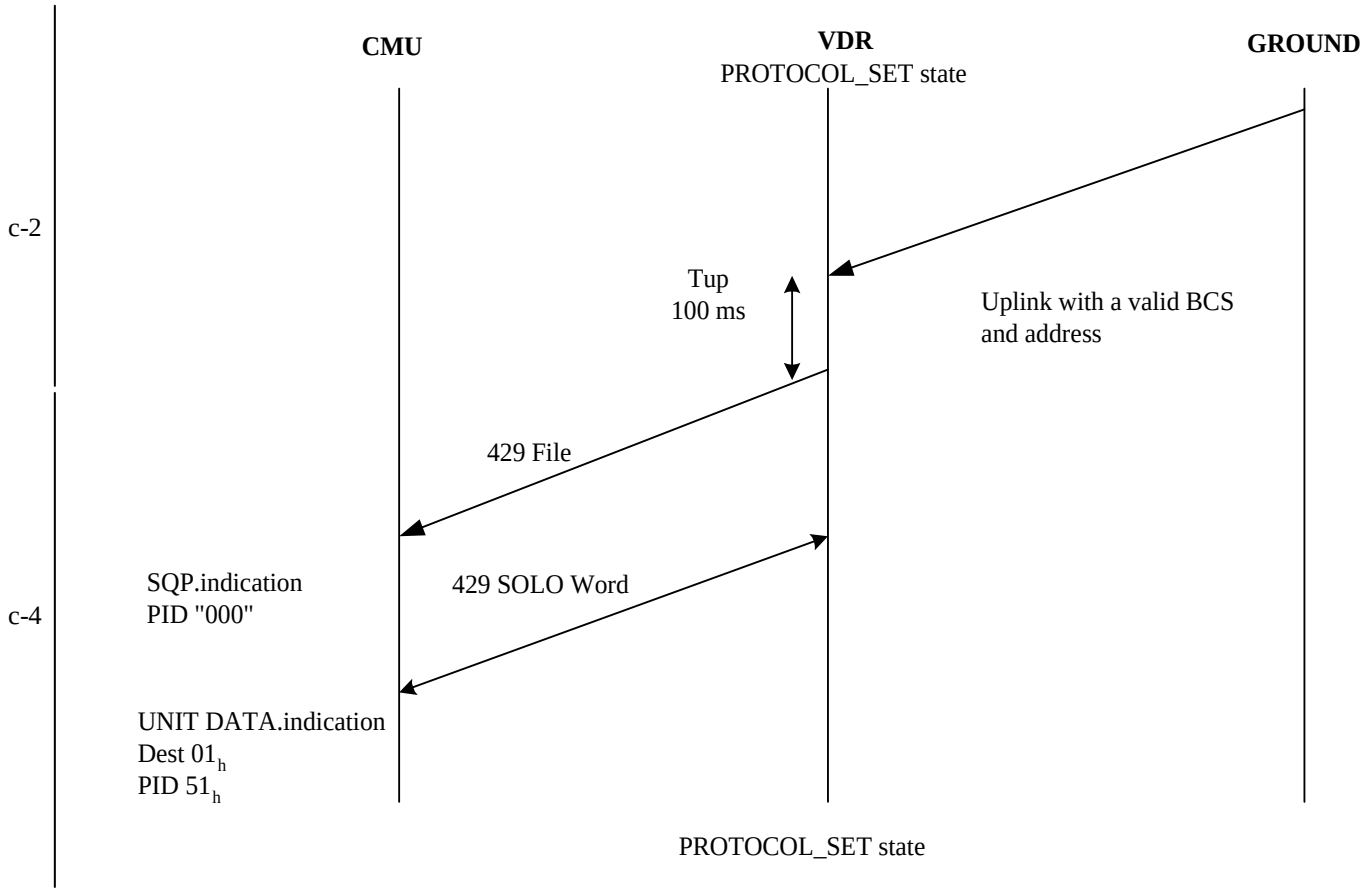
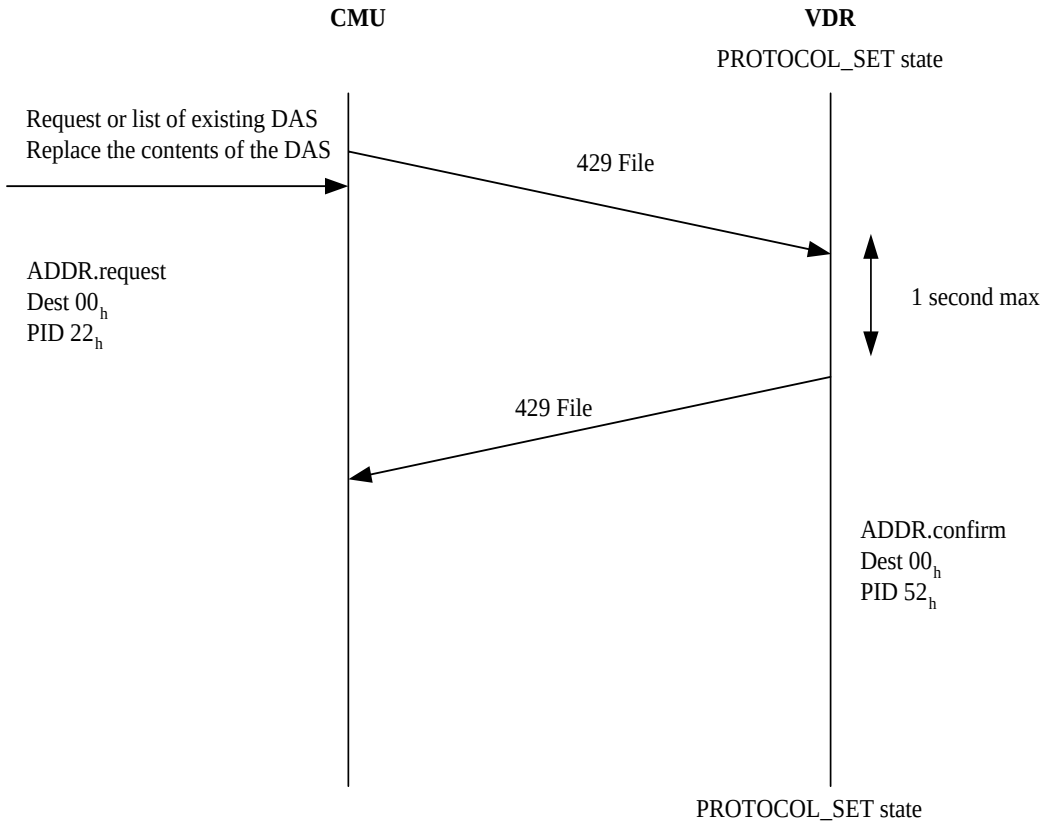


Figure A11-4 Uplink Process Reporting

c-4 | Note: The UNITDATA.indication and associated SQP.indication should be sent in the order shown.

ATTACHMENT 11
ACARS INTERFACE PROTOCOL (ACARSIP)

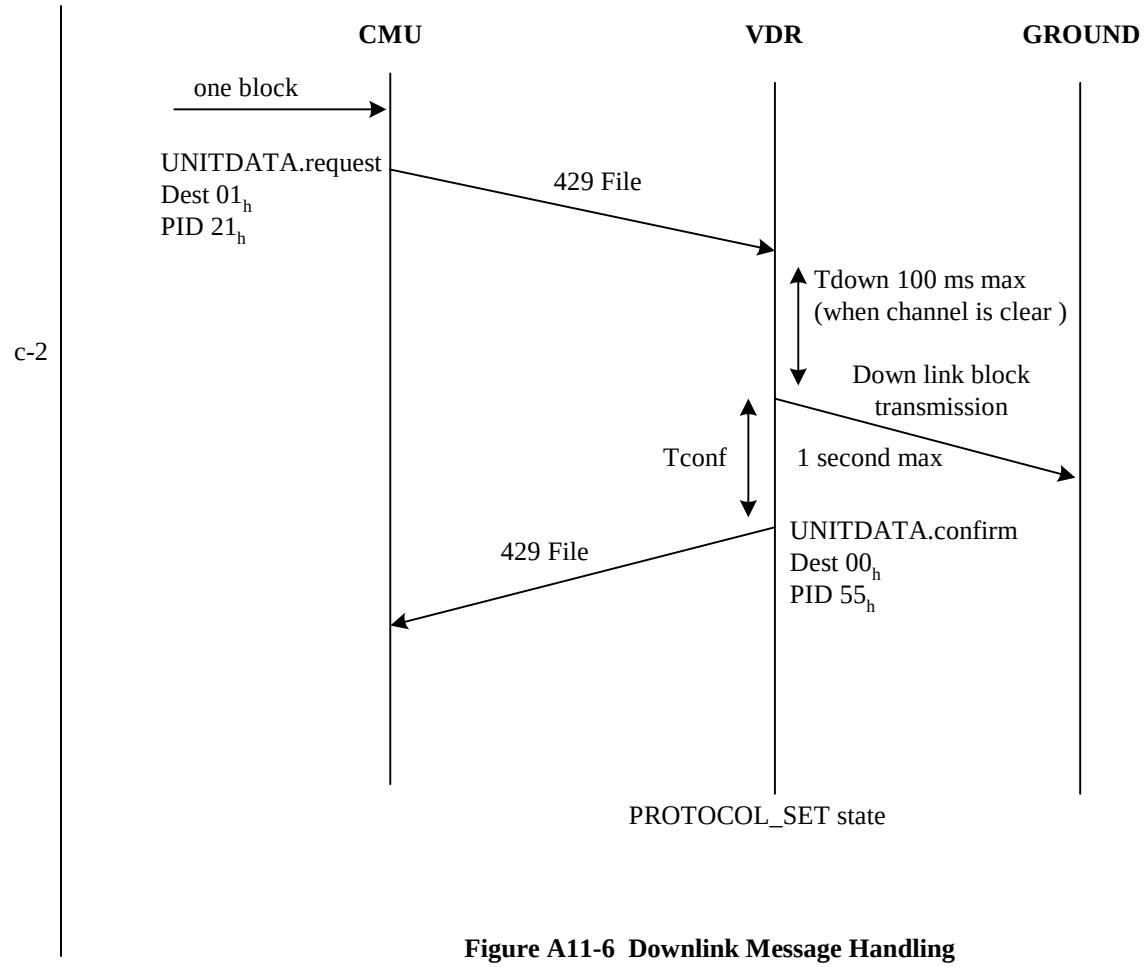
Nominal Condition :



c-2

Figure A11-5 Address Request and Address Response

ATTACHMENT 11
ACARS INTERFACE PROTOCOL (ACARSIP)



c-2

Figure A11-6 Downlink Message Handling

ATTACHMENT 11
ACARS INTERFACE PROTOCOL (ACARSIP)

