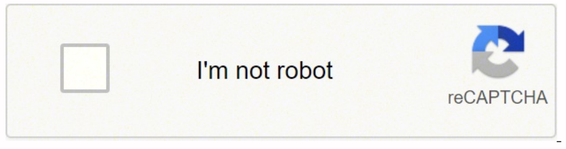

I am not robot!

Arinc 429 labels pdf

Arinc 429 label format. Arinc 429 message example. Arinc 429 label definitions. Arinc 429 label list.

ARINC 429 is the most widely used data transfer method used in aviation. This document provides the standard formats for data parameters and status words transferred between avionic systems. It specifies the physical data bus, electrical characteristics, and data formats. Supplement is 19 is a routine update that defines new ARINC 429 data words, new labels, new equipment IDs, and new System Address Labels (SAL). MARK 33 DIGITAL INFORMATION TRANSFER SYSTEM (DITS) PART 1 FUNCTIONAL DESCRIPTION, ELECTRICAL INTERFACE, LABEL ASSIGNMENTS AND WORD FORMATS ARINC SPECIFICATION 429 PART 1-17 PUBLISHED: May 17, 2004 AN DOCUMENT Prepared by AIRLINES ELECTRONIC ENGINEERING COMMITTEE Published by AERONAUTICAL RADIO, INC. 2551 RIVA ROAD, ANNAPOLIS, MARYLAND 21401 This document is based on material submitted by various participants during the drafting process. Neither AEEC nor ARINC has made any determination whether these materials could be subject to valid claims of patent, copyright or other proprietary rights by third parties, and no representation or warranty, express or implied, is made in this regard.

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Arinc 429 label list.

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Dihedral	τ per state [ns]
chi1	0.573277 0.372246 0.440608
chi2	0.117463 0.241058 0.20674
chi3	Missing[Only 1 points] Missing[Only 1 points]
chi4	0.0569358 0.0630015 0.0983301
chi5	0.0891684 0.0761246 0.0599392

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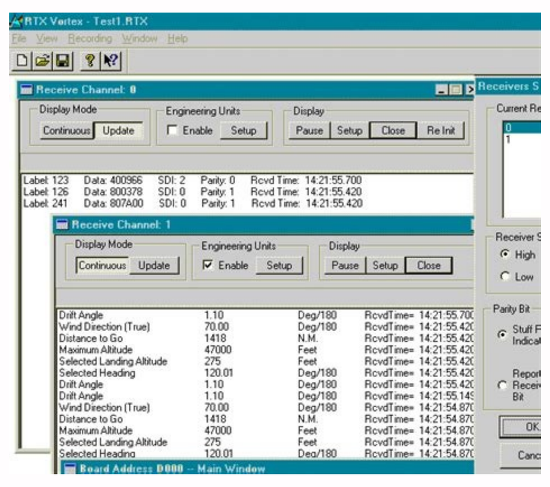

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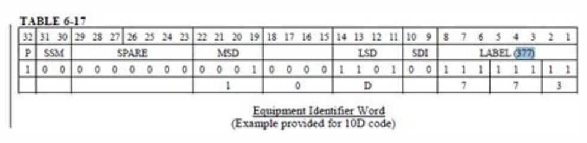

TABLE 6-17

P	SSM	SPARE	MSD	LSD	SDI	LABEL (377)

Equipment Identifier Word
(Example provided for 10D code)

It specifies the physical data bus, electrical characteristics, and data formats. Supplement is 19 is a routine update that defines new ARINC 429 data words, new labels, new equipment IDs, and new System Address Labels (SAL). MARK 33 DIGITAL INFORMATION TRANSFER SYSTEM (DITS) PART 1 FUNCTIONAL DESCRIPTION, ELECTRICAL INTERFACE, LABEL ASSIGNMENTS AND WORD FORMATS ARINC SPECIFICATION 429 PART 1-17 PUBLISHED: May 17, 2004 AN DOCUMENT Prepared by AIRLINES ELECTRONIC ENGINEERING COMMITTEE Published by AERONAUTICAL RADIO, INC. 2551 RIVA ROAD, ANNAPOLIS, MARYLAND 21401 This document is based on material submitted by various participants during the drafting process. Neither AEEC nor ARINC has made any determination whether these materials could be subject to valid claims of patent, copyright or other proprietary rights by third parties, and no representation or warranty, express or implied, is made in this regard. Any use of or reliance on this document shall constitute an acceptance thereof "as is" and be subject to this disclaimer. ARINC Standard – Errata Report 1. Document Title ARINC Specification 429 Part 1-17: Mark 33 – Digital Information Transfer System (DITS) Published: May 17, 2004 2. Reference Page Number: 70 Section Number: Att 2 , Table 2 Date of Submission: 18MAR07 3. Error ARINC 429 Part 1, Table 2, BNR Data, (Label 335 reproduced in part): ARINC Specification 429 (May 17, 2004) Label Eqpt ID (HEX) Parameter Name Units Range (Scale) Sig Bits Pos Sense Resolution Min Transmit Interval (msec) 2 Max Transmit Interval (msec) 2 Max Trans- Port Delay (msec) 3 Notes 002 Track Angle Rate Deg/Sec 32 11 0.015 10 20 004 Track Angle Rate Deg/Sec 32 11 0.015 10 20 005 Track Angle Rate Deg/Sec 32 11 0.015 10 20 02F 038 Track Angle Rate Deg/Sec 32 11 0.015 10 20 03F 056 Track Angle Rate Deg/Sec 32 11 0.015 10 20 060 Track Angle Rate Deg/Sec 32 11 0.015 10 20 10A 335 10B 4. Recommended Correction ARINC 429 Part 1, Table 2, BNR Data (Label 335 reproduced in part). Changes are shaded in yellow. ARINC Specification 429 Part 1-17 REVISED Label Eqpt ID (HEX) Parameter Name Units Range (Scale) Sig Bits Pos Sense Resolution Min Transmit Interval (msec) 2 Max Transmit Interval (msec) 2 Max Trans- Port Delay (msec) 3 Notes 002 Track Angle Rate Deg/Sec ± 32 11 CW 0.015 10 20 FMS 004 Track Angle Rate Deg/Sec ± 32 11 CW 0.015 10 20 IRS 005 Track Angle Rate Deg/Sec ± 32 11 CW 0.015 10 20 AHRS 02F 038 Track Angle Rate Deg/Sec ± 32 11 CW 0.015 10 20 ADIRS 03F 056 Track Angle Rate Deg/Sec ± 32 11 CW 0.015 10 20 GLNU 060 Track Angle Rate Deg/Sec ± 32 11 CW 0.015 10 20 GNU 10A 335 10B ARINC Errata Form 11/24/2004 5. Reason for Correction Table 2 from ARINC Specification 429 Part 1 provides baseline definition of Label 335, Track Angle Rate data. "Notes" column is expanded to show the system acronym for each of the sources identified by the "Equipment ID". Positivr sense is specified as CW (clockwise) to conform to ARINC 705, AHRS, and ARINC 718A, Transponder.

6. Submitter (Optional) Robert H.

(Bob) Saffell (Rockwell Collins) and Paul Prisaznuk (AEEC staff) Comments should be directed to . 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.

[To be completed by IA Staff] Errata Report Identifier: 07-051/ERR-005 Engineer Assigned: Dan Martinec Review Status: ARINC Errata Form 11/24/2004 © 2004 by AERONAUTICAL RADIO, INC. 2551 Riva Road Annapolis, Maryland 21401-7465 USA ARINC SPECIFICATION 429 PART 1-17 MARK 33 DIGITAL INFORMATION TRANSFER SYSTEM (DITS) PART 1 FUNCTIONAL DESCRIPTION, ELECTRICAL INTERFACE, LABEL ASSIGNMENTS AND WORD FORMATS Published: May 17, 2004 Prepared by the Airlines Electronic Engineering Committee Specification 429 Adopted by the Airlines Electronic Engineering Committee: July 21, 1977 Specification 429 Adopted by the Industry: September 15, 1977 Summary of Document Supplements Supplement Adoption Date Published Specification 429-1 April 11, 1978 June 1, 1978 Specification 429-2 December 6, 1978 March 1, 1979 Specification 429-3 August 31, 1979 November 1, 1979 Specification 429-4 June 17, 1980 August 1, 1980 Specification 429-5 March 12, 1981 April 4, 1981 Specification 429-6 December 9, 1981 January 22, 1982 Specification 429-7 November 4, 1982 January 3, 1983 Specification 429-8 November 4, 1983 December 3, 1984 Specification 429-9 October 11, 1984 April 30, 1985 Specification 429-10 November 7, 1985 November 17, 1986 Specification 429-11 June 15, 1988 July 22, 1988 Specification 429-12 October 25, 1989 July 1, 1990 Specification 429-13 October 8, 1991 December 30, 1991 Specification 429-14 November 4, 1992 January 4, 1993 Specification 429-15 April 18, 1995 September 1, 1995 Specification 429-16 November 14, 2000 September 27, 2001 Specification 429-17 May 5, 2004 May 17, 2004 A description of the changes introduced by each supplement is included on goldenrod paper at the end of this document. ii 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. ARINC SPECIFICATION 429 TABLE OF CONTENTS ITEM SUBJECT PAGE iii ARINC SPECIFICATION 429 TABLE OF CONTENTS ITEM SUBJECT PAGE iv ARINC SPECIFICATION 429, PART 1 - Page 1 1.0 INTRODUCTION 1.1 Purpose of this Document This document defines the air transport industry's standards for the transfer of digital data between avionics systems elements. Adherence to these standards is desired for all inter-systems communications in which the system line replaceable units are defined as unit interchangeable in the relevant ARINC characteristics. Their use for intra-system communications in systems in which the line replaceable units are defined in the ARINC characteristics as system interchangeable is not essential, although it may be convenient. 1.2 Organization of ARINC Specification 429 ARINC Specification 429 was originally published in a single volume through version 14 (429-14). The size of the document and the need for improved organization dictated the division of the document into three parts. Those three parts include: Part 1 Functional Description, Electrical Interface, Label Assignments and Word Formats Part 2 Discrete Word Data Formats Part 3 File Data Transfer Techniques Part 1 provides the basic description of the functions and the supporting physical and electrical interfaces for the data transfer system. Data word formats, standard label and address assignments, and application examples are defined. Part 2 lists discrete word bit assignments in label order. Part 3 describes protocols and message definitions for data transferred in large blocks and/or file format. For convenience of the user, the section and attachment numbering has been retained for the material moved from the original Specification to Part 3. Updates to each part of future releases of ARINC 429 will be independent of the other parts to accommodate timely revisions as industry needs dictate. The dash numbers for each Part will NOT be synchronized with the other Parts as time passes. Users of ARINC Specification 429 should ensure that the latest version of each Part is used when designing or procuring equipment. 1.3 Relationship to ARINC Specification 419 ARINC Specification 419, "Digital Data System Compendium", is a catalog of the elements of the several digital data transmission systems that have found application during the "emergent" period of digital avionics technology. The maturing of this technology, now evident in the scope of its planned use on aircraft of the 1980s and beyond, has shown the need for a generally applicable digital information transfer system having capabilities not provided by any combination of the elements presently defined in Specification 419. In defining such a system, this document draws on the experience gained in the preparation of Specification 419 but is otherwise separate and distinct from it. Addition of the element specifications of the system defined herein to the Specification 419 catalog is not anticipated. 1.4 "Mark 33 Digital Information Transfer System" - Basic Philosophy This "Mark 33 Digital Information Transfer System (DITS)" specification describes a system in which an avionics system element having information to transmit does so from a designated output port over a single twisted and shielded pair of wires to all other system elements having need of that information. Bi-directional data flow on a given twisted and shielded pair of wires is not permitted. 1.4.1 Numeric Data Transfer The Mark 33 DITS numeric data transmission characteristics have been developed from those of successful predecessor air transport industry digital information transfer systems.

Data for transmission, encoded in either twos complement fractional binary notation or binary coded decimal notation, is supplied from source systems at rates sufficiently high to ensure small incremental value changes between updates. Transmission is made "open loop", i.e., sinks are not required to inform sources that information has been received. A parity bit is transmitted as part of each data word to permit simple error checks to be performed by the sinks. These, together with data reasonableness checks which may also be performed by the sinks, may be used to prevent the display or other utilization of a erroneous or suspect word. The inherently high integrity of the twisted and shielded wire transmission medium ensures that such drop-outs are few. The low rates of change of the data ensure that when one does occur, it is of no consequence. 1.4.2 ISO Alphabet No. 5 Data Transfer In addition to the transfer of BNR and BCD numeric data as just described, the Mark 33 DITS handles alpha and numeric data encoded per ISO Alphabet No. 5. The same "broadcast" transmission philosophy is used, although the "housekeeping" aspects of system operation differ in order to accommodate particular needs associated with this type of data. These differences will be addressed individually in this document as they arise. 1.4.3 Graphic Data Transfer A third type of data which may eventually be handled by the Mark 33 DITS is graphic data, i.e., the lines, circles, randomly positioned alpha/numeric text and other symbols used on CRT map and similar displays. The technique employed for this purpose can be basically similar to that used for ISO Alphabet No. 5 alpha/numeric data transfer. However, because a need for graphic data handling capability has not yet emerged, the air transport industry has decided not to be specific concerning this technique for the moment. When the need for graphic data handling is established, appropriate specification material will be developed. c-15 c-1 c-1 ARINC SPECIFICATION 429, PART 1 - Page 2 2.0 DIGITAL INFORMATION TRANSFER SYSTEM STANDARDS 2.1 Message Related Elements This section describes the digital data transfer system elements considered to be principally related to the message itself or the manner in which it is handled. 2.1.1 Direction of Information Flow The information output of an avionics system element should be transmitted from a designated port (or ports) to which the receiving ports of other system elements in need of that information are connected. In no case does information flow into a port designated for transmission. COMMENTARY A separate data bus (twisted and shielded pair of wires per Section 2.2.1) for each direction is used when data is required to flow both ways between two avionics systems elements. 2.1.2 Information Element The basic information element is a digital word containing 32 bits. There are five application groups for such words, BNR data, BCD data, Discrete data, Maintenance data (general) and Acknowledgement, ISO Alphabet Number 5 and Maintenance (ISO Alphabet Number 5) data (AIM). Word formats for these different applications are depicted in Attachment 6 while the relevant data handling rules are set forth in Section 2.3.1. When less than the full data field is needed to accommodate the information conveyed in a word in the desired manner, the unused bit positions should be filled with binary zeros or, in the case of BNR/BCD numeric data, valid data bits. If valid data bits are used, the resolution possible for the information may exceed that called for in this Specification. The Commentary following Section 2.1.6 of this document refers. COMMENTARY To permit the use of identical error-checking hardware elements in the handling of BNR and BCD numeric data words, the format for the Mark 33 DITS BCD word differs from that used formerly for this type of data. Bit Number 32 is assigned to parity, Bit Numbers 31 and 30 to the sign/status matrix, Bit Number 29 is the most significant bit of the data field, and the maximum decimal value of the most significant character is 7. Previously, the BCD word contained no parity bit, the sign/status matrix occupied Bit Numbers 32 and 31, Bit Number 30 was the most significant data bit and the maximum decimal value of the most significant character was 3.

This format made the word 8-bit byte oriented with respect to the data. This characteristic is not retained in the Mark 33 system. Also, latitude and longitude can only be encoded in the Mark 33 DITS word with the formerly specified resolution of 0.1 minute of arc if Bit Numbers 9 and 10 are used for data rather than the SDI function described in Section 2.1.4 of this document, and the word is structured differently from the standard shown in Attachment 6. Restructuring the word involves limiting the maximum value of the most significant character to 1 and moving the remaining BCD characters towards the MSB by two bit positions.

It is possible, however, that future latitude and longitude displays will not be the simple, dedicated read-out type for which BCD data is intended.

More likely is the use of some form of multiple-message display, such as a CRT, which will be backed by its own data processor and prefer inputs of BNR data. If this proves to be the case, these special provisions for BCD-encoding will not be required. 2.1.3 Information Identifier The type of information contained in a word is identified by a six-character label. The first three characters are octal characters coded in binary in the first eight bits of the word. The eight bits will: a. identify the information contained within BNR and BCD numeric data words (e.g., DME distance, static air temperature, etc.) and b. identify the word application for Discrete, Maintenance and AIM data. The last three characters of the six-character label are hexadecimal characters used to provide for identification of ARINC 429 bus sources. Each triplet of hexadecimal characters identifies a "black box" with one or more DITS ports. Each three character code (and black box) may have up to 255 eight bit labels assigned to it. The code is used administratively to retain distinction between unlike parameters having like labels assignments. COMMENTARY Some users have expressed a desire to have means for identifying label sets and buses associated with a particular equipment ID code. Octal label 377 has been assigned for this purpose. (The code appears in the 3 LSDs of the BCD Word format). The transmission of the equipment identifier word on a bus will permit receivers attached to the bus to recognize the source of the DITS information. Since the transmission of the equipment identifier word is optional, receivers should not depend on that word for correct operation. Label code assignments are set forth in Attachment 1-1 to this document.

Special Note: In some ARINC 429 DITS applications, a bus will be dedicated to delivering a single information element from a source to one or more identical sink devices. In such circumstances, the sink device designer might be tempted to assume that decoding the word label is not necessary. Experience has shown, however, that system developments frequently occur that result in the need for additional information elements to appear on the bus. If a sink device designed for service prior to such a development cannot decode the original word label, it cannot differentiate between this word and the new data in the new situation. The message for sink designers should therefore be quite clear - provide label decoding from the outset, no matter how strong the temptation to omit it might be. c-2 c-1 c-1 c-1 c-2 c-4 c-2 c-12 c-4 c-2 c-1 ARINC SPECIFICATION 429, PART 1 - Page 3 2.0 DIGITAL INFORMATION TRANSFER SYSTEM STANDARDS COMMENTARY Adherence to the label code assignments of Attachment 1-1 is essential in inter-system communications and in intra-system communications where the system elements are defined as "unit interchangeable" per ARINC Report 403. The assignment of label codes for all such communications must be coordinated with the air transport industry if chaos is to be avoided. A manufacturer who finds that Attachment 1-1 does not specify the label he needs for such system application must not simply choose one from those unassigned and drive on. The user should contact AEEC Staff for assistance. A web page on the ARINC Website (ARINC.com) has been developed to assist you in contacting the AEEC Staff. 2.1.4 Source/Destination Identifier Bit Numbers 9 and 10 of numeric data words should be reserved for a data source/destination identification function. They are not available for this function in alpha/numeric (ISO Alphabet Number 5) data words (see Section 2.3.1.3 of this document) or when the resolution needed for numeric (BNR/BCD) data necessitates their use of valid data. The source/destination identifier function may find application when specific words need to be directed to a specific system of a multi-system installation or when the source system of a multi-system installation needs to be recognizable from the word content. When it is used, a source equipment should encode its aircraft installation number in Bit Numbers 9 and 10 as shown in the table below. A sink equipment should recognize words containing its own installation number code and words containing code "00," the "all-call" code.

COMMENTARY Equipment will fall into the categories of source only, sink only, or both source and sink. Use of the SDI bits by equipment functioning only as a source or only as a sink is described above. Both the source and sink texts above are applicable to equipment functioning as both a source and a sink. Such equipment should recognize the SDI bits on the inputs and should also encode the SDI bits, as applicable, on the outputs. DME, VOR, ILS and other sensors, are examples of source and sink equipment generally considered to be only source equipment. These are actually sinks for their own control panels. Many other types of equipment are also misconstrued as source only or sink only.

A simple rule of thumb is: if a unit has a 429 input port and a 429 output port, it is a source and sink! With the increase of equipment consolidation, e.g., centralized control panels, the correct use of the SDI bits cannot be overstressed. Bit Number 10 9 Installation Number 0 0 1 1 0 1 0 1 See Note Below 1 2 3 Note: In certain specialized applications of the SDI function the all-call capability may be forfeited so that code "00" is available as an "installation Number 4" identifier. When the SDI function is not used, binary zeros or valid data should be transmitted in Bit Numbers 9 and 10. COMMENTARY This document does not address the practical question of how the SDI bits will be set in those multi-installation systems in which the source/destination function is desired. One way would be to use program pins on the individual installation black boxes which would be wired to set up the appropriate code. The ARINC Characteristics devoted to the individual systems will define the method actually to be used. 2.1.5 Sign/Status Matrix This section describes the coding of the Sign/Status Matrix (SSM) field. In all cases the SSM field uses Bits 30 and 31. For BNR data words, the SSM field also includes Bit 29. The SSM field may be used to report hardware equipment condition (fault/normal), operational mode (functional test), or validity of data word content (verified/no computed data).

The following definitions apply in this Specification: Invalid Data - is defined as any data generated by a source system whose fundamental characteristic is the inability to convey reliable information for the proper performance of a user system. There are two categories of invalid data, namely, "No Computed Data" and "Failure Warning." No Computed Data - is a particular case of data invalidity where the source system is unable to compute reliable data for reasons other than system failure. This inability to compute reliable data is caused exclusively by a definite set of events or conditions whose boundaries are uniquely defined in the system characteristic. Failure Warning - is a particular case of data invalidity where the system monitors have detected one or more failures. These failures are uniquely characterized by boundaries defined in the system characteristic. The system indicators should always be flagged during a "Failure Warning" condition.

When a "No Computed Data" condition exists, the source system should annunciate its outputs to be invalid by setting the sign/status matrix of the affected words to the "No Computed Data" code, as defined in the subsections which follow. The system indicators may or may not be flagged, depending on system requirements.

While the unit is in the functional test mode, all output data words generated within the unit (i.e., pass through words are excluded) should be coded for "Functional Test." Pass through data words are those words received by the unit and retransmitted without alteration. When the SSM code is used to transmit status and more than one reportable condition exists, the condition with the highest priority should be encoded in Bit Numbers 30 and 31. The order of condition priorities to be used is shown in the table below. c-1 c-8 c-1 c-12 ARINC SPECIFICATION 429, PART 1 - Page 4 2.0 DIGITAL INFORMATION TRANSFER SYSTEM STANDARDS 2.1.5 Sign/Status Matrix (cont'd) Failure Warning No Computed Data Functional Test Normal Operation Priority 1 Priority 2 Priority 3 Priority 4 Each data word type has its own unique utilization of the SSM field. These various formats are described in the following subsections. 2.1.5.1 BCD Numeric When a failure is detected within a system which would cause one or more of the words normally output by that system to be unreliable, the system should stop transmitting the affected word or words on the data bus. Some avionic systems are capable of detecting a fault condition which results in less than normal accuracy.

In these systems, when a fault of this nature (for instance, partial sensor loss) which results in degraded accuracy is detected, each unreliable BCD digit should be encoded "1111" when transmitted on the data bus. For equipments having a display, the "1111" code should, when received, be recognized as representing an inaccurate digit and a "dash" or equivalent symbol should be displayed in place of the inaccurate digit. Parameters for which such a degraded mode of operation is possible are identified in the Note column of the tables in Attachment 2. The sign (plus/minus, north/south, etc.) of BCD Numeric Data should be encoded in bit numbers 30 and 31 of the word as shown in the table below. Bit Numbers 30 and 31 of BCD Numeric Data words should be "zero" where no sign is needed.