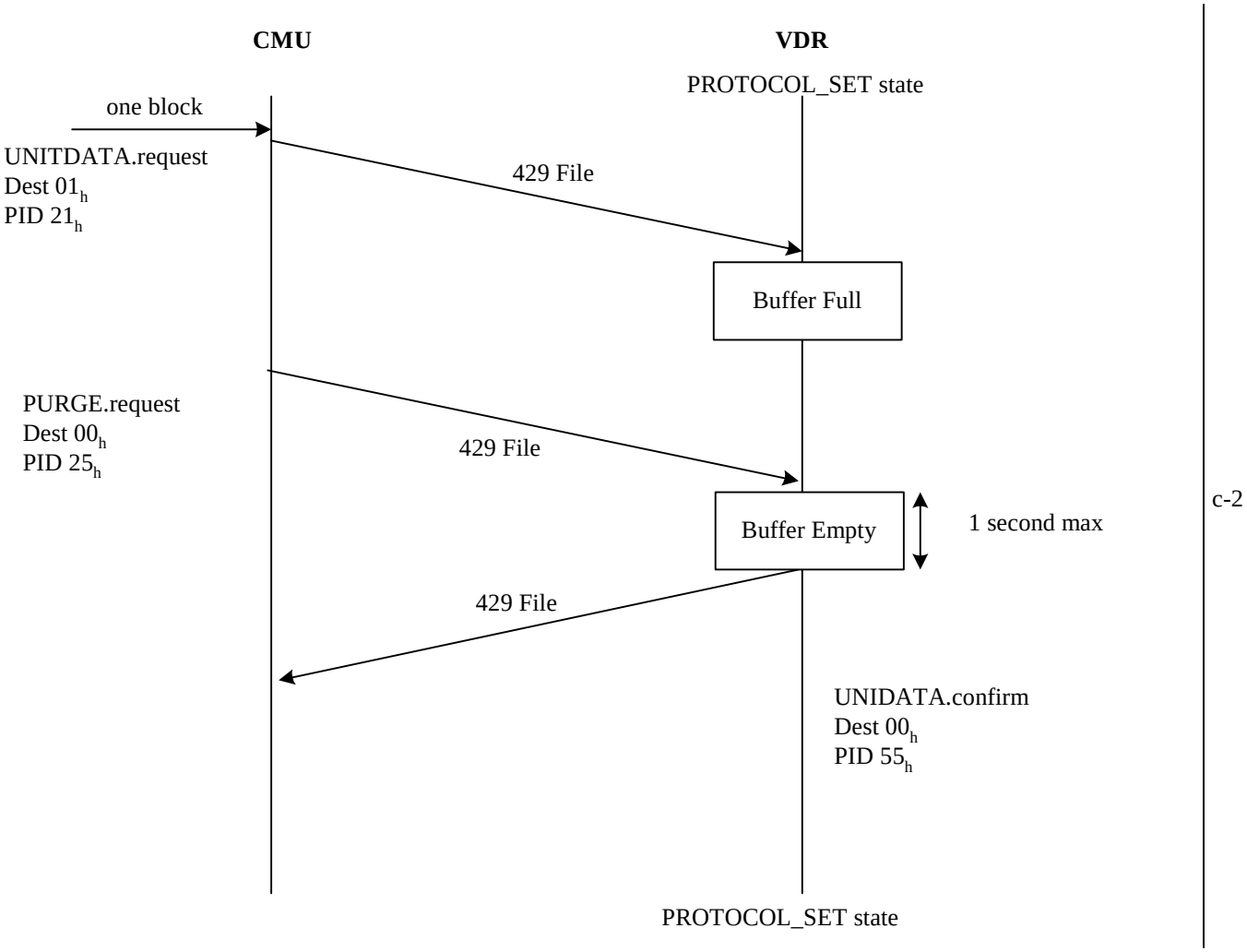


Figure A11-7 Purge Request With an Untransmitted Buffer (See Section A11.5.12)

ATTACHMENT 11
ACARS INTERFACE PROTOCOL (ACARSIP)

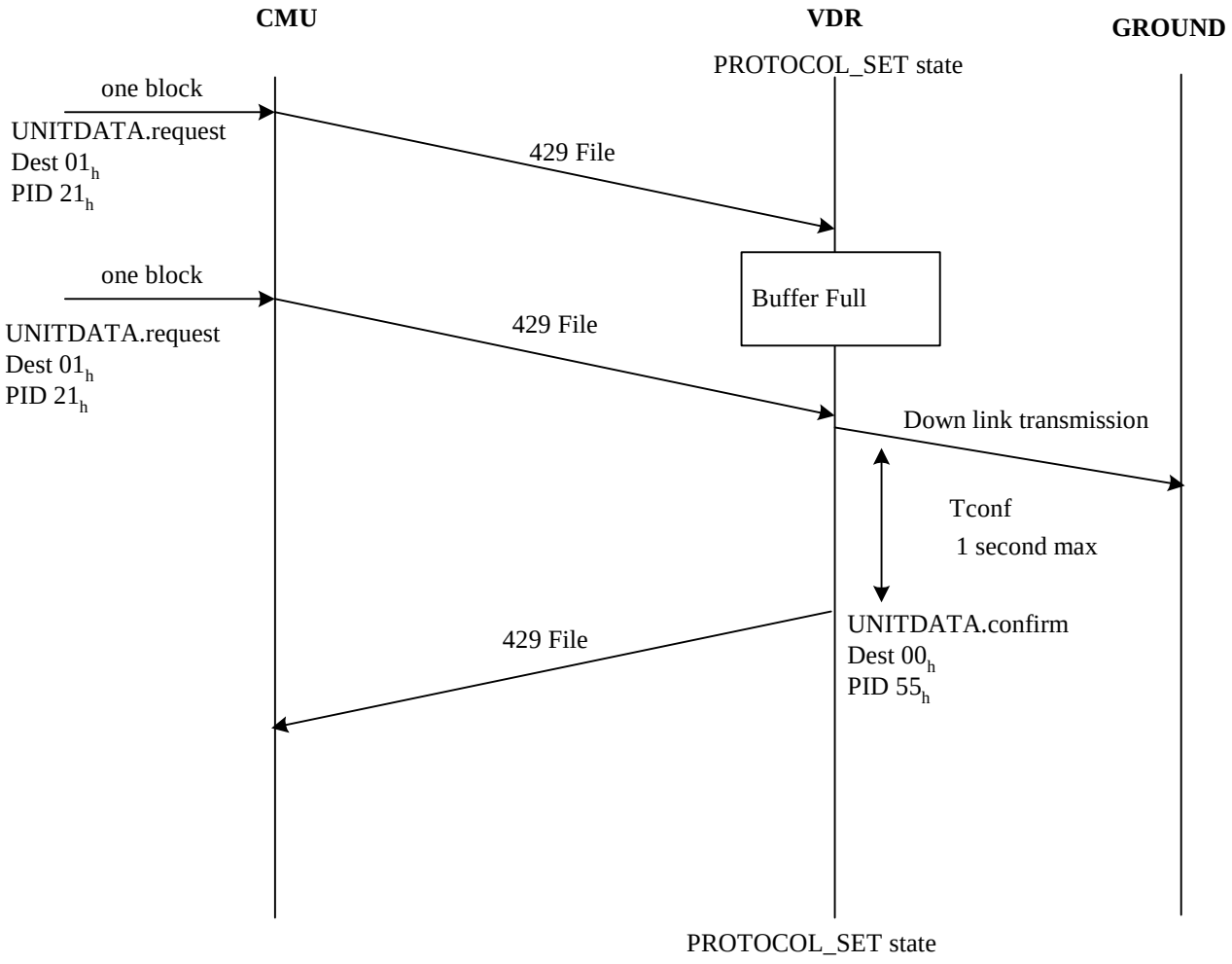
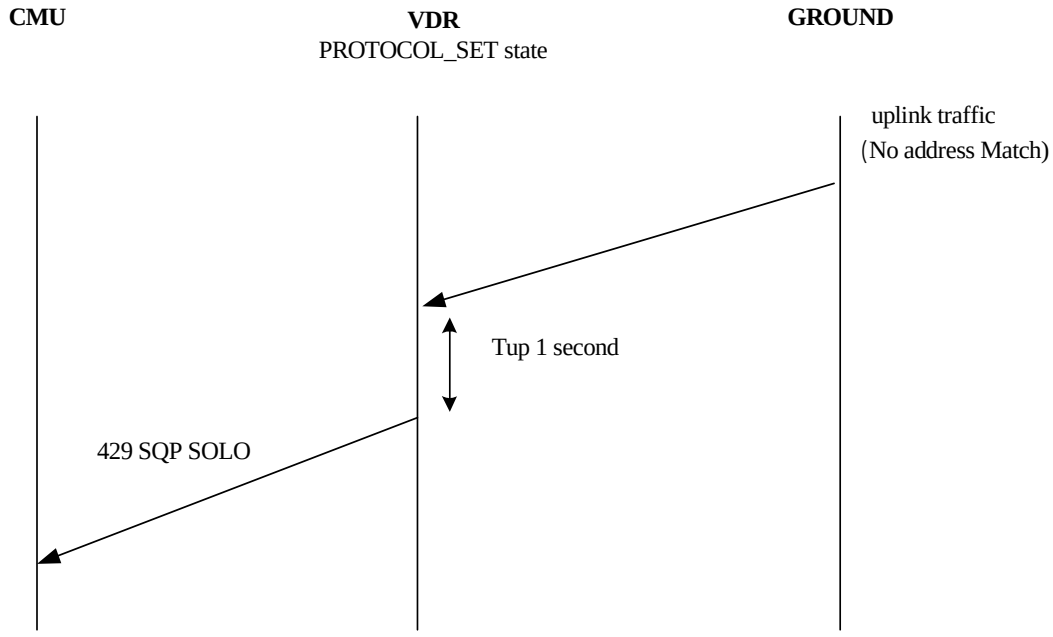


Figure A11-8 UNITDATA.request With a Full Buffer

c-3

ATTACHMENT 11
ACARS INTERFACE PROTOCOL (ACARSIP)

Nominal condition:

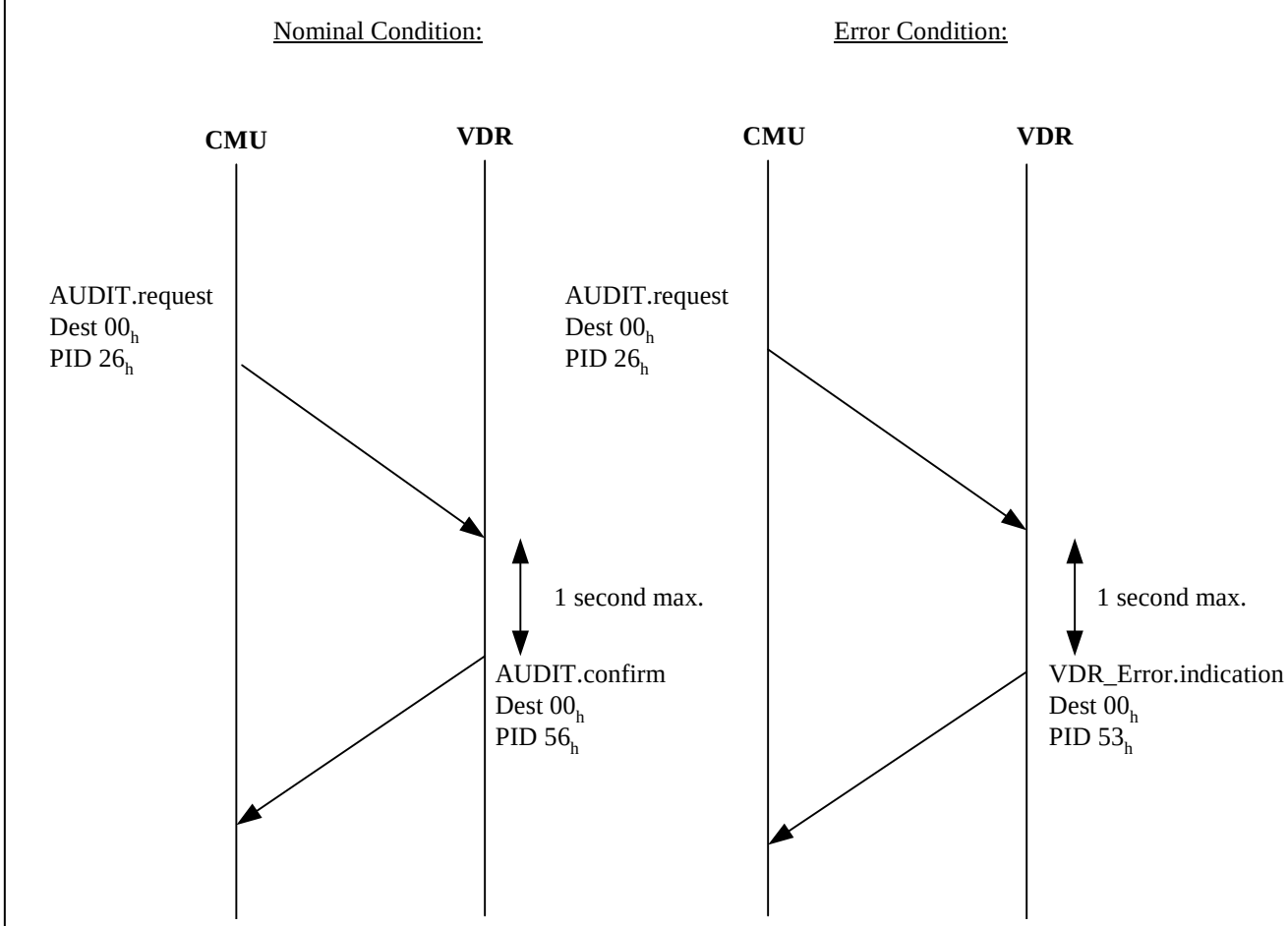


c-2
c-4
c-2
c-4

Figure A11-9 SQP Message Handling

c-2

ATTACHMENT 11
ACARS INTERFACE PROTOCOL (ACARSIP)



c-2

Figure A11-10 VDR AUDIT.request and AUDIT.confirm

ATTACHMENT 11
ACARS INTERFACE PROTOCOL (ACARSIP)