The "No Computed Data" code should be annunciated in the affected BCD Numeric Data word(s) when a source system is unable to compute reliable data for reasons other than system failure. When the "Functional Test" code appears in Bits 30 and 31 of an instruction input data word, it should be interpreted as a command to perform a functional test. COMMENTARY A typical instruction input to a radio, for example, would be a channel change command word. When this command word is received with the "Functional Test" coding in the SSM field, the radio should exercise its functional test. When the "Functional Test" code appears as a system output, it should be interpreted as advice that the data in the BCD Numeric Data word contents are the result of the execution of a functional test. A functional test should produce indications of 1/8 of positive full-scale values unless indicated otherwise in the associated ARINC Equipment Characteristic. BCD NUMERIC SIGN/STATUS MATRIX Bit Number 31 30 Meaning 0 0 1 1 0 1 0 1 Plus, North, East, Right, To, Above No Computed Data Functional Test Minus, South, West, Left, From, Below 2.1.5.2 BNR Numeric Data Words The status of the transmitter hardware should be encoded in the Status Matrix field (Bit Numbers 30 and 31) of BNR Numeric Data words as shown in the table below.

A source system should annunciate any detected failure that causes one or more of the words normally output by that system to be unreliable by setting Bit Numbers 30 and 31 in the affected word(s) to the "Failure Warning" code defined in the table below.

Words containing this code should continue to be supplied to the data bus during the failure condition. The "No Computed Data" code should be annunciated in the affected BNR Numeric Data word(s) when a source system is unable to compute reliable data for reasons other than system failure. When it appears as a system output, the "Functional Test" code should be interpreted as advice that the data in the word results from the execution of a functional test. A functional test should produce indications of 1/8 of positive full-scale values unless indicated otherwise in an ARINC equipment characteristic. If, during the execution of a functional test, a source system detects a failure which causes one or more of the words normally output by that system to be unreliable, it should immediately change the states of Bit Numbers 30 and 31 in the affected words such that the "Functional Test" annunciation is replaced with "Failure Warning" annunciation. BNR STATUS MATRIX Bit Number 31 30 Meaning 0 0 1 1 0 1 0 1 Failure Warning No Computed Data Functional Test Normal Operation The sign (plus, minus, north, south, etc.) of BNR Numeric Data words should be encoded in the Sign Matrix field (Bit Number 29) as shown in the table below. Bit Number 29 should be "zero" when no sign is needed. c-12 c-12 ARINC SPECIFICATION 429, PART 1 - Page 5 2.0 DIGITAL INFORMATION TRANSFER SYSTEM STANDARDS SIGN MATRIX Bit Number 29 Meaning 0 1 Plus, North, East, Right, To, Above Minus, South, West, Left, From, Below Some avionic systems are capable of detecting a fault condition which results in less than normal accuracy. In these systems, when a fault of this nature (for instance, partial sensor loss) which results in degraded accuracy is detected, the equipment should continue to report "Normal" for the sign status matrix while indicating the degraded performance by coding bit 11 as follows: ACCURACY STATUS Bit Number 11 Meaning 0 1 Nominal Accuracy Degraded Accuracy This implies that degraded accuracy can be coded only in BNR words not exceeding 17 bits of data. Parameters for which such a degraded mode of operation is possible are identified in the notes column of the tables in Attachment 2. 2.1.5.3 Discrete Data Words A source system should annunciate any detected failure that could cause one or more of the words normally output by that system to be unreliable. Three methods are defined. The first method is to set Bit Numbers 30 and 31 in the affected word(s) to the "Failure Warning" code defined in the table below. Words containing the "Failure Warning" code should continue to be supplied to the data bus during the failure condition. When using the second method, the equipment may stop transmitting the affected word or words on the data bus. Designers should use this method when the display or use of the discrete data by a system is undesirable.

The third method applies to data words which are defined such that they contain failure information within the data field. For these applications, refer to the associated ARINC equipment characteristic to determine proper SSM reporting. Designers should preclude mixing operational and BITE data in the same word. The "No Computed Data" code should be annunciated in the affected Discrete Data word(s) when a source system is unable to compute reliable data for reasons other than system failure. When the "Functional Test" code appears as a system output, it should be interpreted as advice that the data in the Discrete Data word contents are the result of the execution of a functional test. DISCRETE DATA WORDS Bit Number 31 30 Meaning 0 0 1 1 0 1 0 1 Verified Data, Normal Operation No Computed Data Functional Test Failure Warning 2.1.6 Data Standards The units, ranges, resolutions, refresh rates, number of significant bits, pad bits, etc. for the items of information to be transferred by the Mark 33 DITS are tabulated in Attachment 2 to this document. COMMENTARY Note that Section 2.3.1.1 of this document calls for numeric data to be encoded in BCD and binary, the latter using twos complement fractional notation. In this notation, the most significant bit of the data field represents one half of the maximum value chosen for the parameter being defined. Successive bits represent the increments of a binary fraction series.

Negative numbers are encoded as the twos complements of positive value and the negative sign is annunciated in the sign/status matrix. In establishing a given parameter's binary data standards for inclusion in Attachment 2, the units maximum value and resolution are first determined in that order. The least significant bit of the word is then given a value equal to the resolution increment, and the number of significant bits is chosen such that the maximum value of the fractional binary series just exceeds the maximum value of the parameter, i.e., equals the next whole binary number greater than the maximum parameter value less one least significant bit value. For example, if the Mark 33 DITS is required to transfer altitude in units of feet over a range of zero to 100,000 feet with a resolution of one foot, the number of significant bits is 17 and the maximum value of the fractional binary series is 131,071 (i.e., 131,072 - 1). Note that because accuracy is a quality of the measurement process and not the data transfer process, it plays no part in the selection of word characteristics. Obviously, the resolution provided in the DITS word should equal or exceed the accuracy in order not to degrade it. For the binary representation of angular data, the Mark 33 DITS employs "degrees divided by 180o" as the unit of data transfer and ±1 (semicircle) as the range for twos complement fractional notation encoding (ignoring, for the moment, the subtraction of the least significant bit value). Thus the angular range 0 through 359.XXX degrees is encoded as 0 through ±179.XXX degrees, the value of the most significant bit is one half semicircle and there are no discontinuities in the code. This may be illustrated as follows. Consider encoding the angular range 0o to 360o in 1o increments. Per the general encoding rules above, the positive semicircle will cover the range 0o to 179o (one least significant bit less than full range). All the bits of the code will be "zeros" for 0o and "ones" for 179o, and the sign/status matrix will indicate the positive sign.

The negative semicircle will cover the range 180o to 359o. All the bits will be "zeros" for 180o. The codes for angles between 181o to 359o will be determined by taking the twos complements of the fractional binary series for c-12 c-15 c-12 c-15 c-12 c-1 c-3 ARINC SPECIFICATION 429, PART 1 - Page 6 2.0 DIGITAL INFORMATION TRANSFER SYSTEM STANDARDS 2.1.6 Data Standards (cont'd) COMMENTARY (cont'd) the result of subtracting each value from 360. Thus, the code for 181o is the twos complement of the code for 179o. Throughout the negative semicircle, which includes 180o, the sign/status matrix contains the negative sign. For convenience, all binary word ranges in Attachment 2 are shown as whole binary numbers rather than such numbers less one least significant bit value. Also, the resolutions shown are approximate only. Accurate resolutions can be determined, if required, by reference to the range values and numbers of significant bits for the words of interest. It should be noted that in all applications of the twos complement fractional notation, the maximum value of the word, once chosen, cannot be changed by the use of more bits in the data field. The number of bits in the word affects only the resolution of the data, not its range. Binary Coded Decimal (BCD) data is encoded per the numeric subset of the ISO Alphabet #5 code (see Attachment 5 to this document) using Bit Numbers 1 through 4 of the seven-bit-per-character code. Alpha/numeric data is encoded using all seven bits per character of the ISO Alphabet #5 code and is transmitted using the special word format described in Section 2.3.1.3 of this document.

2.2 Electrically Related Elements This section describes the digital transfer system elements considered to be principally related to the electrical aspects of the signal circuit. 2.2.1 Transmission System Interconnect A data source should be connected to the data sink(s) by means of a single twisted and shielded pair of wires. The shields should be grounded at both ends to an aircraft ground close to the rack connector and at all production breaks in the cable. COMMENTARY In practical wire line digital information transmission systems, cable characteristics and electrical mismatches can produce distortion of the digital data pulses. Also, noise due to electrical interference perturbs digital

signals. The performance of a digital receiver depends upon the receiver input signal characteristics (data with distortion and noise) and the receiver design. Prior to the selection of the voltage and impedance parameters set forth in this section of this document, the pulse distortion likely to be encountered in systems built around them in existing size commercial aircraft was evaluated and judged to be acceptable for a well-designed receiver. No restriction is placed by this specification, therefore, on the number or length of stubs for installations on aircraft no larger than those existing, e.g., B 747. See Appendix A to this document for a report of this investigation. Tests have shown that some receivers continue decoding data properly when one side of the transmission line is open or shorted to ground. When this condition exists noise immunity decreases and intermittent operation may occur. Users desire protection against non-annunciated system operation in this mode. This protection may consist of additional circuitry to detect and annunciate the fault, or to increase the receiver threshold to above 5.5 volts, which is the maximum signal level under this one-wire fault condition. Most ARINC Characteristics now contain text specifying that DITS receivers should discontinue operation when the voltage thresholds fall into the undefined regions between "Null" and "Hi" or "Null" and "Lo." Manufacturers building DITS receivers are urged to incorporate this feature in their circuitry whether it is to be used in ARINC 7XX-series equipment or Non-ARINC devices. 2.2.2 Modulation RZ bipolar modulation should be used. This is tri-level state modulation consisting of "HI," "NULL" and "LO" states. 2.2.3 Voltage Levels 2.2.3.1 Transmitter Voltage Levels The differential output signal across the specified output terminals (balanced to ground at the transmitter) should be as given in the following table when the transmitter is open circuit: HI (V) NULL (V) LO (V) Line A to Line B Line A to Ground Line B to Ground +10 +1.0 +5 +0.5 -5 +0.5 0 +0.5 0 +0.25 0 +0.25 -10 +1.0 -5 +0.5 +5 +0.5 c-3 c-5 c-5 c-4 c-4 c-5 ARINC SPECIFICATION 429, PART 1 - Page 7 2.0 DIGITAL INFORMATION TRANSFER SYSTEM STANDARDS 2.2.3.2 Receiver Voltage Levels The differential voltage presented at the receiver input terminals will be dependent upon line length, stub configuration and the number of receivers connected. In the absence of noise, the normal ranges of voltages presented to the receiver terminals (A and B) would be: "HI" +7.25V to +11V "NULL" +0.5V to -0.5V "LO" -7.25V to -11V In practice, these nominal voltages will be perturbed by noise and pulse distortion. Thus, receivers should associate the following voltage ranges with the three states indicated: "HI" +6.5V to 13V "NULL" +2.5V to -2.5V "LO" -6.5V to -13V COMMENTARY Receiver reaction is currently undefined herein for voltages that fall in the range just above and below the "Null" range. Respective equipment characteristics should be referenced for desired receiver response in this range. However, it is desirable that all DITS receivers will discontinue operation when the voltage levels fall into the undefined regions. Manufacturers are urged, as new equipment is developed, to "design in" the rejection capability. The opinion is held by some people that conditions on transmission lines will be encountered which will require receivers to operate with less than the above defined minimum difference of 4.0V between the NULL and HI and NULL and LO states.

Receiver designers are encouraged to investigate the possibilities and problems of working with a minimum difference of 1 volt between these states and to report their findings. Receiver input common mode voltages (terminal A to ground and terminal B to ground) are not specified because of the difficulties of defining ground with any satisfactory degree of precision. Receiver manufacturers are encouraged to work with the differential input voltage (line A to line B) and not line-to-ground voltages.

2.2.4 Impedance Levels 2.2.4.1 Transmitter Output Impedance The transmitter output impedance should be 75 ±5 ohms, divided equally between line A and line B to provide an impedance balanced output. This output impedance should be present for the "HI," "NULL" and "LO" transmitter output conditions and also during transitions between these levels. COMMENTARY The output impedance of the transmitter is specified as 75 ± 5 ohms to provide an approximate match to the characteristic impedance of the cable.

The match can only be approximate due to the wide range of characteristic impedances which may be encountered due to the variety of conductor wire gauges and insulation properties. Measurements on a few samples of wire showed a spread of characteristic impedance of 63 to 71 ohms. An extrapolation over the wire gauges 20 to 26 for wrapped and extruded insulation indicate an expected characteristic impedance spread of 60 to 80 ohms approx. Twisted shielded wire specifications do not control the characteristic impedance of the cable, thus future developments in insulation techniques may result in cables having characteristic impedances outside the range estimated.

2.2.4.2 Receiver Input Impedance The receiver should exhibit the following characteristics, measured at the receiver input terminals: Differential Input Resistance RI = 12,000 ohms minimum Differential Input Capacitance CI = 50pF maximum Resistance to Ground RH and RG ≥ 12,000 ohms Capacitance to Ground CH and CG ≤ 50pF. The total receiver input resistance including the effects of RI, RH and RG in parallel should be 8,000 ohms minimum (400 ohms minimum for twenty receiver loads).

No more than twenty receivers should be connected on to one digital data bus and each receiver should incorporate isolation provisions to ensure that the occurrence of any reasonably probable failure does not cause loss of data to the others. See Attachment 4 to this document for a pictorial representation of the input and output circuit standards. COMMENTARY The above characteristics apply to differential amplifier receivers. Opto-isolator technology is progressing and may soon find application in digital data receivers. Opto-isolator receivers impose slightly greater loads on data buses than differential amplifier receivers and the way in which they are characterized is different. It is probable, however, that a future revision of this Specification will include material specifically related to their use.

2.2.5 Fault Tolerance 2.2.5.1 Receiver External Fault Voltage Tolerance Receivers should withstand without sustaining damage the following steady-state voltages being applied to their terminals, superimposed upon a normally operating bus. Operation within specification limits is not required under these conditions. a. 30 Vac RMS applied across terminals A and B, or b. ±29 Vdc applied between terminal A and ground, or c. ±29 Vdc applied between terminal B and ground. c-5 c-4 c-4 c-4 c-4 c-4 c-4 ARINC SPECIFICATION 429, PART 1 - Page 8 2.0 DIGITAL INFORMATION TRANSFER SYSTEM STANDARDS 2.2.5.2 Transmitter External Fault Voltage Transmitter failures caused by external fault voltages should not cause other transmitters or other circuitry in the unit to function outside of their specification limits or to fail. 2.2.5.3 Transmitter External Fault Load Tolerance Transmitters should indefinitely withstand without sustaining damage a short circuit applied: a. across terminals A and B, or b. from terminal A to ground, or c. from terminal B to ground, or d. b and c above, simultaneously. 2.2.6 Fault Isolation 2.2.6.1 Receiver Fault Isolation Each receiver should incorporate isolation provisions to ensure that the occurrence of any reasonably probable internal LRU or bus receiver failure does not cause any input bus to operate outside of its specification limits (both undervoltage or overvoltage).

2.2.6.2 Transmitter Fault Isolation Each transmitter should incorporate isolation provisions to ensure that it does not under any reasonably probable LRU fault condition provide an output voltage in excess of: a. a voltage greater than 30 Vac RMS between terminal A and B, or b. greater than ±29 Vdc between A and ground, or c.

greater than ±29 Vdc between B and ground. 2.3 Logic Related Elements This section describes the digital transfer system elements considered to be principally related to the logic aspects of the signal circuit. 2.3.1 Digital Language 2.3.1.1 Numeric Data The Mark 33 DITS should accommodate numeric data encoded in two digital languages, (i) BNR expressed in twos complement fractional notation and (ii) BCD per the numerical subset of ISO Alphabet Number 5 (see Attachment 5 to this document). An information item encoded in both languages will be assigned a unique address for each (see Section 2.1.3 and Attachment 1-1). Word formats are illustrated in Attachment 6 to this document.

2.3.1.2 Discretes In addition to handling numeric data as specified above, the Mark 33 DITS should also be capable of accommodating discrete items of information either in the unused (pad) bits of data words or, when necessary, in dedicated words. Any discrete information contained in a numeric data word assigned a label in Attachment 1-1 is specified in the definition for that word in Attachment 6. The rule to be followed in the assignment soft bits to discrete in numeric data words is to start with the least significant bit of the word and to continue towards the most significant bit available in the word. Attachment 6 shows its against the background of the generalized word structure.

There are two types of discrete words. These are general purpose discrete words, and dedicated discrete words. Seven labels (270 XXX-276 XXX) are assigned to the general purpose words in Attachment 1-1. These words should be used in ascending label order (starting with 270 XXX) when the system receiving the data can identify its source by reference to the port at which it arrives. 2.3.1.3 Maintenance Data (General Purpose) The general purpose maintenance words are assigned labels in sequential order as are the labels for the general purpose discrete words. The lowest octal value label assigned to the maintenance words should be used when only one maintenance word is transmitted. When more than one word is transmitted the lowest octal value label should be used first and the other labels used sequentially until the message has been completed. The general purpose maintenance words may contain discrete, BCD or BNR numeric data but should never contain ISO Alphabet Number 5 messages. The general purpose maintenance words should be formatted according to the layouts of the corresponding BCD/BNR/discrete data words shown in Attachment 2. 2.3.1.4 AIM Data The information previously contained in this section is no longer applicable to ARINC Specification 429. For reference purposes, the section header is retained and the original contents of this section are located in Part 3 of this Specification. 2.3.1.5 File Data Transfer This section previously described a character-oriented file data transfer protocol. This definition was used as guidance for the character-oriented file transfer protocol descriptions incorporated into many ARINC equipment characteristics.

The original contents of this section are located in Part 3 of this Specification. The protocol defined in Part 3 is preferred for new applications. The purpose of this bit-oriented communications protocol is to provide for the transparent transfer of data files using the ARINC 429 data bus. COMMENTARY The data transparent protocol described in Part 3 was developed in order to facilitate the communications of the ACARS Management Unit (MU) and the Satellite Data Unit (SDU). Its viability as a universal protocol was recognized by the Systems Architecture and Interfaces (SAI) Subcommittee, which recommended its inclusion herein as the standard means of file data transfer. c-4 c-4 c-4 c-2 c-2 c-4 c-12 c-13 c-2 c-2 ARINC SPECIFICATION 429, PART 1 - Page 9 2.0 DIGITAL INFORMATION TRANSFER SYSTEM STANDARDS The process for determining the protocol (character-oriented or bit-oriented) to be used in the interaction between two units, where this information is not pre-determined is described in Part 3 of ARINC 429. 2.3.1.5.1 Bit-Oriented Protocol Determination The ALO word should be sent by any system which supports the bit-oriented Link Layer protocol just after the system powers-up, or performs a re-initialization for any reason. The ALO/ALR protocol process may also be used when a bit-oriented Link Layer protocol system needs to determine if any of its interfaces support the bit-oriented protocol. All systems which support the Link Layer bit-oriented protocol must be able to respond to the initiation of this process.

Attachment 11C of Part 3 to ARINC 429, shows the ALO and ALR word formats. When a system with a bit-oriented Link Layer protocol has the need to make this determination, it should construct the ALO word and transmit this word to the device in question. The system should then wait for a maximum period of time defined by T12. If the device in question has not responded within T12, the initiating system should initiate another ALO word and again delay up to T12. An initiating system will attempt a maximum of N6 ALO word operations before declaring the device in question as "Not bit-oriented" or "Not able to respond." 2.3.2 Transmission Order The Least Significant Bit (LSB) and Least Significant Character (LSC) of each word should be transmitted first. It may be noted that the least significant bit of the word is the most significant bit of the label and that the label is transmitted ahead of the data in each case. This "reversed label" characteristic is a legacy from past systems in which the octal coding of the label field was, apparently, of no significance. 2.3.3 Data Bit Encoding Logic A "HI" state after the beginning of the bit interval returning to a "NULL" state before the end of the same bit interval signifies a logic "one." A "LO" state after the beginning of the bit interval returning to a "NULL" state before the end of the same bit interval signifies a logic "zero." This is represented graphically in Attachment 7 to this document. 2.3.4 Error Detection/Correction The last bit of each word should be encoded such that word parity is rendered odd to allow error detection in receivers. Note that the parity calculation encompasses all 31 label and information bits of the word. COMMENTARY Air transport industry experience with digital information transfer systems pre-dating the Mark 33 DITS has shown that the twisted shielded pair of wires can be regarded as a high integrity link unlikely to introduce bit errors into the data passing through it. It is for this reason that no means for error correction are specified in this document. The error detection capability specified above may be used as desired in receiving terminals. BNR data, for example, may be checked for parity by reference to the binary state of Bit Number 32 of each word. Also, the data may be submitted to reasonableness checks. BCD may be submitted to reasonableness checks. BCD data intended for human consumption in the cockpit is normally smoothed before transmission to ensure tolerable levels of display jitter. As this process eliminates any obviously wild data points, the need for further error detection is questionable. As pointed out in the Commentary following Section 2.1.2 of this document, the parity bit was added to the BCD word for reasons related to BCD/BNR transmitter hardware commonality, not because a need for it existed for error detection. 2.4 Timing Related Elements This section describes the digital data transfer system elements considered to be principally related to the timing aspects of the signal circuit. 2.4.1 Bit Rate 2.4.1.1 High Speed Operation The bit rate for high speed operation of the system should be 100 kilobits per second ±1%.

2.4.1.2 Low Speed Operation The bit rate for low speed operation of the system should be within the range 12.0 to 14.5 kilobits per second.

The selected rate should be maintained within 1%. NOTE: High bit rate and low bit rate messages will not be intermixed on the same bus. COMMENTARY Although the bit rates specified above should be held within the stated tolerances over the long term, individual bit lengths may fall outside the limits expected from these tolerances. Bit symmetry and jitter should be within the tolerances specified in Attachment 8. Also, notwithstanding the RFI performance of the ARINC 429 DITS reported in Appendix 1 to this document, system designers are advised to avoid selection of 13.6 kilobits per second for low speed operations and precisely 100 kilobits per second for high speed operations to ensure that the system is not responsible for interference to LORAN C systems with which the aircraft might be equipped. 2.4.2 Information Rates The minimum and maximum transmit intervals for each item of information transferred by the Mark 33 DITS are specified in the tables of Attachment 2. Words with like labels but with different SDI codes should be treated as unique items of information. Each and every unique item of information should be transmitted once during an interval bounded in length by the minimum and maximum c-14 c-5c-5 c-4 c-13 c-5 ARINC SPECIFICATION 429, PART 1 - Page 10 2.0 DIGITAL INFORMATION TRANSFER SYSTEM STANDARDS 2.4.2 Information Rates (cont'd) values specified in Attachment 2. Stated another way, a word having the same label and four different SDI codes should appear on the bus four times (once for each SDI code) during that time interval. COMMENTARY There are no values given for refresh rates in this Specification. However, it is desirable that data be refreshed at least once per transmission. Those data actually requiring long processing times or a large number of samples are the only types not expected to be refreshed with every transmission. Discretes contained within data words should be transferred at the bit rate and repeated at the update rate of the primary data. Words dedicated to discretes should be repeated continuously at the rates defined in Attachment 2. COMMENTARY The time intervals between successive transmissions of a given BCD word specified in table 1 of Attachment 2 to this document are, in general, too short for the signal to be of use in driving a display device directly. If the signal was so used the least significant character of the display, would change too rapidly for human perception. Considerations other than human factors demand the time intervals specified. Thus, display designers should incorporate into their devices means for selecting those words to be used for updating the display from the greater quantity delivered. 2.4.3 Clocking Method Clocking is inherent in the data transmission. The identification of the bit interval is related to the initiation of either a "HI" or "LO" state from a previous "NULL" state in a bipolar RZ code. 2.4.4 Word Synchronization The digital word should be synchronized by reference to a gap of four bit times (minimum) between the periods of word transmissions. The beginning of the first transmitted bit following this gap signifies the beginning of the new word. 2.4.5 Timing Tolerances The waveform timing tolerances should be as shown in Attachment 8 to this document. COMMENTARY RF interference radiated by the Mark 33 DITS using the waveform characteristics specified in this section has been shown not to exceed that permitted by Figure 21-5 of RTCA Document DO-160, "Environmental Conditions and Test Procedures for Airborne Electronic/Electrical Equipment and Instruments." Also, conducted RF interference is within the limits specified in Figure 21-2 of DO-160. Appendix 1 to this document refers.

c-5 ARINC SPECIFICATION 429, PART 1 - Page 11 c-17 3.0 MARK 33 DITS APPLICATIONS NOTES 3.1 Radio Systems Management One special application of the Mark 33 DITS is to radio systems frequency selection and function switching. The following paragraphs set forth the rules which should be followed in the application of the DITS to ensure interchangeability of radios and control sources. 3.1.1 Word Format and Digital Language The standard DITS 32-bit BCD word should be used, of which Bit Numbers 1 through 8 constitute the label, Bit Numbers 9 and 10 are reserved for a source/destination identifier code, bit Numbers 11 through 29 constitute the data, Bit Numbers 30 and 31 form the sign/status matrix and Bit Number 32 is the word parity bit. The data field should contain the frequency to which the radio defined by the label field is to tune encoded in BCD characters, together with the discretes required for function switching for that radio. Attachment 6 shows how the word should be structured for each radio system requiring the DITS management service. 3.1.2 Update Rate The nominal update rate for all radio systems management words should be five times per second. 3.1.3 Sign/Status Matrix Since sign is not a characteristic of radio systems management information, the normal states of the sign/status matrix bits will be binary "zeros." However, the radios should recognize the codes for "functional test" and "no computed data," (see Section 2.1.5 of this document). They should interpret the former as an instruction to perform a functional test or functional test sequence.