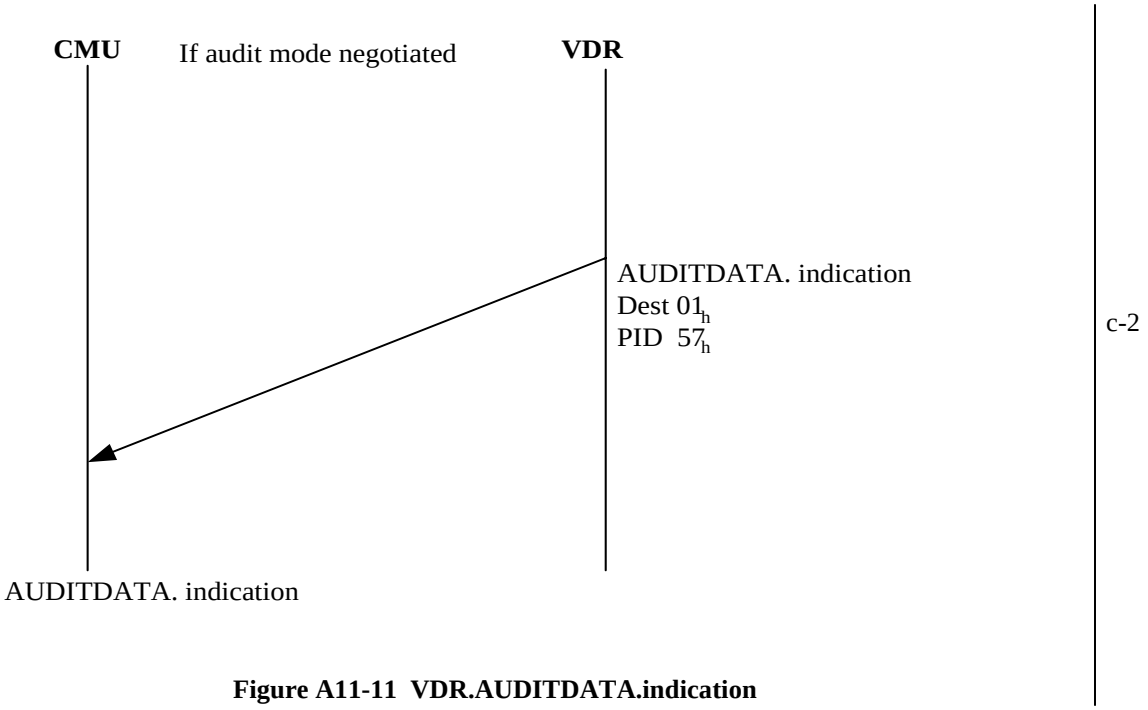


Figure A11-11 VDR.AUDITDATA.indication

ATTACHMENT 11
ACARS INTERFACE PROTOCOL (ACARSIP)

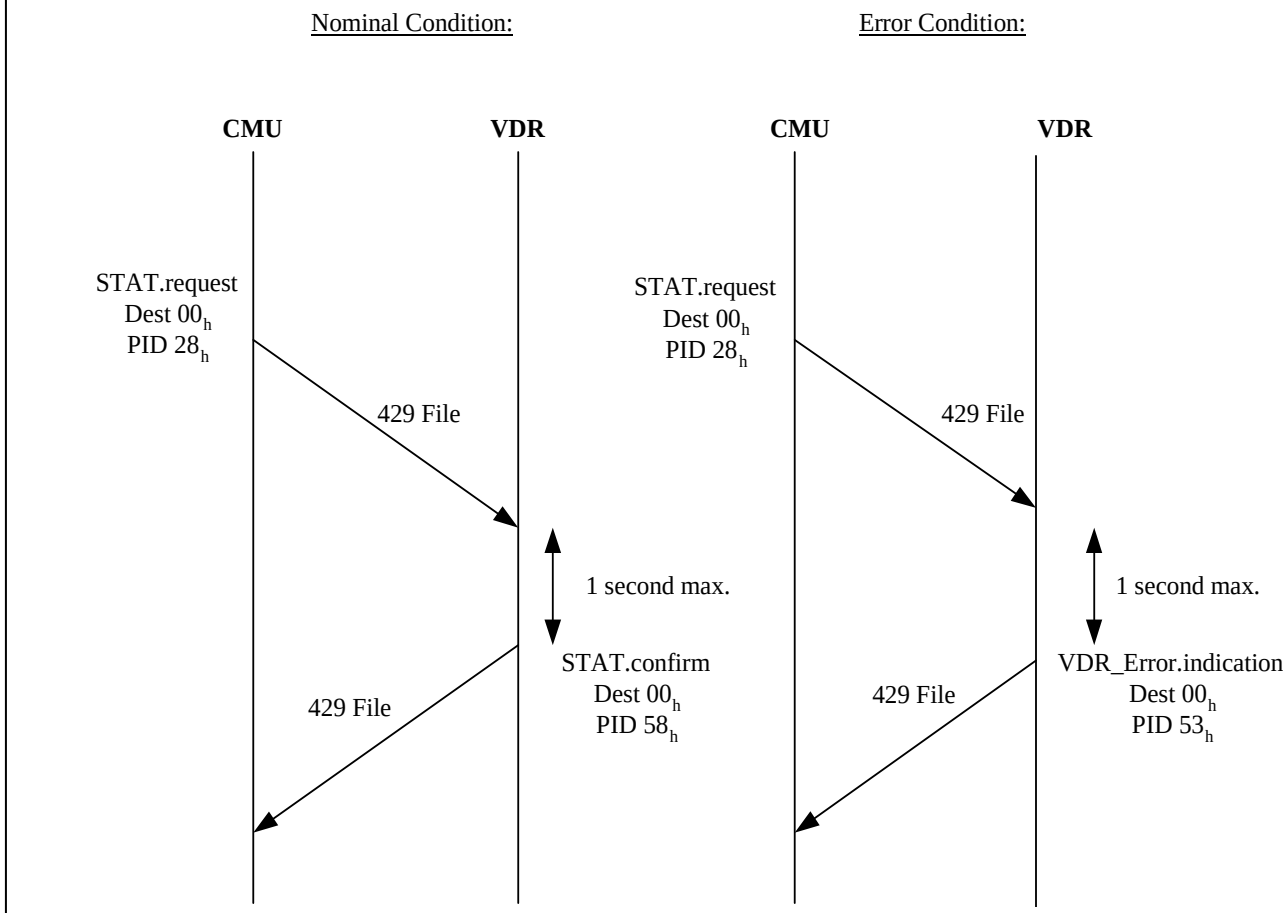


Figure A11-12 VDR STAT.request and STAT. confirm

ATTACHMENT 11
ACARS INTERFACE PROTOCOL (ACARSIP)

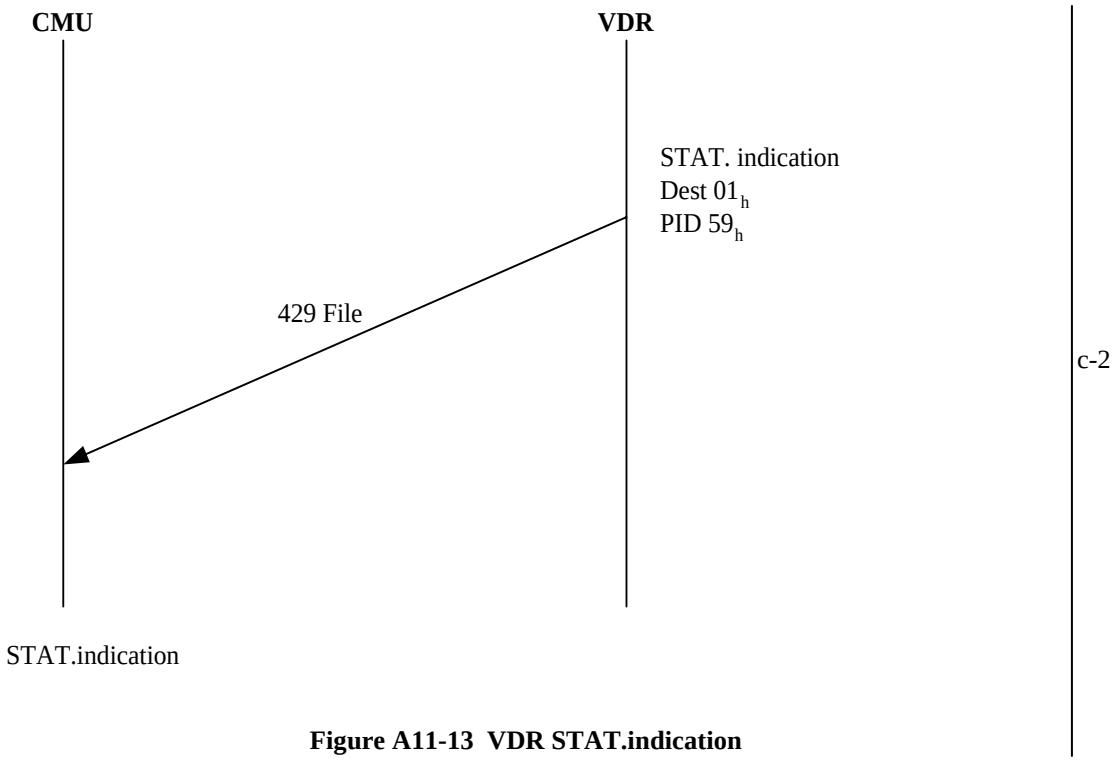


Figure A11-13 VDR STAT.indication

APPENDIX A
TERMS

	Balanced Mode	A communications protocol using a peer-to-peer relation.
	Baud Rate	Signaling rate.
c-3	BER	Bit error rate at the output of the Reed-Solomon decoder.
	Channel Rate	Information rate on the channel (raw data rate).
	Data Rate	Information rate available to the user.
c-3	dBc	dB with respect to carrier.
	dBm	dB with respect to a milliwatt.
	kbps	kilo bits per second
	Reference BER	An uncorrected BER of $1 * 10^{-3}$. This yields a block failure rate of $1 * 10^{-4}$.
c-1	Reference Power Level	This is the sensitivity specified in Section 4.3.1 for a given modulation scheme to achieve the reference BER.
	Unbalanced Mode	A communications protocol using a master-slave relation.
	Uncorrected BER	The raw bit error rate at the input to the Reed-Solomon decoder.

CONVENTIONS

In this document bytes are called octets and are numbered, from right (least significant bit) to left (most significant bit), 1 to 8 (e.g., $_{MSB}8765\ 4321_{LSB}$).

APPENDIX B
ACRONYMS

ac	Alternating Current	c-1
ACARS	Aircraft Communications Addressing and Reporting System	
ACARSIP	ACARS Simple Interface Protocol	c-4
ACK	Acknowledge	
AEEC	Airline Electronic Engineering Committee	
AM	Amplitude Modulation	
AMCP	Aeronautical Mobile Communications Panel	
ANB	Air Navigation Bureau	
ARINC	Aeronautical Radio Incorporated	
ASIP	AVLC Simple Interface Protocol	
ATE	Automatic Test Equipment	
AVLC	Aviation VHF Link Control	
BCS	Block Check Sequence	
BER	Bit Error Rate	
BITE	Built-In Test Equipment	
BOP	Bit-Oriented Protocol	c-1
BP	Bottom Plug	
CFDIU	Centralized Fault Display Interface Unit	
CFDS	Centralized Fault Display System	
CMC	Central Maintenance Computer	
CMU	Communications Management Unit	
CRC	Cyclical Redundancy Check	
COMM	Communications	
CTS	Clear-To-Send	
CU	Channel Utilization	
D8PSK	Differential Eight Phase Shift Keyed	
DAS	Destination Address Set	
dB	decibel	
dBc	Decibels with respect to carrier	c-4
dBm	decibels referenced to 1 milliwatt	
dBW	decibels referenced to 1 watt	
dc	direct current	
DFS	Digital Frequency Select	
DITS	Digital Information Transfer System	
DLS	Data Link Service	
DRB	Download Request Bit	
ECAC	Electromagnetic Compatibility Analysis Center	
EGFI	Extended GFI	
EID	Extended ID	
EMI	Electromagnetic Interference	
FCC	Federal Communications Commission	
FCS	Frame Check Sequence	c-1
FEC	Forward Error Correction	
FM	Frequency Modulated	
GFI	General Format Identifier	
ICAO	International Civil Aviation Organization	
ID	Identification	
I/O	Input/Output	
I/P	Internetworking Protocol	
ISO	International Standards Organization	
kHz	kilo Hertz	
LDU	Link Data Unit	
LME	Link Management Entity	
LRU	Line Replaceable Unit	
MAC	Media Access Control	
LSB	Least Significant Bit	
MASPS	Minimum Aviation System Performance Standard	c-4
MHz	Mega Hertz	c-1
MODEM	Modulator/Demodulator	
MOPS	Minimum Operational Performance Standards	c-4
MP	Middle Plug	c-1
msec	milliseconds	c-4
MSK	Minimum Shift Keying	
MSB	Most Significant Bit	
MU	Management Unit	c-1
MUX	Multiplexer	
N/A	Not Applicable	

APPENDIX B
ACRONYMS

	NCD	No Computed Data
	NCTS	Not-Clear-To-Send
c-1	NIC	New Installation Concepts
	nm	nautical mile
	OMS	Onboard Maintenance System
c-4	OSI	Open-System Interconnect (a model of layered protocols standardized by ISO)
c-1	PA	Power Amplifier
c-4	PICS	Protocol Identifier Code
c-1	PID	Primitive Identifier
	ppm	parts per million
c-4	pps	pulses per second
c-1	PSB	Protocol Status Bit
c-4	RTP	Radio Tuning Panel
	PTT	Push-to-Talk
	RCV	Receive
	RF	Radio Frequency
	RR	Receive Ready Frame
	RTS	Ready-To-Send
	SAL	System Address Label
	SARPs	Standards and Recommended Practices
	SDI	Source/Destination Identifier
	SELCAL	Selective Calling
c-1	SOT	Start of Transmission
	SREJ	Selective Reject
	SQP	Signal Quality Parameter
	SSM	Sign Status Matrix
	SYS	System
	TBD	To Be Determined
	TP	Top Plug
	TSO	Technical Standard Order
	Vdc	Volts direct current
	VDL	VHF Digital Link
	VDR	VHF Data Radio
	VHF	Very High Frequency
	VSWR	Voltage Standing Wave Ratio
	W	Watt

APPENDIX C
BIBLIOGRAPHY

The following documents are referenced in this Characteristic. Designers should be aware that many of these documents are in the continuing process of being supplemented.

ARINC Specification 404A, “Air Transport Equipment Cases and Racking”

ARINC Report 413A, “Guidance for Aircraft Electrical Power Utilization and Transient Protection”

ARINC Specification 429, “Mark 33 Digital Information Transfer System (DITS)” | c-1

ARINC Specification 600, “Air Transport Avionics Equipment Interfaces”

ARINC Report 604, “Guidance for Design and Use of Built-In Test Equipment (BITE)”

ARINC Specification 608A, “Design Guidance for Avionics Test Equipment” | c-1

ARINC Specification 615, “Airborne Computer High Speed Data Loader” | c-4

ARINC Specification 618, “Air-Ground Character-Oriented Protocol Specification”

ARINC Specification 619, “ACARS Protocols for Avionic End Systems” | c-1

ARINC Specification 620, “Data Link Ground System Standard and Interface Specification”

ARINC Report 624, “Design Guidance for Onboard Maintenance System”

ARINC Specification 626, “Standard ATLAS for Modular Test”

ARINC Specification 627, “Programmers Guide for SMART™ Systems Using ARINC 626 ATLAS” | c-1

ARINC Specification 631, “VHF Digital Link Implementation Provisions”

ARINC Specification 637P1, "Aeronautical Telecommunications Network (ATN): Implementation Provisions, Part 1, Protocols and Services" | c-4

ARINC Report 660A, "CNS/ATM Avionics, Functional Allocation and Recommended Architectures"

ARINC Characteristic 716, “Airborne VHF Communication Transceiver”

ARINC Characteristic 724, “Mark 2 Aircraft Communications Addressing and Reporting System (ACARS)” | c-1

ARINC Characteristic 724B, “Aircraft Communications Addressing and Reporting System (ACARS)”

ARINC Characteristic 758, “Communications Management Unit (CMU) Mark-2” | c-1

ICAO Annex 10, Volume III, Part I -- Standards and Recommended Practices (SARPs), Digital Data Communication Systems, Chapter 6, VHF Digital Link

ICAO Document 9776, Manual on VHF Digital Link (VDL) Mode 2 | c-4

RTCA Document DO-160D, “Environmental Conditions and Test Procedures for Airborne Electronic/Electrical Equipment and Instruments”

RTCA Document DO-207, “Minimum Operational Performance Standards for Devices that Prevent Blocked Channels used in Two-Way Radio Communications Due to Unintentional Transmissions”

RTCA Document DO-224A, “Signal-In-Space Minimum Aviation Systems Performance Standards (MASPS) for Advanced VHF Digital Data Communications Including Compatibility with Digital Voice Techniques” | c-4

RTCA Document DO-281, "MOPS for Aircraft VDL Mode 2 Transceiver Operating in the Range 117.975-137.000 MHz" | c-4

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SUPPLEMENT 1
TO
ARINC CHARACTERISTIC 750
VHF DATA RADIO

Published: December 1, 1995

Adopted by the Airlines Electronic Engineering Committee: October 31, 1995

A. PURPOSE OF THIS DOCUMENT

This Supplement primarily introduces a change from Offset Quadrature Amplitude Modulation (OQAM) to Differential Eight Phase Shift Key (D8PSK) modulation as defined in the Draft International Civil Aviation Organization (ICAO) Standards and Recommended Practices (SARPs) for VHF Digital Link (VDL). Section 3.0, Modes of Operation and Section 5.0, Interface and Protocols to the CMU/MU, have been replaced in their entirety. A new Attachment 10, AVPAC Simple Interface Protocol (ASIP), has been added.

B. ORGANIZATION OF THIS DOCUMENT

This Supplement introduces a major rework of ARINC Characteristic 750. The normal practice of publishing a separate supplement to update the existing document has not been followed. The extensiveness of the changes introduced by Supplement 1 has resulted in the impracticality of producing a separate set of replacement pages. Supplement 1 is therefore available only as an integral part of ARINC Characteristic 750-1. The modified and added material on each page is identified by a c-1 in the margins.

C. CHANGES TO ARINC CHARACTERISTIC 750 INTRODUCED BY THIS SUPPLEMENT

This section presents a complete tabulation of the changes and additions to the Characteristic 750 introduced by Supplement 1. Each change or addition is defined by the section number and the title employed in the Characteristic. In each case a brief description of the change or addition is included.

1.2 Airborne Subsystem Configuration

ARINC Characteristic 748 was changed to ARINC Characteristic 758 and Commentary was added.

1.3.1 General

The reference to ARINC Report 414 was changed to ARINC Report 607, "Design Guidance for Avionic Equipment". ARINC Report 414 is now considered obsolete.

1.3.2 Interchangeability Required for the ARINC 750 VHF Data Radio

An editorial change was made and commentary was added.

1.5 Relationship to ICAO Documents

This section was added since ICAO documents are being cited.

2.3 Standard Interwiring

The first paragraph after the commentary was deleted as ARINC Report 414 is now considered obsolete.

3.0 Modes of Operation

Section 3.0 Modes of Operation and subsections were replaced in their entirety.

4.2.1 RF Power Output

RF Power output changed to be consistent with the RTCA MASPS and ICAO SARPS.

4.2.3.1 RF Output Power Level Regulation (D8PSK)

Modulation changed from "OQAM" to "D8PSK". Changes in text made to accommodate new modulation. Commentary was deleted.

4.2.3.3 Radio Transmitter Keying Protection

This section was revised to clarify that there are two maximum transmit timeout modes, one for voice and one for data and that the voice mode timeout is to be compliant with RTCA document DO-207.

4.2.4 Tuning

Text in the first paragraph was changed from "...capable of tuning to any of the 760 25 kHz channels from 118.000 MHz through 136.975 MHz ..." to "...capable of tuning to its assigned channel...".

4.2.7 Modulation Definition for D8PSK

"OQAM" changed to "D8PSK" in the title. A reference was made to the Draft International Civil Aviation Organization (ICAO) Standards and Recommended Practices (SARPs) for VHF Digital Link (VDL) for the modulation definition.

4.2.7.1 Analog Signal Transmission (OQAM)

Section deleted.

4.2.7.2 Data Encoder (OQAM)

Section deleted.

4.2.7.3 Training Sequence (4-OQAM)

Section deleted.

4.2.7.3.1 Pre-Key (4-OQAM)

Section deleted.

4.2.7.3.2 Synchronization and Ambiguity Resolution (4-OQAM)

Section deleted.

4.2.7.3.3 Reserved Symbol (4-OQAM)

Section deleted.

4.2.7.3.4 Transmission Length (4-OQAM)

Section deleted.

4.2.7.3.5 Header Error Correction Code (4-OQAM)

Section deleted.

4.2.7.3.6 Equalizer Training Sequence (4-OQAM)

Section deleted.

4.2.7.4 Training Sequence (16-OQAM)

Section deleted.

4.2.7.4.1 Pre-Key (16-OQAM)

Section deleted.

4.2.7.4.2 Synchronization and Ambiguity Resolution (16-OQAM)

Section deleted.

4.2.7.4.3 Reserved Symbol (16-OQAM)

Section deleted.

4.2.7.4.4 Transmission Length (16-OQAM)

Section deleted.

4.2.7.4.5 Header Error Correction Code (16-OQAM)

Section deleted.

4.2.7.4.6 Equalizer Training Sequence (16-OQAM)

Section deleted.

4.2.7.5 Equalization (OQAM)

Section deleted.

4.2.7.6 Bit Scrambling (OQAM)

Section deleted.

4.2.7.7 Forward Error Correction (OQAM)

Section deleted.

4.2.7.8 Interleaving (OQAM)

Section deleted.

4.2.8.2 Adjacent Channel Emissions (D8PSK)

The section title changed from "Transmitter Occupied Spectrum Mask (OQAM)" to "Adjacent Channel Emissions (D8PSK)". Adjacent channel emissions specifications were made consistent with those specified in the Draft ICAO International Standards Recommended Practices and Procedures for Air Navigation Services ANNEX 10 to the Convention on International Civil Aviation Volume 1, Part 1.

4.2.8.3 Transmitter Phase and Amplitude Balance (D8PSK)

Title and text changed to reflect new D8PSK modulation.

4.2.8.5 Transmitter Phase Acceleration (D8PSK)

Modulation changed from "OQAM" to "D8PSK" in the title. Attack was changed to stabilization in two places and the reference to Section 4.2.3.2 was deleted.

4.3.1 Sensitivity

Modulation changed from "OQAM" to "D8PSK". For D8PSK, BFR changed from "10^{-6}" to "10^{-4}" and signal power level changed from "-105" to "-102" dBm. For MSK, BER changed from "10^{-6}" to "10^{-4}" and signal power level changed from "-105" to "-102" dBm. The commentary was deleted.

4.3.2 Burnout Protection

The brackets around +20 dB were removed. The commentary was deleted.