They should regard the latter as an instruction to remain tuned to the frequency contained in the last valid word received until either another valid word is decoded or their primary power is removed. 3.1.4 Frequency Ranges and Switching Functions 3.1.4.1 ADF Frequency Range: 190kHz to 1750kHz Frequency Selection Increment: 0.5kHz Characters encoded in DITS word: 1000kHz, 100kHz, 10kHz, 1kHz Switching Functions: 0.5kHz on/off, BFO on/off, ADF/ANT mode selection 3.1.4.2 DME Frequency Range: (VOR/ILS) 108.00MHz to 135.95MHz Frequency Selection Increment: (VOR/ILS) 50kHz Characters encoded in DITS word: 10Mhz, 1Mhz, 0.1MHz 0.05MHz (VOR/ILS only) (100MHz character is 1 for VOR/ILS, 10MHz character is limited to 7) Switching Functions: VOR/ILS/MLS Frequency, DME modes, Directed Frequency Numbers, Display Control 3.1.4.3 HF Communications Frequency Range: 2.8MHz to 24MHz Frequency Selection Increment: 1kHz or .1kHz Characters encoded in DITS words: 10MHz, 1MHz, 0.1MHz, Switching Functions: USB/LSB mode selection SB/AM mode selection Note: Two words may be transmitted for HF frequency selection to facilitate frequency resolution of 0.1kHz. 3.1.4.4 ILS Frequency Range: 108.00MHz to 111.95MHz Frequency Selection Increment: 50kHz Characters encoded in DITS words: 10MHz, 1MHz, 0.1MHz, 0.01MHz, (100MHz character is always decimal 1) Switching Functions: None 3.1.4.5 VOR/ILS Frequency Range: 108.00 MHz to 117.95MHz Frequency Selection Increment: 50kHz Characters encoded in DITS words: 10MHz, 1MHz, 0.1MHz, 0.01MHz, (100MHz character is always decimal 1) Switching Functions: ILS Mode 3.1.4.6 VHF Communications Frequency Range: 117.975MHz to 137.000MHz Frequency Selection Increment: 25kHz or 8.33kHz Characters encoded in DITS words: 10MHz, 1MHz, 0.1MHz, 0.01MHz, (100MHz character is always decimal 1) Switching Functions: None 3.1.4.7 ATC Transponder Note: The ATC Transponder operates on two frequencies (one receive and one transmit) which do not require selection. Reply code selection, however, is required and it is this that the Mark 33 DITS accommodates). Reply Code Ranges: 0-7 in four independent groups Code increments: 1 decimal digit per group Number of characters encoded in DITS words: ALL Switching Functions: Ident. Pulse Select, Altitude Reporting On/Off, Altitude Source Select, X-pulse Select (reserved), VFR/IFR Select (reserved), IRS/FMC Input Select (reserved). ARINC SPECIFICATION 429, PART 1 - Page 12 3.0 MARK 33 DITS APPLICATIONS NOTES 3.2 AIM Information Transfer The information previously contained in this section is no longer applicable to ARINC Specification 429. For reference purposes, the section header is retained and the original contents of this section are located in Part 3. ATTACHMENT 1-1LABEL CODES ARINC SPECIFICATION 429, PART 1 - Page 13 1 2 3 4 5 6 7 8 BNR BCD DISC SAL 0 X X 0 0 0 0 0 0 0 0 Not Used 0 0 2 0 0 0 0 0 0 0 1 Distance to Go X 6-250 5 6 0 0 0 0 0 0 0 1 Distance to Go X0 6 0 0 0 0 0 0 0 1 Distance to Go X0 0 2 0 0 0 0 0 0 1 0 Time to Go X 6-250 5 6 0 0 0 0 0 0 1 0 Time to Go X0 6 0 0 0 0 0 0 1 0 Time to Go X1 1 5 0 0 0 0 0 0 1 0 Time to Station X0 0 2 0 0 0 0 0 0 1 1 Cross Track Distance X 6-250 0 1 0 0 0 0 0 1 0 0 Runway Distance to Go X0 D 0 0 0 0 0 1 0 1 Engine Discrete X0 D 0 0 0 0 0 1 1 0 Engine Discrete X0 0 0 0 0 0 1 1 1 Spare0 0 2 0 0 0 0 1 0 0 0 Present Position - Latitude X 6-25-10 0 4 0 0 0 0 1 0 0 0 Present Position - Latitude X0 3 8 0 0 0 0 1 0 0 0 Present Position - Latitude X0 0 2 0 0 0 0 1 0 0 1 Present Position - Longitude X 6-25-10 0 4 0 0 0 0 1 0 0 1 Present Position - Longitude X0 3 8 0 0 0 0 1 0 0 1 Present Position - Longitude X0 0 2 0 0 0 0 1 0 1 0 Ground Speed X 6-250 0 4 0 0 0 0 1 0 1 0 Ground Speed X0 0 5 0 0 0 0 1 0 1 0 Ground Speed X0 2 5 0 0 0 0 1 0 1 0 Ground Speed X0 3 8 0 0 0 0 1 0 1 0 Ground Speed X0 4 D 0 0 0 0 1 0 1 0 QTY-LD SEL (LB) X0 5 6 0 0 0 0 1 0 1 0 Ground Speed X0 6 0 0 0 0 0 1 0 1 0 Ground Speed X0 0 2 0 0 0 0 1 0 1 1 Track Angle - True X 6-250 0 4 0 0 0 0 1 0 1 1 Track Angle - True X0 3 8 0 0 0 0 1 0 1 1 Track Angle - True X0 4 D 0 0 0 0 1 0 1 1 QTY-FLT Deck (LB) X0 B 8 0 0 0 0 1 0 1 1 Control Word for TCAS/Mode S X0 0 4 0 0 0 0 1 1 0 0 Magnetic Heading X0 0 5 0 0 0 0 1 1 0 0 Magnetic Heading X0 3 8 0 0 0 0 1 1 0 0 Magnetic Heading X0 0 2 0 0 0 0 1 1 0 1 Wind Speed X0 0 4 0 0 0 0 1 1 0 1 Wind Speed X0 0 5 0 0 0 0 1 1 0 1 Wind Speed X0 3 8 0 0 0 0 1 1 0 1 Wind Speed X0 0 4 0 0 0 0 1 1 1 0 Wind Direction - True X0 3 8 0 0 0 0 1 1 1 0 Wind Direction - True X0 B 8 0 0 0 0 1 1 1 0 Control Word for TCAS/Mode S X0 1 0 0 0 0 0 1 1 1 1 Selected Runway - True X0 4 D 0 0 0 0 1 1 1 1 Total-FLT Deck (LB) X0 5 5 0 0 0 0 1 1 1 1 Selected Runway Heading X0 A 0 0 0 0 1 1 1 1 Selected Runway Heading X0 B 0 0 0 0 0 1 1 1 1 Selected Runway Heading X0 2 0 0 0 0 1 0 0 0 0 Selected Vertical Speed X 6-250 4 D 0 0 0 1 0 0 0 0 TNK-LD SEL (LB) X0 6 D 0 0 0 1 0 0 0 0 Landing Gear Position Infor & System Status X0 A 1 0 0 0 1 0 0 0 0 Selected Vertical Speed X0 0 2 0 0 0 1 0 0 0 1 Selected EPR X 6-250 0 2 0 0 0 1 0 0 0 1 Selected N1 X 6-250 2 0 0 0 1 0 0 0 1 Selected EPR X0 2 0 0 0 0 1 0 0 0 1 Selected N1 X0 6 D 0 0 0 1 0 0 0 1 Landing Gear Position Infor & System Status X0 A 1 0 0 0 1 0 0 0 1 Selected EPR X0 A 1 0 0 0 1 0 0 0 1 Selected N1 X0 2 0 0 0 0 1 0 0 1 0 Selected Mach X 6-250 4 D 0 0 0 1 0 0 1 0 QTY-LD SEL (KG) X0 6 D 0 0 0 1 0 0 1 0 Landing Gear Position Infor & System Status X0 A 1 0 0 0 1 0 0 1 0 Selected Mach X0 2 0 0 0 0 1 0 0 1 1 Selected Heading X 6-250 4 D 0 0 0 1 0 0 1 1 QTY-LD SEL (KG) X0 6 D 0 0 0 1 0 0 1 1 Landing Gear Position Infor & System Status X0 A 1 0 0 0 1 0 0 1 1 Selected Heading X 0 2 2 0 2 3 0 1 6 0 1 7 0 2 0 0 2 1 0 1 2 0 1 3 0 1 4 0 1 5 0 0 60 0 7 0 1 0 0 1 1 0 0 2 0 0 30 0 40 0 5 DataNotes & Cross Ref. to Tables in Att. 6 0 0 0 0 0 1 Code No. (Octal) Eqpt. ID (Hex) Transmission Order Bit PositionParameter ATTACHMENT 1-1LABEL CODES ARINC SPECIFICATION 429, PART 1 - Page 14 1 2 3 4 5 6 7 8 BNR BCD DISC SAL DataNotes & Cross Ref. to Tables in Att. 6 Code No. (Octal) Eqpt. ID (Hex) Transmission Order Bit PositionParameter 0 1 1 0 0 0 1 0 1 0 0 Selected Course #1 X 6-250 2 0 0 0 0 1 0 1 0 0 Selected Course #1 X0 6 D 0 0 0 1 0 1 0 0 Landing Gear Position Infor & System Status X0 A 1 0 0 0 1 0 1 0 0 Selected Course #1 X0 B 1 0 0 0 1 0 1 0 0 Selected Course #1 X0 2 0 0 0 0 1 0 1 0 1 Selected Altitude X 6-250 4 D 0 0 0 1 0 1 0 1 Load SEL Control X0 A 1 0 0 0 1 0 1 0 1 Selected Altitude X0 0 3 0 0 0 1 0 1 1 0 Selected Airspeed X 6-250 2 0 0 0 0 1 0 1 1 0 Selected Airspeed X0 A 1 0 0 0 1 0 1 1 0 Selected Airspeed X0 0 2 0 0 0 1 0 1 1 1 TACAN Selected Course X0 1 1 0 0 0 1 0 1 1 1 Selected Course # 2 X0 2 0 0 0 0 1 0 1 1 1 Selected Course # 2 X0 4 D 0 0 0 1 0 1 1 1 Total-FLT Deck (KG) X0 5 6 0 0 0 1 0 1 1 1 TACAN Selected Course X0 6 0 0 0 0 1 0 1 1 1 TACAN Selected Course X0 A 1 0 0 0 1 0 1 1 1 Selected Course # 2 X0 B 1 0 0 0 1 0 1 1 1 Selected Course # 2 X0 2 0 0 0 0 1 1 0 0 0 VHF COM Frequency X 6-450 2 4 0 0 0 1 1 0 0 0 VHF COM Frequency X0 4 D 0 0 0 1 1 0 0 0 TNK-LD SEL (KG) X0 B 6 0 0 0 1 1 0 0 0 VHF COM Frequency X 6-450 2 0 0 0 0 1 1 0 0 1 Beacon Transponder Code X 6-460 B 8 0 0 0 1 1 0 0 1 Beacon Transponder Code X0 1 2 0 0 0 1 1 0 1 0 ADF Frequency X 6-400 2 0 0 0 0 1 1 0 1 0 ADF Frequency X 6-400 B 2 0 0 0 1 1 0 1 0 ADF Frequency X 6-400 0 2 0 0 0 1 1 0 1 1 ILS Frequency X 6-440 1 0 0 0 0 1 1 0 1 1 ILS Frequency X0 2 0 0 0 0 1 1 0 1 1 ILS Frequency X0 5 5 0 0 0 1 1 0 1 1 Landing System Mode/Frequency X Note 30 5 6 0 0 0 1 1 0 1 1 ILS Frequency X0 6 0 0 0 0 1 1 0 1 1 ILS Frequency X0 0 2 0 0 0 1 1 1 0 0 VOR/ILS Frequency X 6-44-10 0 6 0 0 0 1 1 1 0 0 Baro Correction (mb) #3 X0 1 1 0 0 0 1 1 1 0 0 VOR/ILS Frequency X0 2 0 0 0 0 1 1 1 0 0 VOR/ILS Frequency X0 2 5 0 0 0 1 1 1 0 0 VOR/ILS Frequency X0 5 6 0 0 0 1 1 1 0 0 VOR/ILS Frequency X0 6 0 0 0 0 1 1 1 0 0 VOR/ILS Frequency #1 X0 B 0 0 0 0 1 1 1 0 0 VOR/ILS Frequency X0 0 2 0 0 0 1 1 1 0 1 DME Frequency X 6-410 0 6 0 0 0 1 1 1 0 1 Baro Correction (ins of Hg) #3 X0 0 9 0 0 0 1 1 1 0 1 DME Frequency X 6-410 2 0 0 0 0 1 1 1 0 1 DME Frequency X0 2 5 0 0 0 1 1 1 0 1 DME Frequency X0 5 5 0 0 0 1 1 1 0 1 Paired DME Frequency X0 5 6 0 0 0 1 1 1 0 1 DME Frequency X0 6 0 0 0 0 1 1 1 0 1 DME Frequency #1 X0 A 9 0 0 0 1 1 1 0 1 DME Frequency X0 0 2 0 0 0 1 1 1 1 0 MLS Frequency X0 2 0 0 0 0 1 1 1 1 0 MLS Frequency X0 5 5 0 0 0 1 1 1 1 0 MLS Channel Selection X0 5 6 0 0 0 1 1 1 1 0 MLS Frequency Channel X0 6 0 0 0 0 1 1 1 1 0 MLS Frequency Channel X0 C 7 0 0 0 1 1 1 1 0 MLS Frequency X0 0 2 0 0 0 1 1 1 1 1 HF COM Frequency X 6-420 B 9 0 0 0 1 1 1 1 1 HF COM Frequency X0 0 0 1 0 0 0 0 0 Spare0 0 2 0 0 1 0 0 0 0 1 Set Latitude X0 0 4 0 0 1 0 0 0 0 1 Set Latitude X0 2 0 0 0 1 0 0 0 0 1 Set Latitude X0 5 6 0 0 1 0 0 0 0 1 Set Latitude X0 6 0 0 0 1 0 0 0 0 1 Set Latitude X0 A 4 0 0 1 0 0 0 0 1 Set Latitude X 0 3 6 0 3 7 0 4 0 0 4 1 0 3 2 0 3 3 0 3 4 0 3 5 0 2 6 0 2 7 0 3 0 0 3 1 0 2 4 0 2 5 ATTACHMENT 1-1LABEL CODES ARINC SPECIFICATION 429, PART 1 - Page 15 1 2 3 4 5 6 7 8 BNR BCD DISC SAL DataNotes & Cross Ref. to Tables in Att. 6 Code No. (Octal) Eqpt. ID (Hex) Transmission Order Bit PositionParameter 0 0 2 0 0 1 0 0 0 1 0 Set Longitude X0 0 4 0 0 1 0 0 0 1 0 Set Longitude X0 2 0 0 0 1 0 0 0 1 0 Set Longitude X0 5 6 0 0 1 0 0 0 1 0 Set Longitude X0 6 0 0 0 1 0 0 0 1 0 Set Longitude X0 A 4 0 0 1 0 0 0 1 0 Set Longitude X0 0 2 0 0 1 0 0 0 1 1 Set Magnetic Heading X0 0 4 0 0 1 0 0 0 1 1 Set Magnetic Heading X0 2 0 0 0 1 0 0 0 1 1 Set Magnetic Heading X0 5 6 0 0 1 0 0 0 1 1 Set Magnetic Heading X0 6 0 0 0 1 0 0 0 1 1 Set Magnetic Heading X0 A 4 0 0 1 0 0 0 1 1 Set Magnetic Heading X0 0 4 0 0 1 0 0 1 0 0 True Heading X0 3 8 0 0 1 0 0 1 0 0 True Heading X0 0 3 0 0 1 0 0 1 0 1 Minimum Airspeed X0 3 3 0 0 1 0 0 1 1 0 Engine Serial No. (LSDs) X 6-151 0 A 0 0 1 0 0 1 1 0 Engine Serial No. (LSDs) X 6-151 0 B 0 0 1 0 0 1 1 0 Engine Serial No. (LSDs) X 6-150 2 0 0 0 1 0 0 1 1 1 VHF COM Frequency X0 2 4 0 0 1 0 0 1 1 1 VHF COM Frequency X0 3 3 0 0 1 0 0 1 1 1 Engine Serial No. (MSDs) X 6-160 B 6 0 0 1 0 0 1 1 1 VHF COM Frequency X1 0 A 0 0 1 0 0 1 1 1 Engine Serial No. (MSDs) X 6-161 0 B 0 0 1 0 0 1 1 1 Engine Serial No. (MSDs) X 6-160 0 0 1 0 1 0 0 0 Spare0 0 0 1 0 1 0 0 1 Spare 0 0 4 0 0 1 0 1 0 1 0 Body Pitch Acceleration X 0 3 7 0 0 1 0 1 0 1 0 Longitude Zero Fuel CG X0 3 8 0 0 1 0 1 0 1 0 Body Pitch Acceleration X 0 0 4 0 0 1 0 1 0 1 1 Body Roll Acceleration X 0 0 5 0 0 1 0 1 0 1 1 Track Angle - Magnetic X0 3 8 0 0 1 0 1 0 1 1 Body Roll Acceleration X 0 0 4 0 0 1 0 1 1 0 0 Body Yaw Acceleration X 0 3 7 0 0 1 0 1 1 0 0 Zero Fuel Weight (KG) X0 3 8 0 0 1 0 1 1 0 0 Body Yaw Acceleration X0 0 0 1 0 1 1 0 1 Spare0 0 2 0 0 1 0 1 1 1 0 Estimated Time of Arrival X0 0 5 0 0 1 0 1 1 1 0 Wind Direction - Magnetic X0 3 7 0 0 1 0 1 1 1 0 Gross Weight (KG) X0 5 6 0 0 1 0 1 1 1 0 ETA (Active Waypoint) X0 6 0 0 0 1 0 1 1 1 0 ETA (Active Waypoint) X0 0 0 1 0 1 1 1 1 Spare0 0 2 5 0 0 1 1 0 0 0 0 S/G Hardware Part No X 6-360 3 7 0 0 1 1 0 0 0 0 Tire Loading (Left Body Main) X0 3 C 0 0 1 1 0 0 0 0 Tire Pressure (Left Inner) X0 2 0 0 1 1 0 0 0 1 ACMS Information X 6-290 0 B 0 0 1 1 0 0 0 0 1 Pseudo Range X0 2 5 0 0 1 1 0 0 0 1 S/G Software Configuration Part No. X 6-370 3 7 0 0 1 1 0 0 0 1 Tire Loading (Right Body Main) X0 3 C 0 0 1 1 0 0 0 1 Tire Pressure (Left Outer) X0 5 6 0 0 1 1 0 0 0 1 ACMS Information X0 6 0 0 0 1 1 0 0 0 1 ACMS Information X0 0 2 0 0 1 1 0 0 1 0 ACMS Information X 6-290 0 B 0 0 1 1 0 0 1 0 Pseudo Range Fine X0 3 7 0 0 1 1 0 0 1 0 Tire Loading (Left Wing Main) X0 3 C 0 0 1 1 0 0 1 0 Tire Pressure (Right Inner) X0 5 6 0 0 1 1 0 0 1 0 ACMS Information X0 6 0 0 0 1 1 0 0 1 0 ACMS Information X0 0 2 0 0 1 1 0 0 1 1 ACMS Information X 6-290 0 B 0 0 1 1 0 0 1 1 Range Rate X0 3 7 0 0 1 1 0 0 1 1 Tire Loading (Right Wing Main) X0 3 C 0 0 1 1 0 0 1 1 Tire Pressure (Right Outer) X0 5 6 0 0 1 1 0 0 1 1 ACMS Information X0 6 0 0 0 1 1 0 0 1 1 ACMS Information X 0 0 B 0 0 1 1 0 1 0 0 Delta Range X 0 3 7 0 0 1 1 0 1 0 0 Tire Loading (Nose) X0 3 C 0 0 1 1 0 1 0 0 Tire Pressure (Nose) X 0 6 2 0 6 3 0 6 4 0 5 6 0 5 7 0 6 0 0 6 1 0 5 2 0 5 3 0 5 4 0 5 5 0 4 6 0 4 7 0 5 0 0 5 1 0 4 2 0 4 3 0 4 4 0 4 5 ATTACHMENT 1-1LABEL CODES ARINC SPECIFICATION 429, PART 1 - Page 16 1 2 3 4 5 6 7 8 BNR BCD DISC SAL DataNotes & Cross Ref. to Tables in Att. 6 Code No. (Octal) Eqpt.