4.3.3 Selectivity

Section rewritten to reflect selectivity for D8PSK modulation.

4.3.4.2 Undesired Signal Rejection

Title changed from "Receiver Operation in the Presence of Interfering Transmissions" and new text added on undesired signal rejection to be consistent with the Draft ICAO International Standards Recommended Practices and Procedures for Air Navigation Services ANNEX 10 to the Convention on International Civil Aviation Volume 1, Part 1.

4.3.4.3 Interference Immunity Performance

Title changed from "Undesired Response" and new text added on interference immunity performance to be consistent with the Draft ICAO International Standards Recommended Practices and Procedures for Air Navigation Services ANNEX 10 to the Convention on International Civil Aviation Volume 1, Part 1.

4.3.4.4 Receiver Performance in the Presence of Out-of-Band FM Broadcast Interference

Section deleted.

4.3.4.5 Adjacent Channel Interference

Section deleted.

4.3.6 Channel Sense Algorithm

A reference was made to the Draft International Civil Aviation Organization (ICAO) Standards and Recommended Practices (SARPs) for VHF Digital Link (VDL) for the Channel Sense Algorithm definition.

4.3.6.1 Channel Quiescent Value

Section deleted.

4.3.6.2 Channel Busy Threshold

Section deleted.

4.3.6.3 Channel Sense Reporting

Section deleted.

4.4 Transmitter-Receiver Interaction

A reference was made to the Draft International Civil Aviation Organization (ICAO) Standards and Recommended Practices (SARPs) for VHF Digital Link (VDL) for the transmitter-receiver interaction definition.

4.4.1 Transmitter to Receiver Turnaround Time

Section deleted.

4.4.2 Receiver to Transmitter Turnaround Time

Section deleted.

5.0 Interface and Protocols to the [C]MU

Section 5.0 and subsections were replaced in their entirety.

6.1.1 ATE Testing

Editorial change was made to reference ARINC Specification 608A, "Design Guidance for Avionics Test Equipment".

7.2.1 OMS Interfaces

References to the appropriate Attachments were corrected.

7.2.3 Bit-Oriented CFDS Interfaces

References to the appropriate Attachments were corrected.

7.2.4 MU/CMU BITE Interfaces

References to the appropriate Attachments were corrected.

ATTACHMENT 1 AIRBORNE SUBSYSTEM BLOCK DIAGRAM

The diagram has been updated to include the HF Data Link Subnetwork.

ATTACHMENT 3 STANDARD INTERWIRING

MP5D changed from "Reserved for 716 Compatibility" to "8.33 kHz Program for 716 Compatibility".

ATTACHMENT 6 SIGNAL IN SPACE MASKS

The titles of Tables A6-1 and A6-2 were changed to reflect the D8PSK modulation. Table A6-3 was deleted.

ATTACHMENT 7 EXAMPLE SYMBOL ENCODING

Attachment 7 was updated to reflect the modulation change from OQAM to D8PSK.

ATTACHMENT 8 VDR TABLES

Table A8-2 Bit-Oriented CFDS BITE Command Summary Word Input to VDR - Equipment ID 050 was added.

Table A8-3 Bit-Oriented CFDS BITE Fault Summary Word Output From VDR - Editorial change to title.

Table A8-5 AVPAC SQP Word - Modulation changed from "4-OQAM" to "D8PSK" and "16-OQAM" changed to "Reserved".

Table A8-7 VDR System Address Label (SAL) Word - Title changed. SDI and SAL comments added.

Table A8-8 VDR Status Word - Bits 11 and 13 comments changed. Bits 14 through 16 function and comments were changed.

Table A8-9 VDR Equipment ID Word - Bits 11 through 22 and Bits 30-31 comments were changed.

Table A8-10 System Address Label Field - TBD's deleted under SAL column.

Table A8-13 Protocol ID, EGFI and EID Codes - New table. Replaces ID Field Table which was deleted.

Table A8-14 [C]MU/VDR Command and Control Primitives - Table was added.

Table A8-15 [C]MU Status Word - Table was added.

ATTACHMENT 10 AVPAC SIMPLE INTERFACE PROTOCOL (ASIP)

This is a new attachment. It replaces the former Attachment 10, Ideal Modulator (4-OQAM - 16-OQAM).

APPENDIX A TERMS

The Reference BER term was revised. A section reference was changed in the Reference Power Level term.

APPENDIX B ACRONYMS

The acronym list was updated.

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SUPPLEMENT 2
TO
ARINC CHARACTERISTIC 750
VHF DATA RADIO

Published: December 24, 1997

Adopted by the Airlines Electronic Engineering Committee: October 14, 1997

A. PURPOSE OF THIS SUPPLEMENT

This Supplement introduces the VDR mode A interface definition which includes a new VDR mode determination table and state diagram, and revised VDR Status Word and Protocol ID tables. A new timer value table for the version 1 Bit-Oriented Protocol (BOP) was added as well as a new attachment containing the ACARS Interface Protocol (ACARSIP).

B. ORGANIZATION OF THIS SUPPLEMENT

This Supplement introduces a major rework of ARINC Characteristic 750. The normal practice of publishing a separate supplement to update the existing document has not been followed. The extensiveness of the changes introduced by Supplement 2 has resulted in the impracticality of producing a separate set of replacement pages. Supplement 2 is therefore available only as an integral part of ARINC Characteristic 750-2. The modified and added material on each page is identified by a c-2 in the margins.

C. CHANGES TO ARINC CHARACTERISTIC 750 INTRODUCED BY THIS SUPPLEMENT

This section represents a complete tabulation of the changes and additions to Characteristic 750 introduced by Supplement 2. Each change or addition is defined by the section number and title currently employed in Characteristic 750. In each case a brief description of the change or addition is included.

1.2 Airborne Subsystem Configuration

Deleted references to ARINC Specifications 637 and 638. Added references to ICAO ATN and VDL SARPs. Deleted commentary.

1.5 Relationship to ICAO Documents

Changed ICAO address.

3.3 Mode Determination

Deleted the first bullet item concerning Voice/Data Select (pin MP7C). Added presence and contents of the Label 276 word. Added state of the Voice/Data discrete.

3.3.1 Presence of Label 276 Word

Section added.

3.3.2 Content of Label 276 Word

Section added.

3.3.3 Mode Determination State Table

Section added.

3.3.4 Mode Transition Time

Section added.

3.4 Primary [C]MU Determination

First sentence deleted. Editorial changes.

3.4.1.1 ACTIVE/STANDBY Determination

Added “for five seconds” after set to “0” in first paragraph. Editorial revision.

3.5 [C]MU 750 Data Mode Selection

Changed title from 750 Data Mode Protocol Management and moved text to Section 3.6. Added new text with references to Table 3-1 and Section 5.3.2.5 to determine the VDR’s next mode of operation.

3.6 750 Data Mode Protocol Management

Formerly Section 3.5.

3.7 [C]MU ARINC 429 Broadcast

Section added.

4.2.8.5 Transmitter Frequency/Phase Performance During Training Sequence (DSPSK)

Changed Section title. Added frequency change specification. Changed phase acceleration from 30 Hz/sec to 150 Hz/sec.

5.1.2.1 ARINC 429 BOP Version 1

Added reference to unique timer values for the version 1 Bit-Oriented Protocol contained in Attachment 8, Table A8-16. Added commentary and merged text from Section 5.1.2.2. Changed default values for options O3, O4, O5, and O12. Changed options O6, O7, and O9 to Reserved. Also, editorial change.

5.1.2.2 ARINC 429 BOP Version 3

Renamed section and reserved as a placeholder for the ARINC 429 Version 3 definition. Moved text to Section 5.1.2.1.

5.1.3.1 BOP File Transfer Extended GFI Code

Editorial change.

5.1.3.2 SOLO Word Extended ID Code

Added Primitive ID field. Changed 8-bit data field to a 9-bit data field. Added reference to Attachment 8, Table A8-13 and commentary. Revised the general format for the [C]MU/VDR SOLO words that contain an “F_h” in the ID field.

5.2 ARINC 750 Data Mode Initialization and Protocol States

Changed reference in first paragraph. Added text concerning the [C]MU determining which 750 Datamode protocol the VDR is in. Added Protocol State table.

5.3.2 Protocol Negotiation

Reformatted text. Added reference to Attachment 8, Table A8-14.

5.3.2.1 PR_SET.request

Deleted last two sentences of the Response definition.

5.3.2.2 PR_SET.confirm

Added text concerning the state the VDR enters depending on whether the VDR supports the requested protocol from the CMU. Added ERROR protocol code to SOLO word Message Format.

5.3.2.5 MODE_SET.request

Section added.

5.3.2.6 MODE_SET.confirm

Section added.

5.3.3 Reserved

Section added.

5.3.4.2 VDR_BITE.confirm

Added Content column to the BITE Booleans MSB bit discretes table and incremented the bit numbers by 1. Changed LSB bit discretes to reserved for future use. Editorial revision to clarify the transmitted order of the part number in the example.

5.3.5 Error Messages

Section renumbered from Section 5.3.6. Former Section 5.3.5, Transmitter Temperature Protection Command, deleted.

5.3.5.1 TX_TEMP.request

Section deleted.

5.3.5.2 TX_TEMP.confirm

Section deleted.

5.4 Reserved

Section added.

5.5.2.3 Download Request Bit

Added "(bit 11)" to first sentence.

5.5.2.4 VDR Status Bit

Changed section title from "Transmit/Receive Bit" to "VDR Status Bit". Replaced text with VDR Status bit (bit 18) information.

5.5.2.6 Voice/Data Status Bit

Revised Voice/Data status bit (bit 17) definition in first paragraph. Deleted remainder of section.

5.5.2.7 750/716 Data Mode

Section added.

5.5.3 Transmitted Equipment Identification Word

Changed reference from "Table A8-12" to "Attachment 8, Table A8-11".

5.5.5 Received Status Word

Reformatted text. Added VDR considers the [C]MU active and available for 750 protocol operations only if bit 20 is set to "1".

ATTACHMENT 8 - VDR TABLES

Table A8-2, Bit-Oriented CFDS BITE Command Summary Word Input to VDR

Changed Equipment ID from "050" to "016" and reformatted table.

Table A8-4, VDR Mode Command

Table A8-4, ACARS SQP Word Label 124 (octal), replaced with VDR Mode Commad Table.

Table A8-5, Reserved

Table A8-5, AVPAC SQP Word Label 125 (octal), deleted and made Reserved.

Table A8-6, Reserved

Table A8-6, AVPAC SQP Word Label 126 (octal), deleted and made Reserved.

Table A8-8, VDR Status Word

Changed bit 12 from "Transmit/Receive bit" to "Spare". Changed bit 18 from "pad" to "VDR Status bit". Changed bit 19 from "pad" to "750/716 Data Mode."

Table A8-13, Protocol ID, EGFI and EID codes

Added ACARSIP and ERROR rows to table.

Table A8-14, [C]MU/VDR Command and Control Primitives

Deleted "TX Temp disable request" and "TX Temp disable confirm" rows from table. Added "Mode set request" and "Mode set confirm" rows to table.

Table A8-15, Reserved

Table A8-15 [CMU] Status Word, deleted and made reserved.

Table A8-16, Variables of High Speed Bit-Oriented Protocol - Version 1

Table added.

Figure A8-1, VDR Mode and Protocol Determination States

Figure added.

ATTACHMENT 10 - AVPAC SIMPLE INTERFACE PROTOCOL (ASIP)

Editorial corrections.

ATTACHMENT 11 - ACARS INTERFACE PROTOCOL (ACARSIP)

Attachment added.

APPENDIX C - BIBLIOGRAPHY

Deleted references to ARINC Specifications 637 and 638.

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SUPPLEMENT 3
TO
ARINC CHARACTERISTIC 750
VHF DATA RADIO

Published: November 30, 2000

Adopted by the Airlines Electronic Engineering Committee: June 26, 2000

A. PURPOSE OF THIS SUPPLEMENT

This Supplement includes revisions to Section 3.0 "Modes of Operation", Section 5.0 "Interface and Protocols to the CMU", Attachment 3 "Standard Interwiring", Attachment 8 "VDR Tables and Figures", Attachment 10 "AVLC Simple Interface Protocol (ASIP)", and Attachment 11 "ACARS Interface Protocol (ACARSIP)."