ID (Hex) Transmission Order Bit PositionParameter 0 0 3 0 0 1 1 0 1 0 1 Gross Weight X0 0 B 0 0 1 1 0 1 0 1 SV Position X X0 3 7 0 0 1 1 0 1 0 1 Gross Weight X0 0 2 0 0 1 1 0 1 1 0 Longitudinal Center of Gravity X0 0 B 0 0 1 1 0 1 1 0 SV Position X Fine X0 3 7 0 0 1 1 0 1 1 0 Longitudinal Center of Gravity X0 3 7 0 0 1 1 0 1 1 1 Lateral Center of Gravity X0 0 2 0 0 1 1 1 0 0 0 Reference Airspeed (Vref) X0 0 B 0 0 1 1 1 0 0 0 SV Position Y X0 2 9 0 0 1 1 1 0 0 0 AC Frequency (Engine) X0 3 7 0 0 1 1 1 0 0 0 Hard landing Magnitude #1 X0 5 6 0 0 1 1 1 0 0 0 Reference Airspeed (Vref) X0 6 0 0 0 1 1 1 0 0 0 Reference Airspeed (Vref) X0 C C 0 0 1 1 1 0 0 0 Brakes - Metered Hydraulic Pressure L (Normal) X0 0 2 0 0 1 1 1 0 0 1 Take-Off Climb Airspeed (V2) X0 0 B 0 0 1 1 1 0 0 1 SV Position Y Fine X0 2 9 0 0 1 1 1 0 0 1 AC Frequency (Alt. Sources) X0 3 3 0 0 1 1 1 0 0 1 VBV X0 3 7 0 0 1 1 1 0 0 1 Hard Landing Magnitude #2 X0 C C 0 0 1 1 1 0 0 1 Brakes - Metered Hydraulic Pressure L (Alt) X0 0 2 0 0 1 1 1 0 1 0 VR (Rotation Speed) X0 0 B 0 0 1 1 1 0 1 0 SV Position Z X0 1 C 0 0 1 1 1 0 1 0 Stator Vane Angle X0 2 9 0 0 1 1 1 0 1 0 AC Voltage (Engine) X0 2 F 0 0 1 1 1 0 1 0 Stator Vane Angle X0 3 3 0 0 1 1 1 0 1 0 Stator Vane Angle X0 C C 0 0 1 1 1 0 1 0 Brakes - Metered Hydraulic Pressure R (Normal) X0 0 2 0 0 1 1 1 0 1 1 V1 (Critical Engine Failure Speed) X0 0 B 0 0 1 1 1 0 1 1 SV Position Z Fine X0 1 C 0 0 1 1 1 0 1 1 Oil Quantity X0 2 9 0 0 1 1 1 0 1 1 Oil Quantity X0 A 2 0 0 1 1 1 0 1 1 V2 (Critical Engine Failure Speed) X0 C C 0 0 1 1 1 0 1 1 Brakes - Metered Hydraulic Pressure R (Alt.) X0 D 0 0 0 1 1 1 0 1 1 Engine Oil Quantity X0 0 2 0 0 1 1 1 1 0 0 Zero Fuel Weight X0 0 B 0 0 1 1 1 1 0 0 UTC Measure Time X0 2 C 0 0 1 1 1 1 0 0 Zero Fuel Weight X0 3 3 0 0 1 1 1 1 0 0 LP Compressor Bleed Position (3.0) X0 3 7 0 0 1 1 1 1 0 0 Zero Fuel Weight (lb) X0 5 6 0 0 1 1 1 1 0 0 Zero Fuel Weight X0 6 0 0 0 1 1 1 1 0 0 Zero Fuel Weight X1 1 4 0 0 1 1 1 1 0 0 Zero Fuel Weight X0 0 2 0 0 1 1 1 1 0 1 Gross Weight X0 0 3 0 0 1 1 1 1 0 1 Gross Weight X0 0 8 0 0 1 1 1 1 0 1 Maximum Hazard Alert Level Output X0 0 B 0 0 1 1 1 1 0 1 Geodetic Altitude X0 2 9 0 0 1 1 1 1 0 1 AC Voltage (Alt. Sources) X0 2 C 0 0 1 1 1 1 0 1 Gross Weight X0 3 7 0 0 1 1 1 1 0 1 Gross Weight X0 3 E 0 0 1 1 1 1 0 1 Gross Weight X1 1 4 0 0 1 1 1 1 0 1 Aircraft Gross Weight X 0 0 8 0 0 1 1 1 1 1 0 Hazard Azimuth Output X 0 0 B 0 0 1 1 1 1 1 0 GNSS Altitude (MSL) X0 2 9 0 0 1 1 1 1 1 0 AC Voltage (Bus Bar) X0 3 7 0 0 1 1 1 1 1 0 Longitudinal Center of Gravity X0 3 E 0 0 1 1 1 1 1 0 Longitudinal Center of Gravity X1 1 4 0 0 1 1 1 1 1 0 Aircraft Longitudinal Center of Gravity X 0 7 6 0 7 7 2 0 7 3 0 7 4 0 7 5 0 6 6 0 6 7 0 7 0 0 7 1 0 6 5 ATTACHMENT 1-1LABEL CODES ARINC SPECIFICATION 429, PART 1 - Page 17 1 2 3 4 5 6 7 8 BNR BCD DISC SAL DataNotes & Cross Ref. to Tables in Att. 6 Code No. (Octal) Eqpt. ID (Hex) Transmission Order Bit PositionParameter 0 0 2 0 0 1 1 1 1 1 1 Target Airspeed X0 0 8 0 0 1 1 1 1 1 1 Hazard Azimuth Output X0 0 B 0 0 1 1 1 1 1 1 GPS Hor/Vert Deviation X0 2 9 0 0 1 1 1 1 1 1 AC Load (Engine) X0 3 7 0 0 1 1 1 1 1 1 Lateral Center of Gravity X0 5 6 0 0 1 1 1 1 1 1 Target Airspeed X0 6 0 0 0 1 1 1 1 1 1 Target Airspeed X1 1 4 0 0 1 1 1 1 1 1 Zero Fuel Center of Gravity X0 0 1 0 1 0 0 0 0 0 0 Selected Course #1 X 6-270 0 2 0 1 0 0 0 0 0 0 Selected Course #1 X0 1 1 0 1 0 0 0 0 0 0 Selected Course #1 X0 2 0 0 1 0 0 0 0 0 0 Selected Course #1 X0 2 9 0 1 0 0 0 0 0 0 AC Load (Alt. Source) X0 3 7 0 1 0 0 0 0 0 0 Gross Weight (Kilogram) X0 5 6 0 1 0 0 0 0 0 0 Selected Course #1 X0 6 0 0 1 0 0 0 0 0 0 Selected Course #1 X0 A 1 0 1 0 0 0 0 0 0 Selected Course #1 X0 B 1 0 1 0 0 0 0 0 0 Selected Course #1 X0 B B 0 1 0 0 0 0 0 0 Outbound Flaps - PDU X0 0 2 0 1 0 0 0 0 0 1 Selected Heading X 6-270 0 B 0 1 0 0 0 0 0 0 1 HDOP X0 2 0 0 1 0 0 0 0 0 1 Selected Heading X0 2 5 0 1 0 0 0 0 0 1 Selected Heading X0 2 9 0 1 0 0 0 0 0 1 DC Current (TRU) X0 5 A 0 1 0 0 0 0 0 1 FQIC X0 A 1 0 1 0 0 0 0 0 1 Selected Heading X0 B B 0 1 0 0 0 0 0 1 Inboard Flaps - PDU X1 1 4 0 1 0 0 0 0 0 1 C/G Target X0 0 2 0 1 0 0 0 0 1 0 Selected Altitude X 6-270 0 B 0 1 0 0 0 0 1 0 VDOP X0 2 0 0 1 0 0 0 0 1 0 Selected Altitude X0 2 9 0 1 0 0 0 0 1 0 DC Current (Battery) X0 5 6 0 1 0 0 0 0 1 0 Selected Altitude X0 6 0 0 1 0 0 0 0 1 0 Selected Altitude X0 A 1 0 1 0 0 0 0 1 0 Selected Altitude X0 0 1 0 1 0 0 0 0 1 1 Selected Airspeed X 6-270 0 2 0 1 0 0 0 0 1 1 Selected Airspeed X0 0 3 0 1 0 0 0 0 1 1 Selected Airspeed X0 0 B 0 1 0 0 0 0 1 1 GNSS Track Angle X0 1 B 0 1 0 0 0 0 1 1 Left/PDU Flap X0 2 0 0 1 0 0 0 0 1 1 Selected Airspeed X0 2 9 0 1 0 0 0 0 1 1 DC Voltage (TRU) X0 5 6 0 1 0 0 0 0 1 1 Selected Airspeed X0 6 0 0 1 0 0 0 0 1 1 Selected Airspeed X0 A 1 0 1 0 0 0 0 1 1 Selected Airspeed X0 B B 0 1 0 0 0 0 1 1 Left Outboard Flap Position X0 0 1 0 1 0 0 0 1 0 0 Selected Vertical Speed X 6-270 0 2 0 1 0 0 0 1 0 0 Selected Vertical Speed X0 1 B 0 1 0 0 0 1 0 0 Right/PDU Flap X0 2 0 0 1 0 0 0 1 0 0 Selected Vertical Speed X0 2 9 0 1 0 0 0 1 0 0 DC Voltage (Battery) X0 2 B 0 1 0 0 0 1 0 0 Selected Vertical Speed X0 5 6 0 1 0 0 0 1 0 0 Selected Vertical Speed X0 6 0 0 1 0 0 0 1 0 0 Selected Vertical Speed X0 A 1 0 1 0 0 0 1 0 0 Selected Vertical Speed X0 B B 0 1 0 0 0 1 0 0 Right Outboard Flap Position X 1 0 2 1 0 3 1 0 4 0 7 7 1 0 0 1 0 1 ATTACHMENT 1-1LABEL CODES ARINC SPECIFICATION 429, PART 1 - Page 18 1 2 3 4 5 6 7 8 BNR BCD DISC SAL DataNotes & Cross Ref. to Tables in Att. 6 Code No. (Octal) Eqpt. ID (Hex) Transmission Order Bit PositionParameter 0 0 2 0 1 0 0 0 1 0 1 Selected Runway Heading X0 1 0 0 1 0 0 0 1 0 1 Selected Runway Heading X0 1 B 0 1 0 0 0 1 0 1 Left/PDU Slat X0 2 0 0 1 0 0 0 1 0 1 Selected Runway Heading X0 2 9 0 1 0 0 0 1 0 1 Oil Temperature Input (IDG/CSD) X0 5 5 0 1 0 0 0 1 0 1 Selected Runway Heading X0 5 6 0 1 0 0 0 1 0 1 Selected Runway Heading X0 6 0 0 1 0 0 0 1 0 1 Selected Runway Heading X0 A 1 0 1 0 0 0 1 0 1 Selected Runway Heading X0 B 0 0 1 0 0 0 1 0 1 Selected Runway Heading X0 B B 0 1 0 0 0 1 0 1 Left Inboard Flap Position X0 0 2 0 1 0 0 0 1 1 0 Selected Mach X 6-270 1 B 0 1 0 0 0 1 1 0 Right/PDU Slat X0 2 0 0 1 0 0 0 1 1 0 Selected Mach X0 2 9 0 1 0 0 0 1 1 0 Oil Temperature Input (IDG/CSD) X0 5 6 0 1 0 0 0 1 1 0 Selected Mach X0 6 0 0 1 0 0 0 1 1 0 Selected Mach X0 A 1 0 1 0 0 0 1 1 0 Selected Mach X0 B B 0 1 0 0 0 1 1 0 Right Inboard Flap Position X0 0 2 0 1 0 0 0 1 1 1 Selected Cruise Altitude X0 1 B 0 1 0 0 0 1 1 1 Flap/Slat Lever X0 3 7 0 1 0 0 0 1 1 1 Longitude Zero Fuel C/G X0 5 6 0 1 0 0 0 1 1 1 Selected Cruise Altitude X0 6 0 0 1 0 0 0 1 1 1 Selected Cruise Altitude X0 B B 0 1 0 0 0 1 1 1 Flap Lever Position - Median Value X0 0 1 0 1 0 0 1 0 0 0 Selected Course #2 X0 0 2 0 1 0 0 1 0 0 0 Selected Course #2 X0 0 B 0 1 0 0 1 0 0 0 GNSS Latitude X0 1 0 0 1 0 0 1 0 0 0 Selected Course #2 X0 1 1 0 1 0 0 1 0 0 0 Selected Course #2 X0 2 0 0 1 0 0 1 0 0 0 Selected Course #2 X0 A 1 0 1 0 0 1 0 0 0 Selected Course #2 X0 B 1 0 1 0 0 1 0 0 0 Selected Course #2 X0 B B 0 1 0 0 1 0 0 0 Flap Lever Position - Center X0 0 1 0 1 0 0 1 0 0 1 Test Word A X0 0 B 0 1 0 0 1 0 0 1 GNSS Longitude X0 1 D 0 1 0 0 1 0 0 1 Test Word A X0 0 2 0 1 0 0 1 0 1 0 Runway Length X0 0 B 0 1 0 0 1 0 1 0 GNSS Ground Speed X0 A 1 0 1 0 0 1 0 1 0 Selected EPR X0 A 1 0 1 0 0 1 0 1 0 Selected N1 X0 B B 0 1 0 0 1 0 1 0 Flap Lever Position - Left0 0 1 0 0 1 0 1 1 Spare0 0 2 0 1 0 0 1 1 0 0 Desired Track X 6-270 2 9 0 1 0 0 1 1 0 0 Brake Temperature (Left Inner L/G) X0 2 F 0 1 0 0 1 1 0 0 Ambient Pressure X0 3 F 0 1 0 0 1 1 0 0 Pamb Sensor X0 5 6 0 1 0 0 1 1 0 0 Desired Track X0 6 0 0 1 0 0 1 1 0 0 Desired Track X0 B B 0 1 0 0 1 1 0 0 Flap Lever Position - Right X0 C C 0 1 0 0 1 1 0 0 Wheel Torque Output X1 0 A 0 1 0 0 1 1 0 0 Selected Ambient Static Pressure X1 0 B 0 1 0 0 1 1 0 0 Selected Ambient Static Pressure X1 3 A 0 1 0 0 1 1 0 0 Ambient Pressure X0 0 2 0 1 0 0 1 1 0 1 Waypoint Bearing X0 2 9 0 1 0 0 1 1 0 1 Brake Temperature (Left Outer L/G) X0 2 F 0 1 0 0 1 1 0 1 Fuel Temperature X0 3 F 0 1 0 0 1 1 0 1 Fuel Temperature X0 5 6 0 1 0 0 1 1 0 1 Waypoint Bearing X0 6 0 0 1 0 0 1 1 0 1 Waypoint Bearing X0 B C 0 1 0 0 1 1 0 1 Fuel Temperature X0 C C 0 1 0 0 1 1 0 1 Wheel Torque Output X 6-260 0 2 0 1 0 0 1 1 1 0 Cross Track Distance X 6-270 0 B 0 1 0 0 1 1 1 0 Horizontal GLS Deviation Rectilinear X0 2 9 0 1 0 0 1 1 1 0 Brake Temperature (Right Inner L/G) X0 5 5 0 1 0 0 1 1 1 0 Horizontal GLS Deviation Rectilinear X0 5 6 0 1 0 0 1 1 1 0 Cross Track Distance X0 6 0 0 1 0 0 1 1 1 0 Cross Track Distance X0 C C 0 1 0 0 1 1 1 0 Wheel Torque Output X 6-26 1 1 6 1 1 2 1 1 3 1 1 4 1 1 5 1 0 6 1 0 7 1 1 0 1 1 1 0 5 ATTACHMENT 1-1LABEL CODES ARINC SPECIFICATION 429, PART 1 - Page 19 1 2 3 4 5 6 7 8 BNR BCD DISC SAL DataNotes & Cross Ref. to Tables in Att. 6 Code No. (Octal) Eqpt. ID (Hex) Transmission Order Bit PositionParameter 0 0 2 0 1 0 0 1 1 1 1 Vertical Deviation X 6-270 0 B 0 1 0 0 1 1 1 1 Vertical GLS Deviation Rectilinear X0 2 9 0 1 0 0 1 1 1 1 Brake Temperature (Right Inner L/G) X0 5 5 0 1 0 0 1 1 1 1 Vertical GLS Deviation Rectilinear X0 5 6 0 1 0 0 1 1 1 1 Vertical Deviation X0 6 0 0 1 0 0 1 1 1 1 Vertical Deviation X0 C C 0 1 0 0 1 1 1 1 Wheel Torque Output X 6-260 0 2 0 1 0 1 0 0 0 0 Range to Altitude X0 0 B 0 1 0 1 0 0 0 0 GNSS Latitude Fine X0 2 9 0 1 0 1 0 0 0 0 Pack Bypass Turbine Position X0 5 6 0 1 0 1 0 0 0 0 Range to Altitude X0 6 0 0 1 0 1 0 0 0 0 Range to Altitude X0 0 2 0 1 0 1 0 0 0 1 Horizontal Command Signal X0 0 B 0 1 0 1 0 0 0 1 GNSS Longitude Fine X0 2 5 0 1 0 1 0 0 0 1 Pitch Limit X0 2 9 0 1 0 1 0 0 0 1 Pack Outlet Temperature X0 5 6 0 1 0 1 0 0 0 1 Horizontal Command Signal X0 6 0 0 1 0 1 0 0 0 1 Horizontal Command Signal X0 0 2 0 1 0 1 0 0 1 0 Vertical Command Signal X0 2 9 0 1 0 1 0 0 1 0 Pack Turbine Inlet Temperature X0 5 6 0 1 0 1 0 0 1 0 Vertical Command Signal X0 6 0 0 1 0 1 0 0 1 0 Vertical Command Signal X0 0 2 0 1 0 1 0 0 1 1 Throttle Command X0 0 B 0 1 0 1 0 0 1 1 Digital Time Mark X0 A 5 0 1 0 1 0 0 1 1 Client Device for GNSS Receiver X 6-491 E 2 0 1 0 1 0 1 0 0 Horizontal Alarm Limit X0 0 2 0 1 0 1 0 1 0 1 Universal Time Coordinated (UTC) X 6-250 0 B 0 1 0 1 0 1 0 1 Universal Time Coordinated (UTC) X0 3 1 0 1 0 1 0 1 0 1 Universal Time Coordinated (UTC) X 6-25 0 5 6 0 1 0 1 0 1 0 1 Universal Time Coordinated (UTC) X0 6 0 0 1 0 1 0 1 0 1 Universal Time Coordinated (UTC) X0 0 2 0 1 0 1 0 1 1 0 Vertical Deviation (wide) X0 2 6 0 1 0 1 0 1 1 0 FWC Word X0 2 9 0 1 0 1 0 1 1 0 Pack Flow X0 5 6 0 1 0 1 0 1 1 0 Vertical Deviation (Wide) X0 6 0 0 1 0 1 0 1 1 0 Vertical Deviation (Wide) X0 0 2 0 1 0 1 0 1 1 1 Selected Landing Altitude X0 1 B 0 1 0 1 0 1 1 1 Slat Angle X 6-110 3 3 0 1 0 1 0 1 1 1 P14 X1 0 A 0 1 0 1 0 1 1 1 Fan Discharge Static Pressure X1 0 B 0 1 0 1 0 1 1 1 Fan Discharge Static Pressure X1 E 2 0 1 0 1 0 1 1 1 Vertical Alarm Limit X 6-500 0 B 0 1 0 1 1 0 0 0 Aut Horiz Integ Limit X0 1 A 0 1 0 1 1 0 0 0 Fan Inlet Total Temperature X 0 1 C 0 1 0 1 1 0 0 0 Fan Inlet Total Temperature X 0 2 F 0 1 0 1 1 0 0 0 Fan Inlet Total Temperature X0 3 5 0 1 0 1 1 0 0 0 Intruder Range X 6-210 3 F 0 1 0 1 1 0 0 0 Fan Inlet Total Temperature X1 0 A 0 1 0 1 1 0 0 0 Selected Total Air Temperature X1 0 B 0 1 0 1 1 0 0 0 Selected Total Air Temperature X1 3 A 0 1 0 1 1 0 0 0 Inlet Temperature X0 1 A 0 1 0 1 1 0 0 1 Fan Inlet Total Pressure X0 1 C 0 1 0 1 1 0 0 1 Fan Inlet Total Pressure X0 2 D 0 1 0 1 1 0 0 1 Fan Inlet Total Pressure X0 2 F 0 1 0 1 1 0 0 1 Fan Inlet Total Pressure X0 3 3 0 1 0 1 1 0 0 1 Fan Inlet Total Pressure X0 3 5 0 1 0 1 1 0 0 1 Intruder Altitude X 6-221 3 A 0 1 0 1 1 0 0 1 Inlet Pressure X0 1 A 0 1 0 1 1 0 1 0 Exhaust Gas Total Pressure X0 1 C 0 1 0 1 1 0 1 0 Exhaust Gas Total Pressure X0 3 3 0 1 0 1 1 0 1 0 Exhaust Gas Total Pressure X0 3 5 0 1 0 1 1 0 1 0 Intruder Bearing X 6-230 0 B 0 1 0 1 1 0 1 1 Aut Horiz Integ Limit X0 1 A 0 1 0 1 1 0 1 1 Thrust Lever Angle X 0 2 F 0 1 0 1 1 0 1 1 Thrust Lever Angle X 0 3 F 0 1 0 1 1 0 1 1 Thrust Lever Angle X1 0 A 0 1 0 1 1 0 1 1 Selected Throttle Lever Angle X1 0 B 0 1 0 1 1 0 1 1 Selected Throttle Lever Angle X 1 3 2 1 3 3 1 2 6 1 2 7 1 3 0 1 3 1 1 2 2 1 2 3 1 2 5 1 1 7 1 2 0 1 2 1 1 2 4 ATTACHMENT 1-1LABEL CODES ARINC SPECIFICATION 429, PART 1 - Page 20 1 2 3 4 5 6 7 8 BNR BCD DISC SAL DataNotes & Cross Ref. to Tables in Att. 6 Code No. (Octal) Eqpt. ID (Hex) Transmission Order Bit PositionParameter 0 1 C 0 1 0 1 1 1 0 0 Power Lever Angle X1 0 A 0 1 0 1 1 1 0 0 Throttle Lever Angle X1 0 B 0 1 0 1 1 1 0 0 Throttle Lever Angle X1 3 A 0 1 0 1 1 1 0 0 Throttle Lever Angle X0 1 C 0 1 0 1 1 1 0 1 Engine Vibration #1 X0 2 9 0 1 0 1 1 1 0 1 Engine Fan Vibration X0 5 A 0 1 0 1 1 1 0 1 ACT 1 Fuel Quantity Display X0 0 B 0 1 0 1 1 1 1 0 Vertical Figure of Merit X0 1 C 0 1 0 1 1 1 1 0 Engine Vibration #2 X 0 2 9 0 1 0 1 1 1 1 0 Engine Turbine Vibration X 0 5 A 0 1 0 1 1 1 1 0 ACT 2 Fuel Quantity Display X0 1 B 0 1 0 1 1 1 1 1 Flap Angle X 6-110 2 A 0 1 0 1 1 1 1 1 Flap Angle X 6-110 2 F 0 1 0 1 1 1 1 1 Thrust Reverser Position Feedback X0 3 F 0 1 0 1 1 1 1 1 Thrust Reverser Position Feedback X0 5 A 0 1 0 1 1 1 1 1 Center+ACT1+ACT2 FQ Display X1 0 A 0 1 0 1 1 1 1 1 Selected Thrust Reverser Position X1 0 B 0 1 0 1 1 1 1 1 Selected Thrust Reverser Position X1 4 0 0 1 0 1 1 1 1 1 Flap Angle X 6-110 0 1 0 1 1 0 0 0 0 0 Flight Director - Roll X 6-270 0 B 0 1 1 0 0 0 0 0 UTC Fine X0 2 5 0 1 1 0 0 0 0 0 Flight Director - Roll X0 2 9 0 1 1 0 0 0 0 0 Precooler Output Temperature X0 5 A 0 1 1 0 0 0 0 0 Actual Fuel Quantity Display X1 1 4 0 1 1 0 0 0 0 0 Pump Contactor States X0 0 1 0 1 1 0 0 0 0 1 Flight Director - Pitch X 6-270 0 B 0 1 1 0 0 0 0 1 UTC Fine Fractions X0 2 5 0 1 1 0 0 0 0 1 Flight Director - Pitch X0 2 9 0 1 1 0 0 0 0 1 Precooler Input Temperature X0 5 A 0 1 1 0 0 0 0 1 Preselected Fuel Quantity Display X1 1 4 0 1 1 0 0 0 0 1 Pump Contactor and Pushbutton States X0 0 2 0 1 1 0 0 0 1 0 Flight Director - Fast/Slow X 6-270 0 3 0 1 1 0 0 0 1 0 Flight Director - Fast/Slow X0 0 B 0 1 1 0 0 0 1 0 UTC Fine Fractions X0 2 5 0 1 1 0 0 0 1 0 Flight Director - Fast/Slow X0 5 A 0 1 1 0 0 0 1 0 Left Wing Fuel Quantity Display X1 1 4 0 1 1 0 0 0 1 0 Pump Push Button and LP Switch State X0 0 1 0 1 1 0 0 0 1 1 Flight Director - Yaw X0 4 1 0 1 1 0 0 0 1 1 HPA Command Word X0 5 A 0 1 1 0 0 0 1 1 Center Wing Fuel Quantity Display X1 1 4 0 1 1 0 0 0 1 1 Pump LP Switch State and FCMC Commands X2 4 1 0 1 1 0 0 0 1 1 HPA Response Word X0 2 B 0 1 1 0 0 1 0 0 Altitude Error X0 4 1 0 1 1 0 0 1 0 0 ACU/BSU Contorl Word X0 5 A 0 1 1 0 0 1 0 0 Right Wing Fuel Quantity Display X1 1 4 0 1 1 0 0 1 0 0 Valve Feedback X3 4 1 0 1 1 0 0 1 0 0 ACU/BSU Contorl Word X0 0 2 0 1 1 0 0 1 0 1 TACAN Control X 6-300 2 5 0 1 1 0 0 1 0 1 Discrete Status 2 EFIS X0 2 9 0 1 1 0 0 1 0 1 Discrete Status 2 EFIS X0 A 1 0 1 1 0 0 1 0 1 AFS DFDR Discretes #1 X1 1 4 0 1 1 0 0 1 0 1 Valve Feedback X0 2 5 0 1 1 0 0 1 1 0 Discrete Status 3 EFIS X0 2 9 0 1 1 0 0 1 1 0 Discrete Data #9 X0 A 1 0 1 1 0 0 1 1 0 AFS DFDR Discretes #2 X1 1 2 0 1 1 0 0 1 1 0 TACAN Control X 6-471 1 4 0 1 1 0 0 1 1 0 Valve Feedback X0 2 5 0 1 1 0 0 1 1 1 Discrete Status 4 EFIS X0 2 9 0 1 1 0 0 1 1 1 Discrete Data #10 X0 A 1 0 1 1 0 0 1 1 1 AFS DFDR Discretes #3 X1 1 4 0 1 1 0 0 1 1 1 Valve Feedback X1 1 5 0 1 1 0 0 1 1 1 TACAN Control Word X 6-48/Note 10 0 2 0 1 1 0 1 0 0 0 Universal Time Constant (UTC) X 6-12/6-270 0 B 0 1 1 0 1 0 0 0 Universal Time Constant (UTC) X0 2 9 0 1 1 0 1 0 0 0 Cabin Altitude Rate X0 3 1 0 1 1 0 1 0 0 0 Universal Time Constant (UTC) X 6-12/6-270 5 6 0 1 1 0 1 0 0 0 Universal Time Coordinate X0 6 0 0 1 1 0 1 0 0 0 Universal Time Coordinate X1 1 4 0 1 1 0 1 0 0 0 FCMC Valve Commands X 1 4 6 1 4 7 1 5 0 1 4 2 1 4 3 1 4 4 1 4 5 1 3 6 1 3 7 1 4 0 1 4 1 1 3 4 1 3 5 ATTACHMENT 1-1LABEL CODES ARINC SPECIFICATION 429, PART 1 - Page 21 1 2 3 4 5 6 7 8 BNR BCD DISC SAL DataNotes & Cross Ref. to Tables in Att. 6 Code No. (Octal) Eqpt. ID (Hex) Transmission Order Bit PositionParameter 0 0 2 0 1 1 0 1 0 0 1 Localizer Bearing (True) X0 2 7 0 1 1 0 1 0 0 1 MLS Azimuth Deviation X0 2 9 0 1 1 0 1 0 0 1 Cabin Altitude X0 5 5 0 1 1 0 1 0 0 1 MLS Azimuth Deviation X0 5 6 0 1 1 0 1 0 0 1 Localizer Bearing (True) X0 5 A 0 1 1 0 1 0 0 1 LB/KG Control Word X0 6 0 0 1 1 0 1 0 0 1 Localizer Bearing (True) X1 1 4 0 1 1 0 1 0 0 1 FCMC Valve Commands X0 2 7 0 1 1 0 1 0 1 0 MLS Elevation Deviation X0 2 9 0 1 1 0 1 0 1 0 Cabin Pressure X0 3 8 0 1 1 0 1 0 1 0 Cabin Pressure X0 4 1 0 1 1 0 1 0 1 0 Open Loop Steering X0 5 5 0 1 1 0 1 0 1 0 MLS GP Deviation X0 A D 0 1 1 0 1 0 1 0 Cabin Pressure X 1 1 4 0 1 1 0 1 0 1 0Overhead Panel Switch/Pushbutton & Refuel Panel Battery Power Supply Switch States X 0 1 1 0 1 0 1 0 777 Cabin Interphone System - System Address Label X See Attachment 110 0 2 0 1 1 0 1 0 1 1 Maximum Altitude X0 2 7 0 1 1 0 1 0 1 1 Flare X0 2 9 0 1 1 0 1 0 1 1 Pressurization Valve Position (Gr. #1) X0 4 1 0 1 1 0 1 0 1 1 Closed Loop Steering X0 5 5 0 1 1 0 1 0 1 1 MLS Selected Azimuth X1 1 4 0 1 1 0 1 0 1 1 Level States X0 0 2 0 1 1 0 1 1 0 0 Runway Heading (True) X0 2 7 0 1 1 0 1 1 0 0 MLS Auxilliary Data X0 2 9 0 1 1 0 1 1 0 0 Pressurization Valve Position (Gr. #2) X0 5 5 0 1 1 0 1 1 0 0 MLS Max Selectable GP X0 5 6 0 1 1 0 1 1 0 0 Runway Heading (True) X0 6 0 0 1 1 0 1 1 0 0 Runway Heading (True) X1 1 4 0 1 1 0 1 1 0 0 Level States and Low Warning and Transfer Indications X0 1 C 0 1 1 0 1 1 0 1 Maintenance Data #6 X0 2 5 0 1 1 0 1 1 0 1 Discrete Status 5 EFIS X0 2 7 0 1 1 0 1 1 0 1 MLS Selected GP Angle X0 2 9 0 1 1 0 1 1 0 1 Discrete #1 X0 3 3 0 1 1 0 1 1 0 1 Maintenance Data #6 X0 5 5 0 1 1 0 1 1 0 1 MLS Selected Glide Path X0 5 A 0 1 1 0 1 1 0 1 FQIC X0 B B 0 1 1 0 1 1 0 1 Maintenance Data #6 X1 0 A 0 1 1 0 1 1 0 1 Maintenance Data #6 X1 0 B 0 1 1 0 1 1 0 1 Maintenance Data #6 X1 1 4 0 1 1 0 1 1 0 1 XFR Pump Faults & Wing Imbalance Warning X0 1 C 0 1 1 0 1 1 1 0 Maintnance Data #7 X0 2 7 0 1 1 0 1 1 1 0 MLS Dataword 1 X0 2 9 0 1 1 0 1 1 1 0 Discrete #12 X0 3 3 0 1 1 0 1 1 1 0 Maintenance Data #7 X0 4 D 0 1 1 0 1 1 1 0 L Tank Faults X0 5 5 0 1 1 0 1 1 1 0 MLS Basic Data Wd 1 X0 B B 0 1 1 0 1 1 1 0 Maintenance Data #7 X1 0 A 0 1 1 0 1 1 1 0 Maintenance Data #7 X1 0 B 0 1 1 0 1 1 1 0 Maintenance Data #7 X1 1 4 0 1 1 0 1 1 1 0 Refuel Panel Switch States X 0 1 1 0 1 1 1 0 CVR #2 - System Address Label X See Attachment 110 1 C 0 1 1 0 1 1 1 1 Maintenance Data #8 X0 2 7 0 1 1 0 1 1 1 1 MLS Dataword 2 X0 3 3 0 1 1 0 1 1 1 1 Maintenance Data #8 X0 4 D 0 1 1 0 1 1 1 1 R Tank Faults X0 5 5 0 1 1 0 1 1 1 1 MLS Basic Data Wd 2 X0 B B 0 1 1 0 1 1 1 1 Maintenance Data #8 X1 0 A 0 1 1 0 1 1 1 1 Maintenance Data #8 X1 0 B 0 1 1 0 1 1 1 1 Maintenance Data #8 X1 1 4 0 1 1 0 1 1 1 1 Trim Tank Probe Capacitance X 0 1 1 0 1 1 1 1 CVR #1 - System Address Label X See Attachment 11 1 5 6 1 5 7 1 5 2 1 5 3 1 5 4 1 5 5 1 5 1 ATTACHMENT 1-1LABEL CODES ARINC SPECIFICATION 429, PART 1 - Page 22 1 2 3 4 5 6 7 8 BNR BCD DISC SAL DataNotes & Cross Ref. to Tables in Att.