The VDR Mode Determination was completely updated in Section 3 to include status and state variable information for the VDR and CMU. State and New State information was added to Section 5.0 and Attachment 11.

Revisions to Section 4.0 "Interfaces and Protocols to the Ground System", deletion of Attachment 6, Table A6-2 "Tolerance on the Phase Mask of Transmitter for D8PSK", and deletion of Attachment 7 "Example Symbol Encoding" were made to be in alignment with RTCA and EUROCAE VDL Mode 2 Physical Layer MOPS (ED-92).

In general, "AVPAC" has been changed to be "AVLC" or "VDL Mode 2" as appropriate and "[C]MU" has been changed to "CMU" throughout the document.

B. ORGANIZATION OF THIS SUPPLEMENT

The first part of this document, printed on golden-rod paper contains descriptions of changes introduced into this Characteristic by this Supplement. The second part consists of replacement white pages for the Characteristic, modified to reflect the changes. The modified and added material on each page is identified by a "c-3" in the margins. Existing copies of ARINC Characteristic 750 may be updated by simply inserting the replacement white pages where necessary and discarding the pages they replace. The golden-rod pages are inserted inside the rear cover of the Characteristic.

C. CHANGES TO ARINC CHARACTERISTIC 750 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 that will be employed when the Supplement is eventually incorporated. In each case a brief description of the change or addition is included.

1.1 Purpose of this Document

Changed the title of ARINC Specification 631.

1.2 Airborne Subsystem Configuration

Replaced "AVPAC" with "VDL Mode 2" throughout section. Added ICAO VDL SARPs to list.

1.5 Relationship to ICAO Documents

Changed the title of ARINC Specification 631.

1.6 Relationship to Other Documents

New section added.

2.2. Form Factors, Antenna Considerations, Connectors & Index Pin Coding

Changed section title formerly "Form Factors, Connectors & Index Pin Coding

2.2.3 Antenna Considerations for Multiple Systems Operations

New section added.

3.2.3 750 Data Mode

Commentary added.

3.3 Mode Determination

Replaced section and included a new State Variable table.

3.3.1 VD_STATUS State Variable

Changed section title formerly "Presence of Label 276 Word" and replaced section text in its entirety.

3.3.1.1 ARINC Label 276 Word

Added new section.

3.3.1.2 Voice/Data Select Discrete Input

Added new section.

3.3.2 CMU_STATUS State Variable

Changed section title formerly "Content of the Label 276 Word". Replaced section text and included a new CMU_STATUS State Diagram.

3.3.2.1 PRIMARY CMU Determination

Section renumbered; formerly Section 3.4. VDR action of selecting the Primary CMU (in a dual CMU configuration) was clarified.

3.3.2.1.1 ABSENT/PRESENT Determination

Section renumbered; formerly Section 3.4.1. Entirely new text was introduced.

3.3.2.1.2 ACTIVE/STANDBY Determination

Section renumbered; formerly 3.4.1.1. Editorial change.

3.3.2.1.3 Primary CMU Determination Algorithm

Section renumbered; formerly 3.4.1.2.

3.3.2.1.4 Primary CMU Notification

Section renumbered; formerly 3.4.1.3. Added final paragraph.

3.3.2.2 BOP CMU determination

New section added.

3.3.3 A750_STATUS State Variable

Changed section title formerly "Mode Determination State Table" and replaced section.

3.3.3.1 A716 Determination

Added new section.

3.3.3.2 A750 Determination

Added new section.

3.3.4 Mode Determination State Table

Changed section title formerly "Mode Transition Time". Replaced section.

3.3.5 State Transition Time

Added new section.

3.4 CMU 750 Data Mode Support Determination

Formerly Section 3.5. Added reference to Table A8-17.

3.6 CMU ARINC 429 Broadcast

Formerly Section 3.7.

4.1 Introduction

Changed "ACARS" to "Mode A". Changed "AVPAC" to "VDL Mode 2". Changed ARINC Specification 631 title.

4.2.7 Modulation Definition for D8PSK

Added reference to RTCA DO-224.

4.2.8.2 Adjacent Channel Emissions (D8PSK)

Revised to be consistent with the RTCA and EUROCAE VDL Mode 2 Physical Layer MOPS (ED-92).

4.2.8.3 Transmitter Phase and Amplitude Balance (D8PSK)

Revised to be consistent with the RTCA and EUROCAE VDL Mode 2 Physical Layer MOPS (ED-92).

4.2.8.4 Transmitter Data Clock Stability

Added commentary to be consistent with the RTCA and EUROCAE VDL Mode 2 Physical Layer MOPS (ED-92).

4.2.8.6 Transmitter Spurious Radiation

Revised to be consistent with the RTCA and EUROCAE VDL Mode 2 Physical Layer MOPS (ED-92).

4.2.8.7 D8PSK Modulation In-band Spectrum Characteristics

New Section added to be consistent with the RTCA and EUROCAE VDL Mode 2 Physical Layer MOPS (ED-92).

4.3.1 Sensitivity and Dynamic Range

Revised section title and content to be consistent with the RTCA and EUROCAE VDL Mode 2 Physical Layer MOPS (ED-92).

4.3.4 Noise Immunity

Deleted first paragraph of the commentary.

4.3.4.1.1 Bit Error Rate Versus Pulse Interference

Deleted Section.

4.3.4.2 Adjacent Channel Signal Rejection

Revised section title and content to be consistent with the RTCA and EUROCAE VDL Mode 2 Physical Layer MOPS (ED-92).

4.3.4.3 Out-of-Band Interference Rejection Immunity Performance

Revised section title and content to be consistent with the RTCA and EUROCAE VDL Mode 2 Physical Layer MOPS (ED-92).

4.3.4.4 Co-Channel Interference Performance

New Section added to be consistent with the RTCA and EUROCAE VDL Mode 2 Physical Layer MOPS (ED-92).

5.1.2 Bit Oriented Protocols

Revised text to note that Williamsburg Version 3 of the ARINC 429 BOP will be used as the predominant method for file transfer. Williamsburg Version 1 is retained for certain legacy installations. Added text on dynamic switching between Versions 1 and 3.

5.1.2.1 ARINC Specification 429 BOP Version 1 (Williamsburg Version 1)

Expanded the title and made editorial revisions to first paragraph. Moved first sentence of commentary to last sentence of second paragraph.

5.1.2.2 ARINC Specification 429 BOP Version 3 (Williamsburg Version 3)

Expanded the title. Added new text.

5.1.2.3 ARINC Specification 429 Flow Control

Added new section.

5.1.2.3.1 Version 1 Flow Control Mechanism

Added new section.

5.1.2.3.2 Version 3 Flow Control Mechanism

Added new section.

5.1.3 Multiple CMU/VDR Protocol Support

Replaced section.

5.1.3.1 Extended BOP File Format

Revised section. The first paragraph was replaced and the last paragraph was added.

5.1.3.1.1 Williamsburg Version 1 GFI

Added new section.

5.1.3.1.2 Williamsburg Version 3 GFI

Added new section.

5.1.3.2 SOLO Word EID Code

Revised title and section.

5.1.4 Full and Partial Data Word Formats

Text replaced by reference to ARINC Specification 429.

5.2 ARINC 750 Data Mode Initialization and Protocol States

Partitioned into subsections and moved last paragraph to end of new Section 5.2.4 Protocol State Diagram.

5.2.1 PROTOCOL_NULL

Formerly part of Section 5.2.

5.2.2 PROTOCOL_RESET

Formerly part of Section 5.2.

5.2.3 PROTOCOL_SET

Formerly part of Section 5.2. Editorial revisions.

5.2.4 Protocol State Diagram

Added new section and included a new Protocol State Diagram. Also, included last paragraph formerly from Section 5.2.

5.3 VDR Control

Revised title and section.

5.3.1 VDR Control Message Format

Revised title and noted that VDR Control files are of type COMMAND.

5.3.2 Protocol Negotiation

Editorial revisions.

5.3.2.1 PR_SET.request Primitive

Added State and New State information. Editorial revisions including title.

5.3.2.2 PR_SET.confirm Primitive

Added State and New State information. Editorial revisions including title.

5.3.2.3 PR_QUERY.request Primitive

Added State and New State information. Editorial revisions including title.

5.3.2.4 PR_QUERY.confirm Primitive

Added State and New State information. Revised text to indicate that VDR control files are of type COMMAND. Editorial revisions including title.

5.3.2.5 MODE_SET.request Primitive

Added State and New State information. Editorial revision to title.

5.3.2.6 MODE_SET.confirm Primitive

Added State and New State information. Added note. Editorial revision to title.

5.3.3 Flow Control Primitives

Title changed. Added new section.

5.3.3.1 XOFF.request Primitive

Added new section.

5.3.3.2 XON.request Primitive

Added new section.

5.3.4 BITE Data

Deleted text from first sentence.

5.3.4.1 VDR_BITE.request Primitive

Added State and New State information. Editorial revision to title.

5.3.4.2 VDR_BITE.confirm Primitive

Revised text to indicate that the message consists of a VDR Control file whose type is COMMAND. Deleted Destination Code information. Added commentary. Added State and New State information. Added information on number of part numbers and character length. Editorial revisions including title.

5.3.5 Error Messages

Added State and New State information. Editorial revisions.

5.5.1 VDR's System Address Label Word (172)

Replaced text in its entirely.

5.5.2 VDR's Status Word (270)

Changed "The PAD Field (bits 18-29)" to "The PAD bits" in the next to last sentence.

5.5.2.7 750/716 Mode

Revised title and text to refer to 750 or 716 Mode rather than Data mode. Deleted last paragraph.

5.5.2.8 VDR State

Added new section.

5.5.2.9 Active Air/Ground Protocol

Added new section.

7.2 BITE Interfaces

Added last paragraph.

ATTACHMENT 1 - AIRBORNE SUBSYSTEM BLOCK DIAGRAM

Updated Attachment.

ATTACHMENT 3 - STANDARD INTERWIRING

Revised Functions MP11C and MP14A to be for Maintenance System ID.

ATTACHMENT 4 - NOTES APPLICABLE TO STANDARD INTERWIRING

Deleted last sentence in Note H. concerning AVPAC protocol functionality.

ATTACHMENT 6 - SIGNAL IN SPACE MASKS

Deleted Table A6-2, "Tolerance in the Phase Mask of Transmitter for D8PSK" because it is already covered in Section 4.2.8.3 and not readily measurable.

ATTACHMENT 7 - EXAMPLE SYMBOL ENCODING

Deleted attachment.

ATTACHMENT 8 - VDR TABLES AND FIGURES

Table A8-3 Bit-Oriented CFDS BITE Fault Summary Word Output for VDR

Added 8.33 kHz tuning capability for bit 27.

Table A8-7 VDR System Address Label (SAL) Word

Deleted SDI 0, SAL 250 octal. Revised bits 17-24.

Table A8-8 VDR Status Word

Revised bit 19 to refer to 750/716 Mode rather than Data mode. Assigned PAD bits 21-24 to identify VDR States 1-7. Assigned PAD bits 25-27 to identify VDL Modes.

Table A8-10 System Address Label Field

Deleted SAL 250.

Table A8-13 Protocol ID, EGFI and EID Codes

Expanded to include ACARSIP Williamsburg Versions 1 and 3.

Table A8-15 Maintenance System Identification

Added new table.

Table A8-17 VDR State Transition Table

Added new table.

Figure A8-1 VDR Mode and Protocol Determination States

Replaced with new figure.

ATTACHMENT 10 - AVLC SIMPLE INTERFACE PROTOCOL (ASIP)

New Attachment title. Significant revisions have been made to Attachment 10. The ICAO SARPs reference has been updated as well as the initialization procedures, SQP reporting, and address request sections.

Changed "AVPAC" to "AVLC" or "VDL Mode 2" as appropriate.
Replaced the ASIP Functional Split diagram in Section A10.2.