6 Code No. (Octal) Eqpt. ID (Hex) Transmission Order Bit PositionParameter 0 1 C 0 1 1 1 0 0 0 0 Maintenance Data #9 X0 2 5 0 1 1 1 0 0 0 0 Discrete Status 6 EFIS X0 2 7 0 1 1 1 0 0 0 0 MLS Dataword 3 X0 3 3 0 1 1 1 0 0 0 0 Maintenance Data #9 X0 4 D 0 1 1 1 0 0 0 0 C Tank Faults X0 5 5 0 1 1 1 0 0 0 0 MLS Basic Data Wd 3 X0 B B 0 1 1 1 0 0 0 0 Maintenance Data #9 X1 0 A 0 1 1 1 0 0 0 0 Maintenance Data #9 X1 0 B 0 1 1 1 0 0 0 0 Maintenance Data #9 X1 1 4 0 1 1 1 0 0 0 0 Valve Feedback X0 1 C 0 1 1 1 0 0 0 1 Maintenance Data #10 X0 2 5 0 1 1 1 0 0 0 1 Discrete Status 7 EFIS X0 2 7 0 1 1 1 0 0 0 1 MLS Dataword 4 X0 3 3 0 1 1 1 0 0 0 1 Maintenance Data #10 X0 4 D 0 1 1 1 0 0 0 1 A Tank Faults X0 5 5 0 1 1 1 0 0 0 1 MLS Basic Data Wd 4 X1 0 A 0 1 1 1 0 0 0 1 Maintenance Data #10 X1 0 B 0 1 1 1 0 0 0 1 Maintenance Data #10 X1 1 4 0 1 1 1 0 0 0 1 Indicated Pump Status X0 1 2 0 1 1 1 0 0 1 0 ADF Bearing X0 2 5 0 1 1 1 0 0 1 0 ADF Bearing Left/Right X0 2 7 0 1 1 1 0 0 1 0 MLS Dataword 5 X0 2 9 0 1 1 1 0 0 1 0 Crew Oxygen Pressure X0 5 5 0 1 1 1 0 0 1 0 MLS Basic Data Wd 5 X0 D E 0 1 1 1 0 0 1 0 Stick Shaker Margin Proportional Signal X1 1 4 0 1 1 1 0 0 1 0 Indicated Pump Status X1 4 0 0 1 1 1 0 0 1 0 Density Altitude X0 2 7 0 1 1 1 0 0 1 1 MLS Dataword 6 X0 3 7 0 1 1 1 0 0 1 1 Zero Fuel Weight (lb) X0 5 5 0 1 1 1 0 0 1 1 MLS Basic Data Wd 6 X1 1 4 0 1 1 1 0 0 1 1 Indicated Pump Status X 0 1 1 1 0 0 1 1 747 DFDR & A330/340 SSFDR - System Address Label X See Attachment 110 0 2 0 1 1 1 0 1 0 0 Minimum Descent Altitude (MDA) X0 0 3 0 1 1 1 0 1 0 0 Target Height X0 0 7 0 1 1 1 0 1 0 0 Radio Height X 6-13/6-270 2 5 0 1 1 1 0 1 0 0 Radio Height X 6-13/6-270 2 7 0 1 1 1 0 1 0 0 MLS Dataword 7 X0 3 B 0 1 1 1 0 1 0 0 Radio Height X0 5 5 0 1 1 1 0 1 0 0 MLS ABS GP Angle X1 1 4 0 1 1 1 0 1 0 0 Indicated Pump Status X0 0 7 0 1 1 1 0 1 0 1 Radio Height X 6-250 0 B 0 1 1 1 0 1 0 1 Vertical Velocity X0 2 7 0 1 1 1 0 1 0 1 MLS Dataword 8 X0 5 5 0 1 1 1 0 1 0 1 MLS ABS Azimuth Angle X1 1 4 0 1 1 1 0 1 0 1 Indicated Valve Status X0 0 7 0 1 1 1 0 1 1 0 RALT Check Point Dev. X0 0 B 0 1 1 1 0 1 1 0 North/South Velocity X1 1 4 0 1 1 1 0 1 1 0 Indicated Valve Status X0 0 2 0 1 1 1 0 1 1 1 EPU Estimate Position Uncertainty/ (ANP) Actual Navi. Perf. X1 1 4 0 1 1 1 0 1 1 1 Indicated Valve Status X0 2 5 0 1 1 1 1 0 0 0 Decision Height Selected (EFI) X 6-250 C 5 0 1 1 1 1 0 0 0 Decision Height Selected (EFI) X 6-251 1 4 0 1 1 1 1 0 0 0 Wing Imbalance and FQI Failure Warning X 0 1 1 1 1 0 0 0 DFDAU - System Address Label X See Attachment 110 0 2 0 1 1 1 1 0 0 1 RNP Required Navigation Performance X0 A 5 0 1 1 1 1 0 0 1 Vertical Alarm Limit (VAL) and SBAS System Identifier XX X X 0 1 1 1 1 0 0 1 Manufacturer Specific Status See Attachment 10/Note 1 X X X 0 1 1 1 1 0 1 0 Subsystem Identifier 6-34/Note 10 1 0 0 1 1 1 1 0 1 1 Localizer Deviation X 6-6/6-270 2 5 0 1 1 1 1 0 1 1 Localizer Deviation X 6-6/6-270 2 9 0 1 1 1 1 0 1 1 Hydraulic Quantity X0 3 B 0 1 1 1 1 0 1 1 Localizer Deviation X0 5 5 0 1 1 1 1 0 1 1 Localizer Deviation X0 B D 0 1 1 1 1 0 1 1 Hydraulic Quantity X0 D 0 0 1 1 1 1 0 1 1 Hydraulic Oil X 0 1 1 1 1 0 1 1 SDU #2 - System Address Label X See Attachment 11 1 7 2 1 7 3 1 6 6 1 6 7 1 7 0 1 7 1 1 6 2 1 6 3 1 6 4 1 6 5 1 6 0 1 6 1 ATTACHMENT 1-1LABEL CODES ARINC SPECIFICATION 429, PART 1 - Page 23 1 2 3 4 5 6 7 8 BNR BCD DISC SAL DataNotes & Cross Ref. to Tables in Att. 6 Code No. (Octal) Eqpt. ID (Hex) Transmission Order Bit PositionParameter 0 0 3 0 1 1 1 1 1 0 0 Delayed Flap Approach Speed (DFA) X0 0 B 0 1 1 1 1 1 0 0 East/West Velocity X0 1 0 0 1 1 1 1 1 0 0 Glideslope Deviation X 6-6/6-270 2 9 0 1 1 1 1 1 0 0 Hydraulic Pressure X0 3 B 0 1 1 1 1 1 0 0 Glideslope Deviation X 6-6/6-270 5 5 0 1 1 1 1 1 0 0 Glideslope Deviation X0 D 0 0 1 1 1 1 1 0 0 Hydraulic Oil Pressure X 0 1 1 1 1 1 0 0 RFU - System Address Label X See Attachment 110 0 3 0 1 1 1 1 1 0 1 Economical Speed X0 2 9 0 1 1 1 1 1 0 1 EGT (APU) X0 3 3 0 1 1 1 1 1 0 1 Hydraulic Pump Case Drain Temperature X 0 1 1 1 1 1 0 1 HGA/IGA HPA - System Address Label X See Attachment 110 0 3 0 1 1 1 1 1 1 0 Economical Mach X0 2 9 0 1 1 1 1 1 1 0 RPM (APU) X0 3 8 0 1 1 1 1 1 1 0 Left Static Pressure Uncorrected, mb X0 5 A 0 1 1 1 1 1 1 0 Fuel Temperature - Set to Zero X0 A D 0 1 1 1 1 1 1 0 Static Pressure Left, Uncorrected, mb X1 1 4 0 1 1 1 1 1 1 0 Left Outer Tank Fuel Temp & Advisory Warning X0 0 3 0 1 1 1 1 1 1 1 Economical Flight Level X0 2 9 0 1 1 1 1 1 1 1 Oil Quantity (APU) X0 3 8 0 1 1 1 1 1 1 1 Right Static Pressure Uncorrected, mb X0 5 5 0 1 1 1 1 1 1 1 Distance to LTP/FTP X0 5 A 0 1 1 1 1 1 1 1 Fuel Temperature Left Wing Tank X0 A D 0 1 1 1 1 1 1 1 Static Pressure Right, Uncorrected, mb X1 1 4 0 1 1 1 1 1 1 1 Inner Tank 1 Fuel Temp & Advisory Warning X 0 1 1 1 1 1 1 1 LGA/HPA - System Address Label X See Attachment 110 0 2 1 0 0 0 0 0 0 0 Drift Angle X0 0 4 1 0 0 0 0 0 0 0 Drift Angle X0 5 6 1 0 0 0 0 0 0 0 Drift Angle X0 6 0 1 0 0 0 0 0 0 0 Drift Angle X1 1 4 1 0 0 0 0 0 0 0 Inner Tank 2 Fuel Temp & Advisory Warning X0 0 9 1 0 0 0 0 0 0 1 DME Distance X 6-1-10 5 A 1 0 0 0 0 0 0 1 Fuel Temperature Right Wing Tank X1 1 2 1 0 0 0 0 0 0 1 TACAN Distance X1 1 4 1 0 0 0 0 0 0 1 Inner Tank 3 Fuel Temp & Advisory Warning X1 1 5 1 0 0 0 0 0 0 1 DME X 6-251 4 0 1 0 0 0 0 0 0 1 Mach Maximum Operation (Mmo) X1 4 2 1 0 0 0 0 0 0 1 Projected Future Latitude X 1 0 0 0 0 0 0 1 GPS/GNSS Sensor - System Address Label X See Attachment 110 0 2 1 0 0 0 0 0 1 0 Energy Management (clean) X0 0 9 1 0 0 0 0 0 1 0 DME Distance X 6-7/6-270 2 9 1 0 0 0 0 0 1 0 Cabin Compartment Temperature (Group #1) X0 5 A 1 0 0 0 0 0 1 0 Fuel Temperature - Set to Zero X1 1 4 1 0 0 0 0 0 1 0 Inner Tank 4 Fuel Temp & Advisory Warning X1 4 0 1 0 0 0 0 0 1 0 Mach Rate X1 4 2 1 0 0 0 0 0 1 0 Projected Future Latitude Fine X0 0 2 1 0 0 0 0 0 1 1 Energy Management Speed Brakes X0 0 6 1 0 0 0 0 0 1 1 Altitude (1013.25mB) X0 1 8 1 0 0 0 0 0 1 1 Altitude X 6-24/6-270 2 9 1 0 0 0 0 0 1 1 Cabin Compartment Temperature (Group #2) X0 3 5 1 0 0 0 0 0 1 1 Own A/C Altitude X0 3 8 1 0 0 0 0 0 1 1 Altitude (1013.25mB) X0 5 A 1 0 0 0 0 0 1 1 Fuel Tank #6 Temperature X1 0 A 1 0 0 0 0 0 1 1 Ambient Static Pressure X1 0 B 1 0 0 0 0 0 1 1 Ambient Static Pressure X1 1 4 1 0 0 0 0 0 1 1 Trim Tank Fuel Temp & Advisory Warning X1 4 0 1 0 0 0 0 0 1 1 Altitude X0 0 2 1 0 0 0 0 1 0 0 Utitlity Airspeed X0 0 6 1 0 0 0 0 1 0 0 Baro Corrected Altitude #1 X0 2 9 1 0 0 0 0 1 0 0 Cabin Duct Temperature (Group #1) X0 3 8 1 0 0 0 0 1 0 0 Baro Corrected Altitude #1 X0 5 6 1 0 0 0 0 1 0 0 Baro Altitude X0 5 A 1 0 0 0 0 1 0 0 Fuel Tank #7 Temperature X0 6 0 1 0 0 0 0 1 0 0 Baro Altitude X1 1 4 1 0 0 0 0 1 0 0 Right Outer Tank Fuel Temp & Advisory Warning X1 4 0 1 0 0 0 0 1 0 0 Baro Corrected Altitude X 2 0 2 2 0 3 2 0 4 1 7 6 1 7 7 2 0 0 2 0 1 1 7 4 1 7 5 ATTACHMENT 1-1LABEL CODES ARINC SPECIFICATION 429, PART 1 - Page 24 1 2 3 4 5 6 7 8 BNR BCD DISC SAL DataNotes & Cross Ref. to Tables in Att.

6 Code No. (Octal) Eqpt. ID (Hex) Transmission Order Bit PositionParameter 0 0 2 1 0 0 0 0 1 0 1 HF COM Frequency (New Format) X 6-430 0 6 1 0 0 0 0 1 0 1 Mach X 6-270 1 A 1 0 0 0 0 1 0 1 Mach X 6-270 2 9 1 0 0 0 0 1 0 1 Cabin Duct Temperature (Group #2) X0 3 8 1 0 0 0 0 1 0 1 Mach X0 5 A 1 0 0 0 0 1 0 1 Fuel Tank #8 Temperature X0 B 9 1 0 0 0 0 1 0 1 HF COM Frequency (New Format) X1 0 A 1 0 0 0 0 1 0 1 Mach Number X1 0 B 1 0 0 0 0 1 0 1 Mach Number X1 4 0 1 0 0 0 0 1 0 1 Mach X0 0 6 1 0 0 0 0 1 1 0 Computed Airspeed X 6-270 1 8 1 0 0 0 0 1 1 0 Altitude (Variable Resolution) X 6-200 2 9 1 0 0 0 0 1 1 0 Cabin Temp. Reg. Valve Position (Group #1) X0 3 8 1 0 0 0 0 1 1 0 Computed Airspeed X 6-270 5 6 1 0 0 0 0 1 1 0 Computed Airspeed X0 6 0 1 0 0 0 0 1 1 0 Computed Airspeed X0 C C 1 0 0 0 0 1 1 0 Taxi Speed X1 4 0 1 0 0 0 0 1 1 0 Computed Airspeed (CAS) X0 0 2 1 0 0 0 0 1 1 1 HF Control Word X0 0 6 1 0 0 0 0 1 1 1 Max. Allowable Airspeed X0 0 A 1 0 0 0 0 1 1 1 Max. Allowable Airspeed X0 2 5 1 0 0 0 0 1 1 1 Operational Software Part Number X 6-370 2 9 1 0 0 0 0 1 1 1 Cabin Temp. Reg. Valve Position (Group #2) X0 3 8 1 0 0 0 0 1 1 1 Max. Allowable Airspeed X0 B 9 1 0 0 0 0 1 1 1 HF Control Word X1 4 0 1 0 0 0 0 1 1 1 Airspeed Maximum Operating (VMO) X0 0 6 1 0 0 0 1 0 0 0 True Airspeed X 6-270 2 9 1 0 0 0 1 0 0 0 Cargo Compartment Temperature X0 3 8 1 0 0 0 1 0 0 0 True Airspeed X 6-271 4 0 1 0 0 0 1 0 0 0 True Airspeed X 1 0 0 0 1 0 0 0 FCMC Com A340-500/600 - System Address Label X See Attachment 11 0 0 2 1 0 0 0 1 0 0 1 Total Air Temperature X 6-270 0 3 1 0 0 0 1 0 0 1 Total Air Temperature X0 0 6 1 0 0 0 1 0 0 1 Total Air Temperature X0 1 A 1 0 0 0 1 0 0 1 Total Air Temperature X0 2 9 1 0 0 0 1 0 0 1 Cargo Duct Temperature X0 3 8 1 0 0 0 1 0 0 1 Total Air Temperature X0 A D 1 0 0 0 1 0 0 1 Total Air Temperature Indicated X1 0 A 1 0 0 0 1 0 0 1 Total Fan Inlet Temperature X1 0 B 1 0 0 0 1 0 0 1 Total Fan Inlet Temperature X1 4 0 1 0 0 0 1 0 0 1 Total Air Temp (TAT) X1 4 2 1 0 0 0 1 0 0 1 Projected Future Longitude X 1 0 0 0 1 0 0 1 FCMC Mon A340-500/600 - System Address Label X See Attachment 11 0 0 4 1 0 0 0 1 0 1 0 Altitude Rate X 6-270 0 5 1 0 0 0 1 0 1 0 Altitude Rate X0 0 6 1 0 0 0 1 0 1 0 Altitude Rate X0 2 9 1 0 0 0 1 0 1 0 Cargo Temp. Reg. Valve Position X0 3 8 1 0 0 0 1 0 1 0 Altitude Rate X0 3 B 1 0 0 0 1 0 1 0 Altitude Rate X0 5 6 1 0 0 0 1 0 1 0 Altitude Rate X0 6 0 1 0 0 0 1 0 1 0 Altitude Rate X1 4 0 1 0 0 0 1 0 1 0 Altitude Rate X1 4 2 1 0 0 0 1 0 1 0 Projected Future Longitude Fine X 1 0 0 0 1 0 1 0 FCMC Int A340-500/600 - System Address Label X See Attachment 11 0 0 2 1 0 0 0 1 0 1 1 Static Air Temperature X 6-270 0 6 1 0 0 0 1 0 1 1 Static Air Temperature X 6-270 3 8 1 0 0 0 1 0 1 1 Static Air Temperature X0 8 D 1 0 0 0 1 0 1 1 Fuel Used X 6-271 4 0 1 0 0 0 1 0 1 1 Static Air Temp (SAT) X1 4 2 1 0 0 0 1 0 1 1 Veritical Time Interval XX X X 1 0 0 0 1 1 0 0 ICAO Aircraft Address (Part 1) X Note 10 0 6 1 0 0 0 1 1 0 1 Impacted Pressure, Uncorrected, mb X0 1 A 1 0 0 0 1 1 0 1 Impact Pressure X0 2 9 1 0 0 0 1 1 0 1 N1 Actual (EEC) X0 2 9 1 0 0 0 1 1 1 1 EPR Actual (EEC) X0 3 8 1 0 0 0 1 1 0 1 Impacted Pressure, Uncorrected, mb X0 A D 1 0 0 0 1 1 0 1 Impacted Pressure, Uncorrected, mb X1 4 0 1 0 0 0 1 1 1 1 Impact Pressure Subsonic XX X X 1 0 0 0 1 1 1 0 ICAO Aircraft Address (Part 2) X Note 12 1 6 2 1 2 2 2 1 3 2 1 4 2 1 5 2 0 6 2 0 7 2 1 0 2 1 1 2 0 5 ATTACHMENT 1-1LABEL CODES ARINC SPECIFICATION 429, PART 1 - Page 25 1 2 3 4 5 6 7 8 BNR BCD DISC SAL DataNotes & Cross Ref. to Tables in Att. 6 Code No. (Octal) Eqpt. ID (Hex) Transmission Order Bit PositionParameter 0 0 2 1 0 0 0 1 1 1 1 Geometric Vertical Rate X0 0 6 1 0 0 0 1 1 1 1 Static Pressure, Corrected (In. Hg) X0 2 9 1 0 0 0 1 1 1 1 N1 Limit (EEC) X0 2 9 1 0 0 0 1 1 1 1 EPR Actual (EEC) X0 3 8 1 0 0 0 1 1 1 1 Static Pressure, Average, Corrected (In. Hg) X1 4 0 1 0 0 0 1 1 1 1 Static Pressure Corrected (In. Hg) X 0 0 6 1 0 0 1 0 0 0 0 Baro Corrected Altitude #2 X0 3 8 1 0 0 1 0 0 0 0 Baro Corrected Altitude #2 X1 4 0 1 0 0 1 0 0 0 0 Baro Corrected Altitude #2 X 1 0 0 1 0 0 0 0 MCDU #1 - System Address label (Recipient) X See Attachment 11 0 0 6 1 0 0 1 0 0 0 1 Indicated Angle of Attack (Average) X0 3 8 1 0 0 1 0 0 0 1 Indicated Angle of Attack (Average) X0 A D 1 0 0 1 0 0 0 1 Indicated Angle of Attack (Average) X1 2 C 1 0 0 1 0 0 0 1 Indicated Angle of Attack (Average) 1 4 0 1 0 0 1 0 0 0 1 Angle of Attach Indicated Average X 1 0 0 1 0 0 0 1 MCDU #2 - System Address label (Recipient) X See Attachment 11 0 0 6 1 0 0 1 0 0 1 0 Indicated Angle of Attack (#1 Left) X0 1 1 1 0 0 1 0 0 1 0 VOR Omnibearing X 6-101 1 2 1 0 0 1 0 0 1 0 TACAN Bearing X1 1 5 1 0 0 1 0 0 1 0 Bearing X1 2 C 1 0 0 1 0 0 1 0 Indicated Angle of Attack (#1 Left) X1 4 0 1 0 0 1 0 0 1 0 Angle of Attack, Indicated (#1 Left) X 1 0 0 1 0 0 1 0 MCDU #3 - System Address Label X See Attachment 11 0 0 6 1 0 0 1 0 0 1 1 Indicated Angle of Attack (#1 Right) X1 2 C 1 0 0 1 0 0 1 1 Indicated Angle of Attack (#1 Right) X1 4 0 1 0 0 1 0 0 1 1 Angle of Attack, Indicated (#1 Right) X 1 0 0 1 0 0 1 1 Printer #1 - System Address Label X See Attachment 110 0 6 1 0 0 1 0 1 0 0 Indicated Angle of Attack (#2 Left) X1 2 C 1 0 0 1 0 1 0 0 Indicated Angle of Attack (#2 Left) X1 4 0 1 0 0 1 0 1 0 0 Angle of Attack, Indicated (#2 Left) X 1 0 0 1 0 1 0 0 Printer #2 - System Address Label X See Attachment 110 0 2 1 0 0 1 0 1 0 1 Min. Maneuvering Airspeed X0 0 6 1 0 0 1 0 1 0 1 Indicated Angle of Attack (#2 Right) X0 2 B 1 0 0 1 0 1 0 1 Compensated Altitude Rate X0 5 6 1 0 0 1 0 1 0 1 Minimum Maneuvering Airspeed X0 6 0 1 0 0 1 0 1 0 1 Minimum Maneuvering Airspeed X1 2 C 1 0 0 1 0 1 0 1 Indicated Angle of Attack (#2 Right) X1 4 0 1 0 0 1 0 1 0 1 Angle of Attack, Indicated (#2 Right) X 1 0 0 1 0 1 0 1 HUD - System Address Label X See Attachment 110 0 2 1 0 0 1 0 1 1 0 Min.

Op. Fuel Temp (non-conflicting) X 1 0 0 1 0 1 1 0 Data Loader - System Addess Label (High Speed) X See Attachment 110 1 9 1 0 0 1 0 1 1 1 CFDS Bite Command Summary for HFDR X0 3 D 1 0 0 1 0 1 1 1 AVM Command X 6-280 5 3 1 0 0 1 0 1 1 1 CFDS Bite Command Summary for HFDR X0 7 E 1 0 0 1 0 1 1 1 BITE Command Word X0 0 6 1 0 0 1 1 0 0 0 True Airspeed X 6-250 3 8 1 0 0 1 1 0 0 0 True Airspeed X 6-251 4 1 0 0 1 1 0 0 0 Left Outer Probes Capacitance X 1 0 0 1 1 0 0 0 MCDU #4 - System Address Label X See Attachment 11 0 0 6 1 0 0 1 1 0 0 1 Total Air Temperature X 6-250 3 8 1 0 0 1 1 0 0 1 Total Air Temperature X1 1 4 1 0 0 1 1 0 0 1 Inner 2 Tank Probe Capacitance X0 0 4 1 0 0 1 1 0 1 0 Altitude Rate X 6-250 0 5 1 0 0 1 1 0 1 0 Altitude Rate X0 0 6 1 0 0 1 1 0 1 0 Altitude Rate X0 5 5 1 0 0 1 1 0 1 0 GLS Airport ID X1 1 4 1 0 0 1 1 0 1 0 Inner 4 Tank Probe Capacitance X0 0 2 1 0 0 1 1 0 1 1 ACMS Information X 6-310 0 6 1 0 0 1 1 0 1 1 Static Air Temperature X 6-250 3 8 1 0 0 1 1 0 1 1 Static Air Temperature X 6-250 5 6 1 0 0 1 1 0 1 1 ACMS Information X0 6 0 1 0 0 1 1 0 1 1 ACMS Information X1 1 4 1 0 0 1 1 0 1 1 Right Outer Probe Capacitance X0 0 2 1 0 0 1 1 1 0 0 ACMS Information X 6-310 0 6 1 0 0 1 1 1 0 0 Baro Correction (mb) #1 X0 3 8 1 0 0 1 1 1 0 0 Baro Correction (mb) #1 X0 5 6 1 0 0 1 1 1 0 0 ACMS Information X0 6 0 1 0 0 1 1 1 0 0 ACMS Information X 1 0 0 1 1 1 0 0 EIVMU 1 - System Address Label X See Attachment 11 2 3 2 2 3 3 2 3 4 2 2 6 2 2 7 2 3 0 2 3 1 2 2 2 2 2 3 2 2 4 2 2 5 2 1 7 2 2 0 2 2 1 ATTACHMENT 1-1LABEL CODES ARINC SPECIFICATION 429, PART 1 - Page 26 1 2 3 4 5 6 7 8 BNR BCD DISC SAL DataNotes & Cross Ref. to Tables in Att.

6 Code No. (Octal) Eqpt. ID (Hex) Transmission Order Bit PositionParameter 0 0 2 1 0 0 1 1 1 0 1 ACMS Information X 6-310 0 6 1 0 0 1 1 1 0 1 Baro Correction (ins. Hg) #1 X 6-250 3 8 1 0 0 1 1 1 0 1 Baro Correction (ins. Hg) #1 X 6-250 5 6 1 0 0 1 1 1 0 1 ACMS Information X0 6 0 1 0 0 1 1 1 0 1 ACMS Information X 1 0 0 1 1 1 0 1 EIVMU 2 - System Address Label X See Attachment 110 0 2 1 0 0 1 1 1 1 0 ACMS Information X 6-310 0 6 1 0 0 1 1 1 1 0 Baro Correction (mb) #2 X0 3 8 1 0 0 1 1 1 1 0 Baro Correction (mb) #2 X0 5 6 1 0 0 1 1 1 1 0 ACMS Information X0 6 0 1 0 0 1 1 1 1 0 ACMS Information X 1 0 0 1 1 1 1 0 EIVMU 3 - System Address Label X See Attachment 110 0 2 1 0 0 1 1 1 1 1 ACMS Information X0 0 6 1 0 0 1 1 1 1 1 Baro Correction (ins. Hg) #2 X0 0 B 1 0 0 1 1 1 1 1 Horizontal Uncertainty Level X0 3 8 1 0 0 1 1 1 1 1 Baro Correction (ins. Hg) #2 X0 5 6 1 0 0 1 1 1 1 1 ACMS Information X0 6 0 1 0 0 1 1 1 1 1 ACMS Information X 1 0 0 1 1 1 1 1 EIVMU 4 - System Address Label X See Attachment 110 1 0 1 0 0 0 0 0 Spare0 0 2 1 0 1 0 0 0 0 1 Min. Airspeed for Flap Extension X0 0 6 1 0 1 0 0 0 0 1 Corrected Angle of Attack X0 2 C 1 0 1 0 0 0 0 1 Reserved (Special Use) X0 3 8 1 0 1 0 0 0 0 1 Corrected Angle of Attack X0 4 D 1 0 1 0 0 0 0 1 FQIS System Data X 6-350 5 6 1 0 1 0 0 0 0 1 Min. Airspeed for Flap Extension X0 6 0 1 0 1 0 0 0 0 1 Min. Airspeed for Flap Extension X1 4 0 1 0 1 0 0 0 0 1 Angle of Attack, Corrected X1 6 0 1 0 1 0 0 0 0 1 Tank Unit Data X 6-38 1 0 1 0 0 0 0 1 APM-MMR - System Address Label X See Attachment 110 0 6 1 0 1 0 0 0 1 0 Total Pressure X0 0 9 1 0 1 0 0 0 1 0 Ground Station ID (Word #1) X0 1 0 1 0 1 0 0 0 1 0 Ground Station ID (Word #1) X0 1 1 1 0 1 0 0 0 1 0 Ground Station ID (Word #1) X1 1 2 1 0 1 0 0 0 1 0 Ground Station ID (Word #1) X0 1 A 1 0 1 0 0 0 1 0 Total Pressure X0 3 8 1 0 1 0 0 0 1 0 Total Pressure X0 3 B 1 0 1 0 0 0 1 0 Speed Deviation X0 A D 1 0 1 0 0 0 1 0 Total Pressure, Uncorrected, mb X1 4 0 1 0 1 0 0 0 1 0 Total Pressure X 1 0 1 0 0 0 1 0 MMR - System Address Label X See Attachment 110 3 7 1 0 1 0 0 0 1 1 Zero Fuel Weight (kg) X0 5 5 1 0 1 0 0 0 1 1 GLS Runway Selection XX X X 1 0 1 0 0 0 1 1 Simulator to Avionics Control Word X Note 10 0 9 1 0 1 0 0 1 0 0 Ground Station ID (Word #2) X0 1 0 1 0 1 0 0 1 0 0 Ground Station ID (Word #2) X0 1 1 1 0 1 0 0 1 0 0 VOR Ground Station Ident Word #2 X0 1 2 1 0 1 0 0 1 0 0 Ground Station ID (Word #2) X0 1 C 1 0 1 0 0 1 0 0 Fuel Flow (Engine Direct) X0 3 3 1 0 1 0 0 1 0 0 Fuel Flow (Wf) X0 3 B 1 0 1 0 0 1 0 0 Mach Error X0 8 D 1 0 1 0 0 1 0 0 Fuel Flow Rate X1 0 A 1 0 1 0 0 1 0 0 Fuel Mass Flow X1 0 B 1 0 1 0 0 1 0 0 Fuel Mass Flow X1 4 0 1 0 1 0 0 1 0 0 Angle of Attack, Normalized X 1 0 1 0 0 1 0 0 ILS - System Address Label X See Attachment 11 2 4 2 2 4 3 2 4 4 2 3 6 2 3 7 2 4 0 2 4 1 2 3 5 ATTACHMENT 1-1LABEL CODES ARINC SPECIFICATION 429, PART 1 - Page 27 1 2 3 4 5 6 7 8 BNR BCD DISC SAL DataNotes & Cross Ref. to Tables in Att. 6 Code No. (Octal) Eqpt. ID (Hex) Transmission Order Bit PositionParameter 0 0 2 1 0 1 0 0 1 0 1 Minimum Airspeed X0 0 3 1 0 1 0

0 1 0 1 Minimum Airspeed X0 0 A 1 0 1 0 0 1 0 1 Minimum Airspeed X0 2 9 1 0 1 0 0 1 0 1 N3 (Engine) X0 3 8 1 0 1 0 0 1 0 1 Average Static Pressure mb, Uncorrected X0 3 B 1 0 1 0 0 1 0 1 EPR Error X0 5 6 1 0 1 0 0 1 0 1 Minimum Airspeed X0 6 0 1 0 1 0 0 1 0 1 Minimum Airspeed X0 A D 1 0 1 0 0 1 0 1 Average Static Pressure mb, Uncorrected X1 4 0 1 0 1 0 0 1 0 1 Static Pressure, Uncorrected X 1 0 1 0 0 1 0 1 MLS - System Address Label X See Attachment 110 0 2 1 0 1 0 0 1 1 0 General Maximum Speed (VCMAX) X0 0 6 1 0 1 0 0 1 1 0 Average Static Pressure X0 0 9 1 0 1 0 0 1 1 0 DME Ground Station Ident Word #1 X0 1 C 1 0 1 0 0 1 1 0 N1 (Engine Direct) X0 2 9 1 0 1 0 0 1 1 0 N1 (Engine Direct) X0 3 8 1 0 1 0 0 1 1 0 Average Static Pressure mb, Corrected X0 3 B 1 0 1 0 0 1 1 0 Angle of Attack Error X 1 0 1 0 0 1 1 0 AHRS - System Address Label X See Attachment 110 0 2 1 0 1 0 0 1 1 1 Control Minimum Speed (VCMIN) X0 0 9 1 0 1 0 0 1 1 1 DME Ground Station Ident Word #1 X0 0 B 1 0 1 0 0 1 1 1 Horizontal Figure of Merit X0 1 F 1 0 1 0 0 1 1 1 Total Fuel X0 2 C 1 0 1 0 0 1 1 1 Total Fuel X0 3 B 1 0 1 0 0 1 1 1 Speed Error X0 4 D 1 0 1 0 0 1 1 1 Total Fuel X0 5 6 1 0 1 0 0 1 1 1 Control Minimum Speed (VCMIN) X0 5 A 1 0 1 0 0 1 1 1 Total Fuel X0 6 0 1 0 1 0 0 1 1 1 Control Minimum Speed (VCMIN) X0 E B 1 0 1 0 0 1 1 1 Fuel to Remain X1 1 4 1 0 1 0 0 1 1 1 Fuel on Board X1 4 0 1 0 1 0 0 1 1 1 Airspeed Minimum Vmc X 1 0 1 0 0 1 1 1 High-Speed Data Unit #1 (HSDU #1) - SAL X See Attachment 110 0 2 1 0 1 0 1 0 0 0 Continuous N1 Limit X0 2 B 1 0 1 0 1 0 0 0 Maximum Continuous EPR Limit X0 2 C 1 0 1 0 1 0 0 0 Preselected Fuel Quantity X0 3 8 1 0 1 0 1 0 0 0 Indicated Side Slip Angle X0 5 A 1 0 1 0 1 0 0 0 Preselected Fuel Quantity X0 A D 1 0 1 0 1 0 0 0 Indicated Side Slip Angle or AOS X1 1 4 1 0 1 0 1 0 0 0 Preselected Fuel Quantity X1 2 B 1 0 1 0 1 0 0 0 Temperature Rate of Change X 1 0 1 0 1 0 0 0 High-Speed Data Unit #1 (HSDU #2) - SAL X See Attachment 11 0 0 1 1 0 1 0 1 0 0 1 Distance to Go X0 0 2 1 0 1 0 1 0 0 1 Distance to Go X0 0 6 1 0 1 0 1 0 0 1 Baro Corrected Altitude #3 X0 1 A 1 0 1 0 1 0 0 1 Flight Leg Counter X 6-190 3 8 1 0 1 0 1 0 0 1 Baro Corrected Altitude #3 X 1 0 1 0 1 0 0 1 VDR #1 - System Address Label X See Attachment 11 0 0 1 1 0 1 0 1 0 1 0 Time to Go X0 0 2 1 0 1 0 1 0 1 0 Time to Go X0 0 6 1 0 1 0 1 0 1 0 Baro Corrected Altitude #4 X0 1 A 1 0 1 0 1 0 1 0 EPR Idle X0 2 F 1 0 1 0 1 0 1 0 EPR Idle Reference X0 3 8 1 0 1 0 1 0 1 0 Baro Corrected Altitude #4 X0 3 F 1 0 1 0 1 0 1 0 EPR Idle Reference X0 E B 1 0 1 0 1 0 1 0 Time Until Jettison Complete X 1 0 1 0 1 0 1 0 VDR #2 - System Address Label X See Attachment 110 0 2 1 0 1 0 1 0 1 1 Go-Around N1 Limit X0 1 E 1 0 1 0 1 0 1 1 Go-Around EPR Limit X0 3 8 1 0 1 0 1 0 1 1 Corrected Side Slip Angle X 1 0 1 0 1 0 1 1 VDR #3 - System Address Label X See Attachment 110 0 2 1 0 1 0 1 1 0 0 Cruise N1 Limit X0 1 2 1 0 1 0 1 1 0 0 ADF Ground Station Ident Word #1 X0 1 E 1 0 1 0 1 1 0 0 Cruise EPR Limit X0 4 D 1 0 1 0 1 1 0 0 Actual Fuel Quantity (test) X0 5 5 1 0 1 0 1 1 0 0 GBAS ID X1 3 A 1 0 1 0 1 1 0 0 N1 Cruise X1 4 0 1 0 1 0 1 1 0 0 Altitude Rate X 1 0 1 0 1 1 0 0 Network Server System (NSS) - System Address Label X See Attachment 11 2 5 2 2 5 3 2 5 4 2 4 6 2 4 7 2 5 0 2 5 1 2 4 5 ATTACHMENT 1-1LABEL CODES ARINC SPECIFICATION 429, PART 1 - Page 28 1 2 3 4 5 6 7 8 BNR BCD DISC SAL DataNotes & Cross Ref. to Tables in Att. 6 Code No. (Octal) Eqpt. ID (Hex) Transmission Order Bit PositionParameter 0 0 2 1 0 1 0 1 1 0 1 Climb N1 Limit X0 1 2 1 0 1 0 1 1 0 1 ADF Ground Station Ident Word #2 X0 1 E 1 0 1 0 1 1 0 1 Climb EPR Limit X0 2 F 1 0 1 0 1 1 0 1 Max.

Climb EPR Rating X0 3 F 1 0 1 0 1 1 0 1 Max.