Added text specifying that the ASIP should be implemented using only the ARINC 429 Williamsburg Version 3 bit oriented protocol.

Added text specifying that the VDR determines the correct operating mode and the status of any CMU on the ARINC 429 bus and negotiates the Williamsburg version to be used.

Added an SQP algorithm and expanded the number of addresses for setting the contents of the DAS to three.

Added new sections on VDR Buffer Management, VDR Transmit Buffer Purging and Vendor Reserved Primitives.

Added a list of primitives with their associated Section references and changed the form of the primitives. Changed the message formats to be Extended BOP file types. Added reference for primitives composed of Extended SOLO words.

Within the primitive definitions: Deleted the Destination Code information. Revised text to indicate use of Extended BOP file types. Changed Protocol ID code to EGFI. Added State and New State information.

UNITDATA.confirm, CHAN_CONG.indication, and PURGE.request messages added.

In Table A10-1, "VDR - CMU Primitives", the reset request primitive has been deleted. The frame transmission confirm, channel congestion indication, purge, and vendor reserved primitives have been added.

In Table A10-2, "Error Messages", the VDR transmit buffer overflow and out of sequence or unexpected primitive error messages have been added.

In Table A10-3, “Generic Frame Format”, ADDR.request and ADDR.confirm encoding examples have been added.

Added Message Sequence Chart Figures A10-1 through A10-11.

ATTACHMENT 11 - ACARS INTERFACE PROTOCOL (ACARSIP)

A11.2 Functional Overview

Replaced the ACARSIP Functional Split diagram.

A11.3.1 Protocols Overview

Deleted the first three paragraphs concerning command and transfer primitives.

Replaced the first three paragraphs with “The ACARSIP CMU/VDR Interface Protocol consists of Extended BOP files and Extended SOLO words and that the file types are of COMMAND or DATA”.

Revised the first sentence in the sixth paragraph to indicate that the VDR sends SQP information for every received transmission from the ground containing a block with a valid BCS.

A11.3.3 BOP File Transfer GFI Code

Deleted section.

A11.3.4 BOP File Transfer Destination Code

Deleted section.

A11.3.5

Deleted section.

A11.4.15 Subnetwork Statistics Data Function

Editorial revision.

A11.5 Primitives

Revised text and provided references for the format of all the messages exchanged using Extended BOP file transfers between the CMU and VDR. Added reference for the format of primitives composed of Extended SOLO words.

A11.5.1 Message PARAM.request

Deleted Destination Code information. Revised text to indicate use of Extended BOP of type COMMAND. Changed Protocol code to EGFI. Added State and New State information. Changed pre-key default value of 37 ms (19_h) to 37 ms (25_h).

A11.5.2 Message UNITDATA.request

Deleted Destination Code information. Revised text to indicate use of Extended BOP of type DATA. Changed Protocol code to EGFI. Added State and New State information.

A11.5.3 Message ADDR.request

Deleted Destination Code information. Revised text to indicate use of Extended BOP of type COMMAND. Changed Protocol code to EGFI. Added State and New State information.

A11.5.4 Message CMU_ERROR.indication

Deleted Destination Code information. Revised text to indicate use of Extended BOP of type COMMAND. Changed Protocol code to EGFI. Added State and New State information.

A11.5.5 Message AUDIT.request

Deleted Destination Code information. Revised text to indicate use of Extended BOP of type COMMAND. Changed Protocol code to EGFI. Added State and New State information.

A11.5.6 Message PARAM.confirm

Deleted Destination Code information. Revised text to indicate use of Extended BOP of type COMMAND. Changed Protocol code to EGFI. Added State and New State information.

A11.5.7 Message UNITDAT.indication

Deleted Destination Code information. Revised text to indicate use of Extended BOP of type DATA. Changed Protocol code to EGFI. Added State and New State information.

A11.5.8 Message ADDR.confirm

Deleted Destination Code information. Revised text to indicate use of Extended BOP of type COMMAND. Changed Protocol code to EGFI. Added State and New State information.

A11.5.9 Message VDR_ERROR.indication

Deleted Destination Code information. Revised text to indicate use of Extended BOP of type COMMAND. Changed Protocol code to EGFI. Added State and New State information.

A11.5.10 Message SQP.indication

Deleted Destination Code information. Revised Message format to be an Extended SOLO word. Changed bits 24-21 definition from “1_h” to “2_h”. Added the SQP algorithm. Added State and New State information.

A11.5.11 Message UNITDATA.confirm

Added note concerning use of the PURGE.request and UNITDATA.confirm messages. Revised text to indicate use of Extended BOP of type COMMAND. Changed Protocol code to EGFI. Editorial revision.

Added State and New State information. Editorial revision.

A11.5.12 Message PURGE.request

Deleted Destination Code information. Revised text to indicate use of Extended BOP of type COMMAND. Changed Protocol code to EGFI. Editorial revision. Added State and New State information.

A11.5.13 Message AUDIT.confirm

Deleted Destination Code information. Revised text to indicate use of Extended BOP of type COMMAND. Changed Protocol code to EGFI. Added State and New State information.

A11.5.14 Message AUDIT.indication

Deleted Destination Code information. Revised text to indicate use of Extended BOP of type DATA. Changed Protocol code to EGFI. Added State and New State information.

A11.5.15 Message STAT.request

Added text for the periodic and single statistic reporting modes. Deleted Destination Code information. Changed Protocol code to EGFI. Changed the reporting period from "0 to 1440 minutes" to "1 to 1440 minutes". Added State and New State information.

A11.5.16 Message STAT.confirm

Changed Protocol code to EGFI. Changed the reporting period from "0 to 1440 minutes" to "1 to 1440 minutes". Added State and New State information.

A11.5.17 Message STAT.indication

Deleted Destination Code information. Changed the Cumulative VHF channel Busy (Tcu) range from "0 to 100 (00_h to 64_h)" to be "0 to 99 (00_h to 63_h)". Changed Protocol code to EGFI. Added State and New State information.

Table A11-1 VDR-CMU Primitives

Revised table.

Table A11-2 Error Messages

Editorial revisions.

Figure A11-6 Downlink Message Handling

Added "(when channel is clear)" after "Tdown 100 ms max".

Figure A11-7 Purge Request With an Untransmitted Buffer (see Section A11.5.12)

Changed title from "Purge Request With a Full Buffer (Untransmitted)" and added a reference to Section A11.5.12.

Figure A11-8 UNITDATA.request With a Full Buffer

Replaced figure. Formerly "Purge Request With an Empty Buffer".

APPENDIX A – TERMS

Revised term BER. Deleted terms BFR, dBr, and IRR which are no longer used. Added term dBc

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SUPPLEMENT 4
TO
ARINC CHARACTERISTIC 750
VHF DATA RADIO

Published: August 11, 2004

Adopted by the Airlines Electronic Engineering Committee: March 5, 2004

A. PURPOSE OF THIS DOCUMENT

This Supplement primarily provides corrections or updates to Attachment 1 "Airborne Subsystem Block Diagram", Attachment 4 "Notes Applicable to Standard Interwiring", Attachment 8 "VDR Tables and Figures", Attachment 10 "AVLC Simple Interface Protocol", and Attachment 11 "ACARS Interface Protocol." Clarifications were added to the Channel Utilization Parameter and the Vendor Reserved Primitives. In addition, the list of acronyms in Appendix B and Bibliography in Appendix C have been updated.

B. ORGANIZATION OF THIS SUPPLEMENT

The first part of this document printed on golden-rod paper contains descriptions of changes introduced into this Characteristic by this Supplement. The second part consists of replacement white pages for the Characteristic modified to reflect the changes. The modified and added material on each page is identified by a "c-4" in the margins. Existing copies of ARINC Characteristic 750 may be updated simply by inserting the replacement white pages where necessary and discarding the pages they replace. The golden-rod pages are inserted inside the rear cover of the Characteristic.

C. CHANGES TO ARINC CHARACTERISTIC 750 INTRODUCED BY THIS SUPPLEMENT

This section presents a complete tabulation of the changes and additions to ARINC Characteristic 750, introduced by Supplement 4. Each change or addition is defined by the section number and title currently employed in Characteristic 750. In each case a brief description of the change or addition is included.

1.2 Airborne Subsystem Configuration

Changed "AVPAC" to "VDL Mode 2" in the third paragraph. Deleted reference to ARINC Characteristic 597.

4.2.6.1 Training Sequence (MSK)

Changed "AVPAC" to "AVLC" in second sentence. Deleted "For an AVLC transmission, a flag ($7E_h$) follows the bit ambiguity. For an ACARS block, a SYN SYN (16_h 16_h) follows the bit ambiguity."

4.2.8.2 Adjacent Channel Emissions (D8PSK)

Added "per octave" after 5 dB on last line of second paragraph.

4.3.6 Channel Sense Algorithm

A commentary was added at the end of Section 4.3.6.

5.1.2 Bit-Oriented Protocols

Deleted the sentence "The specific version used is negotiated via the ALOHA process described in ARINC Specification 429" just prior to the reference to Section 5.1.3.

ATTACHMENT 1 – AIRBORNE SUBSYSTEM DIAGRAM

Updated diagram.

ATTACHMENT 4 - NOTES APPLICABLE TO STANDARD INTERWIRING

Revised Notes D and E.

ATTACHMENT 8 - VDR TABLES AND FIGURES

Table A8-7 VDR System Address Label (SAL) Word - fixed typographical error in bit 18 row. Added SDI "0" SAL "250 octal" to bits 9-16**.** Changed bit 24 Function to "VDL Mode 2 Supplement 4 SQP." Changed bit 20 and 21 Function to "Reserved for VDL future mode."

Table A8-8 VDR Status Word - Replaced comment block for bits 21 - 24 with a table of bit values for States S1 through S7. Changed bit 25-27 comment from "Mode 3 and 4" to "Reserved for VDL future mode."

Table A8-13 Protocol ID, EFGI and EID codes - Deleted Williamsburg Version 1 from the second protocol row. Deleted the third protocol row ACARSIP Williamsburg Version 3.

Table A8-14 [C]MU/VDR Command and Control Primitives - Added rows for X-off request and X-on request.

Table A8-15 Maintenance System Identification - Added note.

ATTACHMENT 10 - AVLC SIMPLE INTERFACE PROTOCOL (ASIP)

A10.2 Overview

Removed "This implementation places the multiple link support solely in the CMU as opposed to splitting the support between VDR and CMU. ARINC Specification 631 contains a function allocation table that indicates whether the function is in the CMU or the VDR."

A10.3.1 Overview

Added "except for A/G bit" to the end of the first sentence in the third paragraph. Changed "is commanded to tune to a different frequency" to "receives a PARAM.request message" in the next to last paragraph.

A10.4.5 CMU Error Message

Changed "VDR" to "CMU" in second sentence.

A10.4.6 VDR Operating Parameter Data

Changed "receipt of a valid PARAM.request message" to "sending a PARAM.confirm message" in the last sentence of the first paragraph.

A10.4.7 Signal Quality Parameter Reporting

In the second sentence changed "it should only be sent if the frame in that transmission" to "it should only be sent if any frame in the transmission." Added a second SQP formula for determining SQP value. New text added after first paragraph.

A10.4.8 Address Request

Added "all of" after message containing in fourth paragraph third line. Deleted last sentence of fourth paragraph.

A10.4.10 Channel Utilization Parameter

The last sentence of the second paragraph should read "The channel is considered occupied if either the VDR is transmitting or the VDL Mode 2 receiver Channel SenseFunction (see paragraph 4.3.6) indicates that the channel is busy at the time the sample is taken.

A10.4.11 Downlink Message Handling

Added three new paragraphs about the Tdown definition.

A10.4.12 Uplink Message Handling

Added two new paragraphs about the Tup definition.

A10.4.13 Address Screening

Added "except for A/G bit" to the end of the first sentence in first paragraph.

A10.4.17 Vendor Reserved Primitives

After the first sentence, the following sentence was inserted. "Some of the primitives have been set aside per vendor requests for specific functions unique to those vendors. These reserved primitive ID values should only be used by the vendor that they are assigned to, see section A10.5.15." The last sentence of the paragraph was also deleted**.** A commentary was added indicating that vendors should be aware of the possible adverse effect of unlimited transmission of vendor reserved primitives on CMU/VDR system performance. Some system integrators/airframe manufacturers may require that the transmission of vendor reserved primitives be disabled.