Climb EPR Rating X0 4 D 1 0 1 0 1 1 0 1 Fuel Quantity (gal) X0 5 5 1 0 1 0 1 1 0 1 GBAS ID/ Airport ID X0 8 E 1 0 1 0 1 1 0 1 Spoiler Position X1 3 A 1 0 1 0 1 1 0 1 N1 Climb X1 4 0 1 0 1 0 1 1 0 1 Impact Pressure X 1 0 1 0 1 1 0 1 Electronic Flight Bag - Left - System Address Label X See Attachment 110 0 2 1 0 1 0 1 1 1 0 Time for Climb X0 0 A 1 0 1 0 1 1 1 0 V Stick Shaker X0 2 7 1 0 1 0 1 1 1 0 MLS Ground Station Ident Word #1 X0 2 C 1 0 1 0 1 1 1 0 Fuel Quantity (Tanks) #1 X0 4 D 1 0 1 0 1 1 1 0 Fuel Discretes X0 5 5 1 0 1 0 1 1 1 0 MLS Station ID #1 X0 5 6 1 0 1 0 1 1 1 0 Time for Climb X0 5 A 1 0 1 0 1 1 1 0 Fuel Quantity - Left Outer Cell X0 6 0 1 0 1 0 1 1 1 0 Time for Climb X1 1 4 1 0 1 0 1 1 1 0 Left Outer Tank Fuel Quantity X1 4 0 1 0 1 0 1 1 1 0 Equivalent Airspeed X 1 0 1 0 1 1 1 0 Electronic Flight Bag -Right - System Address Label See Attachment 110 0 2 1 0 1 0 1 1 1 1 Time for Descent X0 2 7 1 0 1 0 1 1 1 1 MLS Ground Station Ident Word #2 X0 2 C 1 0 1 0 1 1 1 1 Fuel Quantity (Tanks) #2 X0 5 5 1 0 1 0 1 1 1 1 MLS Station ID #20 5 6 1 0 1 0 1 1 1 1 Time for Descent X0 5 A 1 0 1 0 1 1 1 1 Fuel Quantity Left W/T Tank X0 6 0 1 0 1 0 1 1 1 1 Time for Descent X1 1 4 1 0 1 0 1 1 1 1 Inner Tank 1 Fuel Quantity X1 4 0 1 0 1 0 1 1 1 1 Total Pressure (High Range) X0 0 2 1 0 1 1 0 0 0 0 Date/Flight Leg X 6-80 0 B 1 0 1 1 0 0 0 0 Date X0 2 C 1 0 1 1 0 0 0 0 Fuel Quantity (Tanks) #3 X0 3 1 1 0 1 1 0 0 0 0 Date (No Flight Leg) X 6-180 3 3 1 0 1 1 0 0 0 0 T5 X0 5 6 1 0 1 1 0 0 0 0 Date/Flight Leg X0 5 A 1 0 1 1 0 0 0 0 Fuel Quantity Center Tank X0 6 0 1 0 1 1 0 0 0 0 Date/Flight Leg X 6-80 A 2 1 0 1 1 0 0 0 0 Date/Flight Leg X 6-81 0 A 1 0 1 1 0 0 0 0 LP Turbine Discharge Temperature X1 0 B 1 0 1 1 0 0 0 0 LP Turbine Discharge Temperature X1 1 4 1 0 1 1 0 0 0 0 Collector Cell 1 and 2 Fuel Quantity X0 0 2 1 0 1 1 0 0 0 1 Flight Number X 6-90 2 C 1 0 1 1 0 0 0 1 Fuel Quantity (Tanks) #4 X0 3 3 1 0 1 1 0 0 0 1 P49 X0 5 6 1 0 1 1 0 0 0 1 Flight Number (BCD) X0 5 A 1 0 1 1 0 0 0 1 Fuel Quantity Right I/C or W/T Tank X0 6 0 1 0 1 1 0 0 0 1 Flight Number (BCD) X0 A 2 1 0 1 1 0 0 0 1 Flight Number X 6-91 0 A 1 0 1 1 0 0 0 1 LP Turbine Inlet Pressure X1 0 B 1 0 1 1 0 0 0 1 LP Turbine Inlet Pressure X1 1 4 1 0 1 1 0 0 0 1 Fuel On Board At Engine Start X1 4 4 1 0 1 1 0 0 0 1 Range Ring Radius X 6-52 2 5 6 2 5 7 2 6 0 2 6 1 2 5 5 ATTACHMENT 1-1LABEL CODES ARINC SPECIFICATION 429, PART 1 - Page 29 1 2 3 4 5 6 7 8 BNR BCD DISC SAL DataNotes & Cross Ref. to Tables in Att. 6 Code No. (Octal) Eqpt. ID (Hex) Transmission Order Bit PositionParameter 0 0 2 1 0 1 1 0 0 1 0 Documentary Data X 6-140 0 A 1 0 1 1 0 0 1 0 Predictive Airspeed Variation X0 1 C 1 0 1 1 0 0 1 0 LP Compressor Exist Pressure (PT3) X0 2 C 1 0 1 1 0 0 1 0 Fuel Quantity (Tanks) #5 X0 3 3 1 0 1 1 0 0 1 0 LP Compressor Exist Pressure X0 4 D 1 0 1 1 0 0 1 0 T/U CAP-L Tank 1-4 X0 5 6 1 0 1 1 0 0 1 0 Documentary Data X0 5 A 1 0 1 1 0 0 1 0 Fuel Quantity - Right Outer Cell X0 6 0 1 0 1 1 0 0 1 0 Documentary Data X1 0 A 1 0 1 1 0 0 1 0 HP Compressor Inlet Total Pressure X1 0 B 1 0 1 1 0 0 1 0 HP Compressor Inlet Total Pressure X1 1 4 1 0 1 1 0 0 1 0 Center Tank Fuel Quantity X1 4 4 1 0 1 1 0 0 1 0 Display Range X 6-510 0 2 1 0 1 1 0 0 1 1 Minimum Airspeed for Flap Retraction X0 0 A 1 0 1 1 0 0 1 1 Minimum Airspeed for Flap Retraction X0 1 0 1 0 1 1 0 0 1 1 ILS Ground Station Ident Word #1 X0 1 C 1 0 1 1 0 0 1 1 LP Compressor Exit Temperature X0 2 C 1 0 1 1 0 0 1 1 Fuel Quantity (Tanks) #6 X0 3 3 1 0 1 1 0 0 1 1 LP Compressor Exit Temperature X0 4 D 1 0 1 1 0 0 1 1 T/U CAP-L Tank 5-8 X0 5 5 1 0 1 1 0 0 1 1 Ground Station/Approach X0 5 6 1 0 1 1 0 0 1 1 Minimum Airspeed For Flap Retraction X0 6 0 1 0 1 1 0 0 1 1 Minimum Airspeed For Flap Retraction X1 0 A 1 0 1 1 0 0 1 1 Selected Compressor Inlet Temperature (Total) X1 0 B 1 0 1 1 0 0 1 1 Selected Compressor Inlet Temperature (Total) X1 1 4 1 0 1 1 0 0 1 1 Collector Cell 3 and 4 Fuel Quantity X0 0 2 1 0 1 1 0 1 0 0 Time to Touchdown X0 0 A 1 0 1 1 0 1 0 0 Minimum Airspeed for Slats Retraction X0 1 0 1 0 1 1 0 1 0 0 ILS Ground Station Ident Word #2 X0 1 C 1 0 1 1 0 1 0 0 HP Compressor Exit Pressure X0 2 C 1 0 1 1 0 1 0 0 Fuel Quantity (Tanks) #7 X0 2 F 1 0 1 1 0 1 0 0 Burner Pressure X0 3 3 1 0 1 1 0 1 0 0 HP Compressor Exit Pressure X0 3 F 1 0 1 1 0 1 0 0 Burner Pressure X0 4 D 1 0 1 1 0 1 0 0 T/U CAP-L Tank 9-12 X0 5 5 1 0 1 1 0 1 0 0 Ground Station/Approach X0 5 6 1 0 1 1 0 1 0 0 Time to Touchdown X0 6 0 1 0 1 1 0 1 0 0 Time to Touchdown X1 0 A 1 0 1 1 0 1 0 0 Selected Compressor Discharge Temperature X1 0 B 1 0 1 1 0 1 0 0 Selected Compressor Discharge Temperature X1 1 4 1 0 1 1 0 1 0 0 Fuel Quantity (Tanks) #7 X1 3 A 1 0 1 1 0 1 0 0 Burner Pressure X0 0 2 1 0 1 1 0 1 0 1 Minimum Buffet Airspeed X0 0 4 1 0 1 1 0 1 0 1 Integrated Vertical Acceleration X0 0 A 1 0 1 1 0 1 0 1 Maneuvering Airspeed X0 1 C 1 0 1 1 0 1 0 1 HP Compressor Exit Temperature (TT4.5) X0 2 C 1 0 1 1 0 1 0 1 Fuel Quantity (Tanks) #8 X0 3 3 1 0 1 1 0 1 0 1 HP Compressor Exit Temperature X0 3 8 1 0 1 1 0 1 0 1 Integrated Vertical Acceleration X0 4 D 1 0 1 1 0 1 0 1 T/U CAP-L Tank 13-14 X0 5 6 1 0 1 1 0 1 0 1 Minimum Buffet Airspeed X0 6 0 1 0 1 1 0 1 0 1 Minimum Buffet Airspeed X1 0 A 1 0 1 1 0 1 0 1 Selected Compressor Discharge Temperature X1 0 B 1 0 1 1 0 1 0 1 Selected Compressor Discharge Temperature X1 1 4 1 0 1 1 0 1 0 1 Inner Tank 3 Fuel Quantity X0 0 1 1 0 1 1 0 1 1 0 Test Word B X0 1 D 1 0 1 1 0 1 1 0 Test Word B X0 4 D 1 0 1 1 0 1 1 0 T/U CAP-C Tank 1-4 X1 1 4 1 0 1 1 0 1 1 0 Inner Tank 2 Fuel Quantity X 1 0 1 1 0 1 1 0 Cabin Video System - System Address Label X See Attachment 11 2 6 6 2 6 2 2 6 3 2 6 4 2 6 5 ATTACHMENT 1-1LABEL CODES ARINC SPECIFICATION 429, PART 1 - Page 30 1 2 3 4 5 6 7 8 BNR BCD DISC SAL DataNotes & Cross Ref. to Tables in Att. 6 Code No. (Octal) Eqpt.