A10.5.1 Message PARAM.request

Deleted last sentence from first paragraph. Revised Octet 6 Value or Range to be "0.5 to 125 ms (01h to FA_h)." Added second sentence under Normal Response because the sending of a UNITDATA.confirm as a response to a PARAM.request is a normal response.

In the "Value or Range" Column for parameter "M1 LSB" Change the value from "00_h to FF_h" to "01_h to FF_h."

A10.5.3 Message ADDR.request

Changed "(octet 6 = 0)" to be "(Octets 6 to 17 = 0)" in two places.

A10.5.6 Message PARAM.confirm

Revised Octet 6 Value or Range to be "0.5 to 125 ms (01_h to FA_h)."

In the "Value or Range" Column for parameter "M1 LSB" Change the value from "00_h to FF_h" to "01_h to FF_h."

A10.5.7 Message UNITDATA.indication

Added a note on which order to send the UNITDATA.indication and SQP.indication.

In the above added note, add "associated" between the words "and" and "SQP."

A10.5.10 Message SQP.Indication

Added a note on which order to send the UNITDATA.indication and associated SQP.indication. Additional text was added to the second paragraph to indicate that Octet 5 contains two measurements of SQP. Under the Message Format, Octet 5 was split into a lower and upper nibble for the original and supplement 4 SQP. A corresponding note was added.

Added new paragraph after second paragraph.

After paragraph three a note was added.

A10.5.14 Message PURGE.request

Moved the note under Message Format to be the Normal Response because the issuing of a UNITDATA. confirm as a response to a PURGE.request is a normal response.

A10.5.15 Vendor Reserved Primitives

Changed "undefined" to be "unchanged" under the New State.

After the first paragraph the following was added:

"Some vendors have expressed a desire for a dedicated Vendor reserved primitive and have been assigned a primitive ID value. Only the vendor that has been assigned that primitive ID value should use it. A vendor that desires to have a primitive ID value assigned should contact the AEEC VDL Subcommittee secretary. The following primitive ID values have been assigned:

$F0_h$ – Honeywell
$F1_h$ – Rockwell Collins

Table A10-1 VDR - CMU Primitives - Changed Vendor Reserved Primitives from "N/A" to "Vendor defined."
Table A10-2 Error Messages - Changed the VDR transmit buffer overflow Error Data to None.

Table A10-3 Generic Frame Format - Changed "0xFFFFFF" to be "$FFFFFF_h$" in the third address example. Under the third address example changed octet number 4 from "11111111" to 11111110" due to a typographical error.

Figure A10-4 Uplink Process Reporting - Revised Tup definition. Corrected the 1 second max indicator arrow. Added a note on which order to send the UNITDATA.indication and SQP.indication.

In the note following Figure A10-4, "and SQP" was replaced by "and associated SQP."

Figure A10-6 Downlink Message Handling - Revised Tdown definition.

In the note following Figure A10-6, "PID 2_h1" was replaced by "PID 21_h." Additionally, "PID 5_h6" was replaced by "PID 56_h."

Figure A10-8 UNITDATA.request With a Non-empty Buffer - corrected the Tconf 1 second max arrow to extend down from the Downlink transmission contains both frames line.

Figure A10-9 SQP Message Handling - Deleted "or PROTOCOL_RESET" from two places because this conflicts with the definition in Section A10.4.7.

Figure A10-10 PURGE.Request with an Untransmitted Buffer - Revised figure.

Figure A10-11 Multiple Frames Uplink Processing - Added a note on which order to send the UNITDATA.indication and SQP.indication. In Figure A10-11 "and SQP" was replaced by "and associated SQP."

ATTACHMENT 11 - ACARS INTERFACE PROTOCOL (ACARSIP)

A11.4.6 VDR Operating Parameter Data

Revised last sentence in first paragraph to be consistent with other areas of the document.

Replaced "AM-MSK" with "DSB AM/MSK" in first paragraph.

A11.5.1 Message PARAM.request

Deleted last sentence in first paragraph to be consistent with other areas of the document.

Replaced "AM-MSK" with "DSB AM/MSK" in two places.

A11.5.6 Message PARAM.confirm

The last entry under Parameters is Pre-key length. Pre-key length was changed from "19_h" to "55_h."

A11.5.7 Message UNITDATA.indication

Added a note on which order to send the UNITDATA.indication and SQP.indication.

In the note following section A11.5.7, "and SQP" was replaced by "and associated SQP."

A11.5.10 Message SQP.indication

Added a note on which order to send the UNITDATA.indication and SQP.indication.

Table A11-2 Error Messages - Added the "Out of Sequence or Unexpected Primitive" row.

Figure A11-4 Uplink Process Reporting - Deleted the 1 second max indicator arrow. Reversed the UNITDATA.indication and SQP.indication information on the figure. Added a note on which order to send the UNITDATA.indication and SQP.indication.

Figure A11-9 SQP Message Handling - Deleted "or PROTOCOL_RESET" from two places to be consistent with the definition in Section A11.4.7.

APPENDIX B – ACROYNMS

Updated acronym list.

APPENDIX C - BIBLIOGRAPHY

Updated Bibliography.

ARINC Standard – Errata Report

1. Document Title

ARINC Characteristic 750-4: *VHF Data Radio*
Published: August 11, 2004

2. Reference

Page Number:_____ Section Number: _____ Date of Submission: _____

3. Error

(Reproduce the material in error, as it appears in the standard.)

4. Recommended Correction

(Reproduce the correction as it would appear in the corrected version of the material.)

5. Reason for Correction

(State why the correction is necessary.)

6. Submitter (Optional)

(Name, organization, contact information, e.g., phone, email address.)

Note: Items 2-5 may be repeated for additional errata. All recommendations will be evaluated by the staff. Any substantive changes will require submission to the relevant subcommittee for incorporation into a subsequent supplement.

Please return comments to fax +1 410-266-2047 or standards@arinc.com

ARINC IA Project Initiation/Modification (APIM) Guidelines for Submittal

1. ARINC Industry Activities Projects and Work Program

A project is established in order to accomplish a technical task approved by one or more of the committees (AEEC, AMC, FSEMC) Projects generally but not exclusively result in a new ARINC standard or modify an existing ARINC standard. All projects are typically approved on a calendar year basis. Any project extending beyond a single year will be reviewed annually before being re-authorized. The work program of Industry Activities (IA) consists of all projects authorized by AEEC, AMC, or FSEMC (The Committees) for the current calendar year.

The Committees establish a project after consideration of an ARINC Project Initiation/Modification (APIM) request. This document includes a template which has provisions for all of the information required by The Committees to determine the relative priority of the project in relation to the entire work program.

All recommendations to the committees to establish or reauthorize a project, whether originated by an airline or from the industry, should be prepared using the APIM template. Any field that cannot be filled in by the originator may be left blank for subsequent action.

2. Normal APIM Evaluation Process

Initiation of an APIM

All proposed projects must be formally initiated by filling in the APIM template. An APIM may be initiated by anyone in the airline community, e.g., airline, vendor, committee staff.

Staff Support

All proposed APIMs will be processed by committee staff. Each proposal will be numbered, logged, and evaluated for completeness. Proposals may be edited to present a style consistent with the committee evaluation process. For example, narrative sentences may be changed to bullet items, etc. When an APIM is complete, it will be forwarded to the appropriate Committee for evaluation.

The committee staff will track all ongoing projects and prepare annual reports on progress.

Committee Evaluation and Acceptance or Rejection

The annual work program for each Committee is normally established at its annual meeting. Additional work tasks may be evaluated at other meetings held during the year. Each committee (i.e., AMC, AEEC, FSEMC) has its own schedule of annual and interim meetings.

The committee staff will endeavor to process APIMs and present them to the appropriate Committee at its next available meeting. The Committee will then evaluate the proposal. Evaluation criteria will include:

- Airline support – number and strength of airline support for the project, including whether or not an airline chairman has been identified
- Issues – what technical, programmatic, or competitive issues are addressed by the project, what problem will be solved
- Schedule – what regulatory, aircraft development or modification, airline equipment upgrade, or other projected events drive the urgency for this project

Accepted proposals will be assigned to a subcommittee for action with one of two priorities:

- High Priority – technical solution needed as rapidly as possible
- Routine Priority – technical solution to proceed at a normal pace

Proposals may have designated coordination with other groups. This means that the final work must be coordinated with the designated group(s) prior to submittal for adoption consideration.

Proposals that are not accepted may be classified as follows:

- Deferred for later consideration - the project is not deemed of sufficient urgency to be placed on the current calendar of activities but will be reconsidered at a later date
- Deferred to a subcommittee for refinement – the subcommittee will be requested to, for example, gain stronger airline support or resolve architectural issues
- Rejected – the proposal is not seen as being appropriate, e.g., out of scope of the committee

3. APIM Template

The following is an annotated outline for the APIM. Proposal initiators are requested to fill in all fields as completely as possible, replacing the italicized explanations in each section with information as available. Fields that cannot be completed may be left blank. When using the Word file version of the following template, update the header and footer to identify the project.

ARINC IA Project Initiation/Modification (APIM)

Name of proposed project APIM #: _____

Name for proposed project.

Suggested Subcommittee assignment

Identify an existing group that has the expertise to successfully complete the project. If no such group is known to exist, a recommendation to form a new group may be made.

Project Scope

Describe the scope of the project clearly and concisely. The scope should describe "what" will be done, i.e., the technical boundaries of the project. Example: "This project will standardize a protocol for the control of printers. The protocol will be independent of the underlying data stream or page description language but will be usable by all classes of printers."

Project Benefit

Describe the purpose and benefit of the project. This section should describe "why" the project should be done. Describe how the new standard will improve competition among vendors, giving airlines freedom of choice. This section provides justification for the allocation of both IA and airline resources. Example: "Currently each class of printers implements its own proprietary protocol for the transfer of a print job. In order to provide access to the cockpit printer from several different avionics sources, a single protocol is needed. The protocol will permit automatic determination of printer type and configuration to provide for growth and product differentiation."

Airlines supporting effort

Name, airline, and contact information for proposed chairman, lead airline, list of airlines expressing interest in working on the project (supporting airlines), and list of airlines expressing interest but unable to support (sponsoring airlines). It is important for airline support to be gained prior to submittal. Other organizations, such as airframe manufacturers, avionics vendors, etc. supporting the effort should also be listed.

Issues to be worked

Describe the major issues to be addressed by the proposed ARINC standard.

Recommended Coordination with other groups

Draft documents may have impact on the work of groups other than the originating group. The APIM writer or, subsequently, The Committee may identify other groups which must be given the opportunity to review and comment upon mature draft documents.

Projects/programs supported by work

If the timetable for this work is driven by a new airplane type, major avionics overhaul, regulatory mandate, etc., that information should be placed in this section. This information is a key factor in assessing the priority of this proposed task against all other tasks competing for subcommittee meeting time and other resources.

Timetable for projects/programs

Identify when the new ARINC standard is needed (month/year).

Documents to be produced and date of expected result

The name and number (if already assigned) of the proposed ARINC standard to be either newly produced or modified.

Comments

Anything else deemed useful to the committees for prioritization of this work.

Meetings

The following table identifies the number of meetings and proposed meeting days needed to produce the documents described above.

Activity	Mtgs	Mtg-Days
Document a	*# of mtgs*	*# of mtg days*
Document b	*# of mtgs*	*# of mtg days*

For IA staff use

Date Received_____ IA staff assigned: _____

Potential impact: ____
(A. Safety B. Regulatory C. New aircraft/system D. Other)

Forward to committee(s) (AEEC, AMC, FSEMC): _____ Date Forward:_____

Committee resolution: ____
(0. Withdrawn 1. Authorized 2. Deferred 3. More detail needed 4. Rejected)

Assigned Priority: ____ Date of Resolution:_____

A. – High (execute first) B. – Normal (may be deferred for A.)

Assigned to SC/WG _____