ID (Hex) Transmission Order Bit PositionParameter 0 0 2 1 0 1 1 0 1 1 1 Maximum Maneuver Airspeed X0 0 A 1 0 1 1 0 1 1 1 Predictive Maximum Maneuver Speed X0 2 B 1 0 1 1 0 1 1 1 Throttle Position Command X0 3 3 1 0 1 1 0 1 1 1 Spare T/C X0 4 D 1 0 1 1 0 1 1 1 T/U CAP-C Tank 5-8 X0 5 6 1 0 1 1 0 1 1 1 Maximum Maneuver Airspeed X0 6 0 1 0 1 1 0 1 1 1 Maximum Maneuver Airspeed X1 0 A 1 0 1 1 0 1 1 1 HP Compressor Inlet Temperature (Total) X1 0 B 1 0 1 1 0 1 1 1 HP Compressor Inlet Temperature (Total) X1 1 4 1 0 1 1 0 1 1 1 Inner Tank 4 Fuel Quantity X0 0 1 1 0 1 1 1 0 0 0 Discrete Data #1 X0 0 2 1 0 1 1 1 0 0 0 Discrete Data #1 X0 0 4 1 0 1 1 1 0 0 0 Discrete Data #1 X0 0 5 1 0 1 1 1 0 0 0 Discrete Data #1 X0 0 6 1 0 1 1 1 0 0 0 Discrete Data #1 X0 0 B 1 0 1 1 1 0 0 0 Discrete Data #1 X0 1 A 1 0 1 1 1 0 0 0 Discrete Data #1 X0 1 B 1 0 1 1 1 0 0 0 Discrete Data #1 X0 1 C 1 0 1 1 1 0 0 0 Discrete Data #1 X0 1 E 1 0 1 1 1 0 0 0 Discrete Data #1 X0 2 3 1 0 1 1 1 0 0 0 GPWS Discrete X0 2 4 1 0 1 1 1 0 0 0 MU Output Data Word, Communication Link Status X0 2 5 1 0 1 1 1 0 0 0 Discrete Data #1 X0 2 7 1 0 1 1 1 0 0 0 Discrete Data #1 X0 2 9 1 0 1 1 1 0 0 0 Discrete Data #1 X0 2 F 1 0 1 1 1 0 0 0 Discrete Data #1 X0 3 1 1 0 1 1 1 0 0 0 Discrete Data #1 X0 3 3 1 0 1 1 1 0 0 0 Discrete Data #1 X0 3 5 1 0 1 1 1 0 0 0 Discrete Data #1 X0 3 7 1 0 1 1 1 0 0 0 Discrete Data #1 X0 3 8 1 0 1 1 1 0 0 0 Discrete Data #1 X0 3 9 1 0 1 1 1 0 0 0 MCDU Normal Discrete Word X0 3 A 1 0 1 1 1 0 0 0 Discrete Data #1 X0 3 B 1 0 1 1 1 0 0 0 Discrete Data #1 X0 3 D 1 0 1 1 1 0 0 0 Discrete Data #1 X0 3 E 1 0 1 1 1 0 0 0 Discrete Data #1 X0 3 F 1 0 1 1 1 0 0 0 Discrete Data #1 X0 4 1 1 0 1 1 1 0 0 0 SDU To ACARS MU/CMU Status Word X0 4 A 1 0 1 1 1 0 0 0 Discrete Data #1 X0 4 D 1 0 1 1 1 0 0 0 T/U CAP-C Tank 9 X0 5 0 1 0 1 1 1 0 0 0 VDR Status Word X0 5 3 1 0 1 1 1 0 0 0 HFDL Status Word X0 5 5 1 0 1 1 1 0 0 0 MLS Discrete X0 5 6 1 0 1 1 1 0 0 0 Status Discretes X0 5 A 1 0 1 1 1 0 0 0 Discrete Data #1 X0 6 0 1 0 1 1 1 0 0 0 Intent Status X0 6 0 1 0 1 1 1 0 0 0 Status Discretes X0 6 0 1 0 1 1 1 0 0 0 Discrete Data #1 X0 A 2 1 0 1 1 1 0 0 0 Discrete Data #1 X0 A 8 1 0 1 1 1 0 0 0 Discrete Data #1 X0 A D 1 0 1 1 1 0 0 0 Discrete Data #1 X0 C 5 1 0 1 1 1 0 0 0 Discrete Data #1 X1 0 A 1 0 1 1 1 0 0 0 Discrete Data #1 X1 0 B 1 0 1 1 1 0 0 0 Discrete Data #1 X1 1 4 1 0 1 1 1 0 0 0 Unusable, and Empty Warning X1 1 5 1 0 1 1 1 0 0 0 Stored TACAN Control Word X1 4 0 1 0 1 1 1 0 0 0 Discrete Data #1 X1 4 2 1 0 1 1 1 0 0 0 Aircraft Category (Disc Data 1) X1 4 4 1 0 1 1 1 0 0 0 Display Mode X 2 6 7 2 7 0 ATTACHMENT 1-1LABEL CODES ARINC SPECIFICATION 429, PART 1 - Page 31 1 2 3 4 5 6 7 8 BNR BCD DISC SAL DataNotes & Cross Ref. to Tables in Att. 6 Code No. (Octal) Eqpt. ID (Hex) Transmission Order Bit PositionParameter 0 0 2 1 0 1 1 1 0 0 1 Discrete Data #2 X0 0 5 1 0 1 1 1 0 0 1 AHRS Discrete X0 0 6 1 0 1 1 1 0 0 1 Discrete Data #2 X0 1 8 1 0 1 1 1 0 0 1 Discrete Data #2 X0 1 A 1 0 1 1 1 0 0 1 Discrete Data #2 X0 1 C 1 0 1 1 1 0 0 1 Discrete Data #2 X0 1 E 1 0 1 1 1 0 0 1 Discrete Data #2 X0 2 9 1 0 1 1 1 0 0 1 Discrete Data #2 X0 2 F 1 0 1 1 1 0 0 1 Discrete Data #2 X0 3 1 1 0 1 1 1 0 0 1 Discrete Data #2 X0 3 3 1 0 1 1 1 0 0 1 Discrete Data #2 X0 3 5 1 0 1 1 1 0 0 1 Discrete Data #2 X0 3 8 1 0 1 1 1 0 0 1 Discrete Data #2 X0 3 A 1 0 1 1 1 0 0 1 Discrete Data #2 X0 3 B 1 0 1 1 1 0 0 1 Discrete Data #2 X0 3 F 1 0 1 1 1 0 0 1 Discrete Data #2 X0 4 1 1 0 1 1 1 0 0 1 SDU To ACARS MU/CMU Join/Leave Message X0 4 D 1 0 1 1 1 0 0 1 T/U CAP-A Tank 1-4 X0 5 5 1 0 1 1 1 0 0 1 MMR Discrete X0 5 6 1 0 1 1 1 0 0 1 Discrete Data #2 X0 5 A 1 0 1 1 1 0 0 1 Fuel Density X0 6 0 1 0 1 1 1 0 0 1 Discrete Data #2 X0 A 2 1 0 1 1 1 0 0 1 Discrete Data #2 X0 A 8 1 0 1 1 1 0 0 1 Discrete Data #2 X0 A D 1 0 1 1 1 0 0 1 Discrete Data #2 X0 C 5 1 0 1 1 1 0 0 1 Discrete Data #2 X1 0 A 1 0 1 1 1 0 0 1 Discrete Data #2 X1 0 B 1 0 1 1 1 0 0 1 Discrete Data #2 X1 1 4 1 0 1 1 1 0 0 1 Fuel Transfer Indication X1 4 0 1 0 1 1 1 0 0 1 Discrete Data #2 X1 4 2 1 0 1 1 1 0 0 1 Altitude Filter Limits (Disc Data 2) X1 4 4 1 0 1 1 1 0 0 1 Altitude Filter Setting X 0 0 1 1 1 0 1 0 Discrete Data #3 X0 0 2 1 0 1 1 1 0 1 0 Discrete Data #3 X0 0 3 1 0 1 1 1 0 1 0 Discrete Data #3 X0 0 5 1 0 1 1 1 0 1 0 Air Data AHARS0 1 8 1 0 1 1 1 0 1 0 Discrete Data #3 X0 1 A 1 0 1 1 1 0 1 0 Discrete Data #30 1 C 1 0 1 1 1 0 1 0 Discrete Data #3 X0 2 5 1 0 1 1 1 0 1 0 Discrete Data #3 X0 2 9 1 0 1 1 1 0 1 0 Discrete Data #3 X0 2 F 1 0 1 1 1 0 1 0 Discrete Data #3 X0 3 5 1 0 1 1 1 0 1 0 Discrete Data #3 X0 3 8 1 0 1 1 1 0 1 0 Discrete Data #3 X0 3 A 1 0 1 1 1 0 1 0 Discrete Data #3 X0 3 B 1 0 1 1 1 0 1 0 Discrete Data #3 X0 3 F 1 0 1 1 1 0 1 0 Discrete Data #3 X0 4 D 1 0 1 1 1 0 1 0 T/U CAP-A Tank 5-8 X0 5 3 1 0 1 1 1 0 1 0 HFDL Slave (Disc Data 2) X0 5 6 1 0 1 1 1 0 1 0 Discrete Data #3 X0 5 A 1 0 1 1 1 0 1 0 Fuel Density X0 6 0 1 0 1 1 1 0 1 0 Discrete Data #3 X0 A D 1 0 1 1 1 0 1 0 Discrete Data #3 X0 C 5 1 0 1 1 1 0 1 0 Discrete Data #3 X1 0 A 1 0 1 1 1 0 1 0 Discrete Data #3 X1 0 B 1 0 1 1 1 0 1 0 Discrete Data #3 X1 1 4 1 0 1 1 1 0 1 0 Fuel Transfer Indication X1 4 0 1 0 1 1 1 0 1 0 Discrete Data #3 X1 4 4 1 0 1 1 1 0 1 0 Target Selection Word X 2 7 2 2 7 1 ATTACHMENT 1-1LABEL CODES ARINC SPECIFICATION 429, PART 1 - Page 32 1 2 3 4 5 6 7 8 BNR BCD DISC SAL DataNotes & Cross Ref. to Tables in Att. 6 Code No. (Octal) Eqpt. ID (Hex) Transmission Order Bit PositionParameter 0 0 1 1 0 1 1 1 0 1 1 Discrete Data #4 X0 0 3 1 0 1 1 1 0 1 1 Discrete Data #4 X0 0 B 1 0 1 1 1 0 1 1 GNSS Sensor Status X0 1 8 1 0 1 1 1 0 1 1 Discrete Data #4 X0 1 C 1 0 1 1 1 0 1 1 Discrete Data #4 X0 2 5 1 0 1 1 1 0 1 1 Discrete Data #4 X0 2 9 1 0 1 1 1 0 1 1 Discrete Data #4 X0 2 F 1 0 1 1 1 0 1 1 Discrete Data #4 X0 3 3 1 0 1 1 1 0 1 1 Discrete Data #4 X0 3 5 1 0 1 1 1 0 1 1 Discrete Data #4 X0 3 B 1 0 1 1 1 0 1 1 Discrete Data #4 X0 3 F 1 0 1 1 1 0 1 1 Discrete Data #4 X0 4 D 1 0 1 1 1 0 1 1 T/U CAP-A Tank 9-11 X0 5 5 1 0 1 1 1 0 1 1 GNSS Status X0 5 A 1 0 1 1 1 0 1 1 Sensor Valves Left Wing Tank X0 C 5 1 0 1 1 1 0 1 1 Discrete Data #4 X1 0 A 1 0 1 1 1 0 1 1 Discrete Data #4 X1 0 B 1 0 1 1 1 0 1 1 Discrete Data #4 X1 1 4 1 0 1 1 1 0 1 1 Memos and Status X0 0 1 1 0 1 1 1 1 0 0 Discrete Data #5 X0 0 3 1 0 1 1 1 1 0 0 Discrete Data #5 X0 0 A 1 0 1 1 1 1 0 0 Discrete Data #5 X0 1 8 1 0 1 1 1 1 0 0 Discrete Data #5 X0 1 C 1 0 1 1 1 1 0 0 Discrete Data #5 X0 2 5 1 0 1 1 1 1 0 0 Discrete Data #5 X0 2 9 1 0 1 1 1 1 0 0 Discrete Data #5 X0 2 F 1 0 1 1 1 1 0 0 Discrete Data #5 X0 3 3 1 0 1 1 1 1 0 0 Discrete Data #5 X0 3 5 1 0 1 1 1 1 0 0 Discrete Data #5 X0 3 B 1 0 1 1 1 1 0 0 Discrete Data #5 X0 3 F 1 0 1 1 1 1 0 0 Discrete Data #5 X0 4 D 1 0 1 1 1 1 0 0 T/U CAP-R Tank 1-4 X0 5 A 1 0 1 1 1 1 0 0 Sensor Valves Center Wing Tank X0 C 5 1 0 1 1 1 1 0 0 Discrete Data #5 X1 0 A 1 0 1 1 1 1 0 0 Discrete Data #5 X1 0 B 1 0 1 1 1 1 0 0 Discrete Data #5 X1 1 4 1 0 1 1 1 1 0 0 Fuel Transfer Indications X0 0 1 1 0 1 1 1 1 0 1 Discrete Data #6 X0 0 2 1 0 1 1 1 1 0 1 Discrete Data #6 X0 0 3 1 0 1 1 1 1 0 1 Discrete Data #6 X0 1 8 1 0 1 1 1 1 0 1 Discrete Data #6 X0 1 C 1 0 1 1 1 1 0 1 Discrete Data #6 X0 2 5 1 0 1 1 1 1 0 1 Discrete Data #6 X0 2 9 1 0 1 1 1 1 0 1 Discrete Data #6 X0 2 B 1 0 1 1 1 1 0 1 Discrete Data #6 X0 2 F 1 0 1 1 1 1 0 1 Discrete Data #6 X0 3 5 1 0 1 1 1 1 0 1 Discrete Data #6 X0 3 8 1 0 1 1 1 1 0 1 IR Discrete Word #2 X0 3 B 1 0 1 1 1 1 0 1 Discrete Data #6 X0 3 F 1 0 1 1 1 1 0 1 Discrete Data #6 X0 4 A 1 0 1 1 1 1 0 1 T/U CAP-R Tank 5-8 X0 4 D 1 0 1 1 1 1 0 1 Discrete Data #6 X0 5 A 1 0 1 1 1 1 0 1 Sensor Valves Right Wing Tank X0 5 6 1 0 1 1 1 1 0 1 Discrete Data #6 X0 6 0 1 0 1 1 1 1 0 1 Discrete Data #6 X1 0 A 1 0 1 1 1 1 0 1 Discrete Data #6 X1 0 B 1 0 1 1 1 1 0 1 Discrete Data #6 X1 1 4 1 0 1 1 1 1 0 1 Miscellaneous Warning X 2 7 3 2 7 4 2 7 5 ATTACHMENT 1-1LABEL CODES ARINC SPECIFICATION 429, PART 1 - Page 33 1 2 3 4 5 6 7 8 BNR BCD DISC SAL DataNotes & Cross Ref. to Tables in Att. 6 Code No. (Octal) Eqpt. ID (Hex) Transmission Order Bit PositionParameter 0 0 2 1 0 1 1 1 1 1 0 Discrete Data #7 X0 1 8 1 0 1 1 1 1 1 0 Discrete Data #7 X0 1 C 1 0 1 1 1 1 1 0 Discrete Data #7 X0 2 5 1 0 1 1 1 1 1 0 Discrete Status 8 EFIS X0 2 9 1 0 1 1 1 1 1 0 Discrete Data #7 X0 2 F 1 0 1 1 1 1 1 0 Discrete Data #7 X0 3 F 1 0 1 1 1 1 1 0 Discrete Data #7 X0 4 D 1 0 1 1 1 1 1 0 T/U CAP-R Tank 9-12 X0 5 0 1 0 1 1 1 1 1 0 VDR Mode X0 5 6 1 0 1 1 1 1 1 0 Discrete Data #7 X0 5 8 1 0 1 1 1 1 1 0 Output Status Word #2 X0 5 A 1 0 1 1 1 1 1 0 Discrete Data #7 X0 6 0 1 0 1 1 1 1 1 0 Discrete Data #7 X0 B B 1 0 1 1 1 1 1 0 Discrete Data #7 X1 1 4 1 0 1 1 1 1 1 0 Discrete Data #7 X0 0 1 1 0 1 1 1 1 1 1 0 FCC to Simulator Control Word - Simulator Use Only X0 0 2 1 0 1 1 1 1 1 0 FMC to Simulator Control Word - Simulator Use Only X0 0 3 1 0 1 1 1 1 1 1 0 TCC to Simulator Control Word - Simulator Use Only XX X X 1 0 1 1 1 1 1 1 General Test Word X Note 10 0 4 1 0 1 1 1 1 1 1 IRS Maintenance Discrete X0 1 8 1 0 1 1 1 1 1 1 Discrete Data #8 X0 3 8 1 0 1 1 1 1 1 1 IR Test X0 4 D 1 0 1 1 1 1 1 1 T/U CAP-R Tank 13-14 X1 1 4 1 0 1 1 1 1 1 1 Fuel Transfer and CG Status X 0 0 1 1 0 0 0 0 0 0 Application Dependent X0 1 A 1 1 0 0 0 0 0 0 Application Dependent X0 3 D 1 1 0 0 0 0 0 0 Application Dependent X0 5 A 1 1 0 0 0 0 0 0 Internal Parameter for SPATIAAL X1 0 A 1 1 0 0 0 0 0 0 ECU Internal Temperature X1 0 B 1 1 0 0 0 0 0 0 ECU Internal Temperature XT B D 1 1 0 0 0 0 0 0 Data Loader Address Label (Low Speed) X 1 1 0 0 0 0 0 0 FMC 1 - System Address Label X See Attachment 110 0 1 1 1 0 0 0 0 0 1 Application Dependent X0 0 2 1 1 0 0 0 0 0 1 Application Dependent X0 1 A 1 1 0 0 0 0 0 1 Application Dependent X0 5 6 1 1 0 0 0 0 0 1 Application Dependent X0 5 A 1 1 0 0 0 0 0 1 Internal Parameter for SPATIAAL X0 6 0 1 1 0 0 0 0 0 1 Application Dependent X1 0 A 1 1 0 0 0 0 0 1 Demanded Fuel Metering Valve Position X1 0 B 1 1 0 0 0 0 0 1 Demanded Fuel Metering Valve Position X 1 1 0 0 0 0 0 1 FMC 2 - System Address Label X See Attachment 110 0 1 1 1 0 0 0 0 1 0 Application Dependent X0 0 2 1 1 0 0 0 0 1 0 Application Dependent X0 1 A 1 1 0 0 0 0 1 0 Application Dependent X0 5 6 1 1 0 0 0 0 1 0 Application Dependent X0 5 A 1 1 0 0 0 0 1 0 Internal Parameter for SPATIAAL X0 6 0 1 1 0 0 0 0 1 0 Application Dependent X1 0 A 1 1 0 0 0 0 1 0 Demanded Variable Stator Vane Position X1 0 B 1 1 0 0 0 0 1 0 Demanded Variable Stator Vane Position X 1 1 0 0 0 0 1 0 AIDS (DFDAU) - System Address Label X See Attachment 110 0 1 1 1 0 0 0 0 1 1 Application Dependent X0 0 2 1 1 0 0 0 0 1 1 Application Dependent X0 1 A 1 1 0 0 0 0 1 1 Application Dependent X0 5 6 1 1 0 0 0 0 1 1 Application Dependent X0 5 A 1 1 0 0 0 0 1 1 Internal Parameter for SPATIAAL X0 6 0 1 1 0 0 0 0 1 1 Application Dependent X1 0 A 1 1 0 0 0 0 1 1 Demanded Variable Bleed Valve Position X1 0 B 1 1 0 0 0 0 1 1 Demanded Variable Bleed Valve Position X 1 1 0 0 0 0 1 1 CFDIU - System Address Label X See attachment 110 0 1 1 1 0 0 0 1 0 0 Application Dependent X0 1 A 1 1 0 0 0 1 0 0 Application Dependent X0 5 A 1 1 0 0 0 1 0 0 Internal Parameter for SPATIAAL X1 0 A 1 1 0 0 0 1 0 0 Demanded HPT Clearance Valve Position X1 0 B 1 1 0 0 0 1 0 0 Demanded HPT Clearance Valve Position X 1 1 0 0 0 1 0 0 ACARS - System Address Label X See Attachment 11 3 0 2 3 0 3 3 0 4 2 7 6 2 7 7 3 0 0 3 0 1 ATTACHMENT 1-1LABEL CODES ARINC SPECIFICATION 429, PART 1 - Page 34 1 2 3 4 5 6 7 8 BNR BCD DISC SAL DataNotes & Cross Ref. to Tables in Att. 6 Code No. (Octal) Eqpt. ID (Hex) Transmission Order Bit PositionParameter 0 0 1 1 1 0 0 0 1 0 1 Application Dependent X0 1 A 1 1 0 0 0 1 0 1 Application Dependent X0 5 A 1 1 0 0 0 1 0 1 Internal Parameter for SPATIAAL X1 0 A 1 1 0 0 0 1 0 1 Demanded LPT Clearance Valve Position X1 0 B 1 1 0 0 0 1 0 1 Demanded LPT Clearance Valve Position X 1 1 0 0 0 1 0 1 Weight/Balance System - System Address Label X See Attachment 110 0 1 1 1 0 0 0 1 1 0 Application Dependent X0 1 A 1 1 0 0 0 1 1 0 Application Dependent X0 5 A 1 1 0 0 0 1 1 0 Internal Parameter for SPATIAAL X 1 1 0 0 0 1 1 0 TCAS - System Address Label X See Attachment 110 0 1 1 1 0 0 0 1 1 1 Application Dependent X0 1 A 1 1 0 0 0 1 1 1 Application Dependent X0 5 A 1 1 0 0 0 1 1 1 Internal Parameter for SPATIAAL X 1 1 0 0 0 1 1 1 Satellite Data Unit (SDU) - System Address Label X See Attachment 110 0 2 1 1 0 0 1 0 0 0 Present Position - Latitude X 6-270 0 4 1 1 0 0 1 0 0 0 Present Position - Latitude X0 2 9 1 1 0 0 1 0 0 0 Aileron Position X0 3 8 1 1 0 0 1 0 0 0 Present Position - Latitude X0 4 D 1 1 0 0 1 0 0 0 COMP CAP - TANK X0 5 6 1 1 0 0 1 0 0 0 Present Position Latitude X0 5 A 1 1 0 0 1 0 0 0 Internal Parameter for SPATIAAL X0 6 0 1 1 0 0 1 0 0 0 Present Position Latitude X1 1 4 1 1 0 0 1 0 0 0 Right Outer Tank Fuel Quantity X 1 1 0 0 1 0 0 0 GPWS - System Address Label X See Attachment 110 0 2 1 1 0 0 1 0 0 1 Present Position - Longitude X 6-270 0 4 1 1 0 0 1 0 0 1 Present Position - Longitude X0 2 9 1 1 0 0 1 0 0 1 Aileron Trim X0 3 8 1 1 0 0 1 0 0 1 Present Position - Longitude X0 3 B 1 1 0 0 1 0 0 1 Control Wheel Roll Force X0 5 6 1 1 0 0 1 0 0 1 Present Postion Longitude X0 5 A 1 1 0 0 1 0 0 1 Internal Parameter for SPATIAAL X0 6 0 1 1 0 0 1 0 0 1 Present Postion Longitude X1 1 4 1 1 0 0 1 0 0 1 Right Outer Tank Fuel Quantity X 1 1 0 0 1 0 0 1 GNLU 1 - System Address Label X See Attachment 110 0 2 1 1 0 0 1 0 1 0 Ground Speed X 6-270 0 4 1 1 0 0 1 0 1 0 Ground Speed X0 0 5 1 1 0 0 1 0 1 0 Ground Speed X0 2 9 1 1 0 0 1 0 1 0 Rudder Position X0 3 8 1 1 0 0 1 0 1 0 Ground Speed X0 5 6 1 1 0 0 1 0 1 0 Ground Speed X0 5 A 1 1 0 0 1 0 1 0 Fuel Quantity ACT 1 X0 6 0 1 1 0 0 1 0 1 0 Ground Speed X1 1 4 1 1 0 0 1 0 1 0 Additional Center Tank (Act 1) Fuel Quantity X 1 1 0 0 1 0 1 0 GNLU 2 - System Address Label X See Attachment 110 0 2 1 1 0 0 1 0 1 1 Track Angle - True X0 0 4 1 1 0 0 1 0 1 1 Track Angle - True X0 2 5 1 1 0 0 1 0 1 1 Track Angle - True X0 2 9 1 1 0 0 1 0 1 1 Rudder Trim X0 3 8 1 1 0 0 1 0 1 1 Track Angle - True X0 5 6 1 1 0 0 1 0 1 1 Track Angle - True X0 5 A 1 1 0 0 1 0 1 1 Fuel Quantity ACT 2 X0 6 0 1 1 0 0 1 0 1 1 Track Angle - True X1 1 4 1 1 0 0 1 0 1 1 Additional Center Tank (Act 2) Fuel Quantity X 1 1 0 0 1 0 1 1 GNLU 3 - System Address Label X See Attachment 110 0 2 1 1 0 0 1 1 0 0 Stabilizer Position Indication (B747-400) X0 0 4 1 1 0 0 1 1 0 0 True Heading X0 2 5 1 1 0 0 1 1 0 0 True Heading X0 2 9 1 1 0 0 1 1 0 0 Elevator Position X0 3 8 1 1 0 0 1 1 0 0 True Heading X0 3 B 1 1 0 0 1 1 0 0 Control Wheel Pitch Force X0 5 A 1 1 0 0 1 1 0 0 Internal Parameter for SPATIAAL X1 1 4 1 1 0 0 1 1 0 0 Rear Center Tank (RCT) Fuel Quantity X 1 1 0 0 1 1 0 0 GNU 1 - System Address Label X See Attachment 11 3 1 2 3 1 3 3 1 4 3 0 6 3 0 7 3 1 0 3 1 1 3 0 5 ATTACHMENT 1-1LABEL CODES ARINC SPECIFICATION 429, PART 1 - Page 35 1 2 3 4 5 6 7 8 BNR BCD DISC SAL DataNotes & Cross Ref. to Tables in Att. 6 Code No. (Octal) Eqpt. ID (Hex) Transmission Order Bit PositionParameter 0 0 1 1 1 0 0 1 1 0 1 Stabilizer Position X0 0 2 1 1 0 0 1 1 0 1 Wind Speed X0 0 4 1 1 0 0 1 1 0 1 Wind Speed X0 0 5 1 1 0 0 1 1 0 1 Wind Speed X0 2 9 1 1 0 0 1 1 0 1 Stabilizer Position X0 3 8 1 1 0 0 1 1 0 1 Wind Speed X0 5 6 1 1 0 0 1 1 0 1 Wind Speed X0 5 A 1 1 0 0 1 1 0 1 Internal Parameter for SPATIAAL X0 6 0 1 1 0 0 1 1 0 1 Wind Speed X0 A 1 1 0 0 1 1 0 1 Stabilizer Position X 1 1 0 0 1 1 0 1 GNU 2 - System Address Label X See Attachment 110 0 2 1 1 0 0 1 1 1 0 Wind Direction (True) X0 0 4 1 1 0 0 1 1 1 0 Wind Angle X0 2 9 1 1 0 0 1 1 1 0 Oil Temperature (Engine) X0 3 8 1 1 0 0 1 1 1 0 Wind Angle X0 5 6 1 1 0 0 1 1 1 0 Wind Direction (True) X0 5 A 1 1 0 0 1 1 1 0 Internal Parameter for SPATIAAL X0 6 0 1 1 0 0 1 1 1 0 Wind Direction (True) X0 D 0 1 1 0 0 1 1 1 0 Engine Oil Temperature X1 0 A 1 1 0 0 1 1 1 0 Engine Oil Temperature X1 0 B 1 1 0 0 1 1 1 0 Engine Oil Temperature X 1 1 0 0 1 1 1 0 GNU 3 - System Address Label X See Attachment 110 0 2 1 1 0 0 1 1 1 1 Track Angle - Magnetic X0 0 4 1 1 0 0 1 1 1 1 Track Angle - Magnetic X0 0 5 1 1 0 0 1 1 1 1 Track Angle - Magnetic X0 2 5 1 1 0 0 1 1 1 1 Track Angle - Magnetic X0 2 9 1 1 0 0 1 1 1 1 Oil Pressure (Engine) X0 3 8 1 1 0 0 1 1 1 1 Track Angle - Magnetic X0 5 6 1 1 0 0 1 1 1 1 Track Angle - Magnetic X0 5 A 1 1 0 0 1 1 1 1 Internal Parameter for SPATIAAL X0 6 0 1 1 0 0 1 1 1 1 Track Angle - Magnetic X0 D 0 1 1 0 0 1 1 1 1 Oil Pressure (Engine) X0 0 4 1 1 0 1 0 0 0 0 Magnetic Heading X0 0 5 1 1 0 1 0 0 0 0 Magnetic Heading X0 2 5 1 1 0 1 0 0 0 0 Magnetic Heading X0 2 9 1 1 0 1 0 0 0 0 Engine Fuel Pressure X0 3 5 1 1 0 1 0 0 0 0 Own Aircraft Magnetic Heading X0 3 8 1 1 0 1 0 0 0 0 Magnetic Heading X0 4 D 1 1 0 1 0 0 0 0 Density - Tank X0 5 6 1 1 0 1 0 0 0 0 Magnetic Heading X0 6 0 1 1 0 1 0 0 0 0 Magnetic Heading X0 0 2 1 1 0 1 0 0 0 1 Drift Angle X0 0 4 1 1 0 1 0 0 0 1 Drift Angle X0 0 5 1 1 0 1 0 0 0 1 Drift Angle X0 2 9 1 1 0 1 0 0 0 1 Engine Fuel Temperature X0 3 8 1 1 0 1 0 0 0 1 Drift Angle X0 5 6 1 1 0 1 0 0 0 1 Drift Angle X0 6 0 1 1 0 1 0 0 0 1 Drift Angle X1 0 A 1 1 0 1 0 0 0 1 Exhaust gas Temperature (Total) X1 0 B 1 1 0 1 0 0 0 1 Exhaust gas Temperature (Total) X 1 1 0 1 0 0 0 1 Autothrottle Computer - System Address Label X See Attachment 110 0 2 1 1 0 1 0 0 1 0 Flight Path Angle X0 0 4 1 1 0 1 0 0 1 0 Flight Path Angle X0 0 5 1 1 0 1 0 0 1 0 Flight Path Angle X0 2 9 1 1 0 1 0 0 1 0 Engine Nacelle Temperature X0 3 8 1 1 0 1 0 0 1 0 Flight Path Angle X0 5 6 1 1 0 1 0 0 1 0 Flight Path Angle X0 6 0 1 1 0 1 0 0 1 0 Flight Path Angle X1 0 A 1 1 0 1 0 0 1 0 Total Compressor Discharge Temperature X1 0 B 1 1 0 1 0 0 1 0 Total Compressor Discharge Temperature X 1 1 0 1 0 0 1 0 FCC 1 - System Address Label X See Attachment 11 3 2 2 3 1 6 3 1 7 3 2 0 3 2 1 3 1 5 ATTACHMENT 1-1LABEL CODES ARINC SPECIFICATION 429, PART 1 - Page 36 1 2 3 4 5 6 7 8 BNR BCD DISC SAL DataNotes & Cross Ref. to Tables in Att. 6 Code No. (Octal) Eqpt. ID (Hex) Transmission Order Bit PositionParameter 0 0 2 1 1 0 1 0 0 1 1 Geometric Altitude X0 0 4 1 1 0 1 0 0 1 1 Flight Path Acceleration X 6-270 0 5 1 1 0 1 0 0 1 1 Flight Path Acceleration X0 3 8 1 1 0 1 0 0 1 1 Flight Path Acceleration X0 5 6 1 1 0 1 0 0 1 1 Geometric Altitude X0 6 0 1 1 0 1 0 0 1 1 Geometric Altitude X1 0 A 1 1 0 1 0 0 1 1 Variable Stator Vane Position X1 0 B 1 1 0 1 0 0 1 1 Variable Stator Vane Position X 1 1 0 1 0 0 1 1 FCC 2 - System Address Label X See Attachment 110 0 4 1 1 0 1 0 1 0 0 Pitch Angle X0 0 5 1 1 0 1 0 1 0 0 Pitch Angle X0 2 5 1 1 0 1 0 1 0 0 Pitch Angle X0 3 8 1 1 0 1 0 1 0 0 Pitch Angle X0 4 D 1 1 0 1 0 1 0 0 Tank VSO Quantity X0 5 A 1 1 0 1 0 1 0 0 Effective Pitch Angle X1 0 A 1 1 0 1 0 1 0 0 Selected Fuel Metering Valve Position X1 0 B 1 1 0 1 0 1 0 0 Selected Fuel Metering Valve Position X1 1 4 1 1 0 1 0 1 0 0 Effective Pitch Angle X 1 1 0 1 0 1 0 0 FCC 3 - System Address Label X See Attachment 110 0 4 1 1 0 1 0 1 0 1 Roll Angle X0 0 5 1 1 0 1 0 1 0 1 Roll Angle X0 1 A 1 1 0 1 0 1 0 1 Engine Control Trim Feedback X0 2 5 1 1 0 1 0 1 0 1 Roll Angle X0 2 F 1 1 0 1 0 1 0 1 Stator Vane Feedback X0 3 8 1 1 0 1 0 1 0 1 Roll Angle X0 3 F 1 1 0 1 0 1 0 1 Stator Vane Feedback X0 5 A 1 1 0 1 0 1 0 1 Effective Roll Angle X1 0 A 1 1 0 1 0 1 0 1 Selected Fuel Metering Vane Position X1 0 B 1 1 0 1 0 1 0 1 Selected Fuel Metering Vane Position X1 1 4 1 1 0 1 0 1 0 1 Effective Roll Angle X 1 1 0 1 0 1 0 1 APU - System Address Label X See Attachment 110 0 4 1 1 0 1 0 1 1 0 Body Pitch Rate X0 0 5 1 1 0 1 0 1 1 0 Body Pitch Rate X0 3 8 1 1 0 1 0 1 1 0 Body Pitch Rate X0 4 D 1 1 0 1 0 1 1 0 Uplift Quantity X0 5 A 1 1 0 1 0 1 1 0 Maintenance Word X1 0 A 1 1 0 1 0 1 1 0 Compressor Discharge Static Pressure X1 0 B 1 1 0 1 0 1 1 0 Compressor Discharge Static Pressure X 1 1 0 1 0 1 1 0 APU Controller - System Address Label X See Attachment 110 0 4 1 1 0 1 0 1 1 1 Body Roll Rate X0 0 5 1 1 0 1 0 1 1 1 Body Roll Rate X0 3 8 1 1 0 1 0 1 1 1 Body Roll Rate X0 4 D 1 1 0 1 0 1 1 1 Uplift Density X1 0 A 1 1 0 1 0 1 1 1 Fuel Metering Valve Position X1 0 B 1 1 0 1 0 1 1 1 Fuel Metering Valve Position X 1 1 0 1 0 1 1 1 Mode Control Panel (MCP) - System Address Label X See Attachment 110 0 4 1 1 0 1 1 0 0 0 Body Yaw Rate X0 0 5 1 1 0 1 1 0 0 0 Body Yaw Rate X0 2 F 1 1 0 1 1 0 0 0 HC/TC Cooling Valve Position Feedback X0 3 8 1 1 0 1 1 0 0 0 Body Yaw Rate X0 3 F 1 1 0 1 1 0 0 0 HC/TC Cooling Valve Position Feedback X1 0 A 1 1 0 1 1 0 0 0 Selected HPT Clearance Valve Postion X1 0 B 1 1 0 1 1 0 0 0 Selected HPT Clearance Valve Postion X 1 1 0 1 1 0 0 0 FMC 3 - System Address Label X See Attachment 110 0 4 1 1 0 1 1 0 0 1 Body Longitudinal Acceleration X0 0 5 1 1 0 1 1 0 0 1 Body Longitudinal Acceleration X0 2 F 1 1 0 1 1 0 0 1 LTC Cooling Valve Position Feedback X0 3 8 1 1 0 1 1 0 0 1 Body Longitudinal Acceleration X0 3 F 1 1 0 1 1 0 0 1 LTC Cooling Valve Position Feedback X1 0 A 1 1 0 1 1 0 0 1 Selected LPT Clearance Valve Position X1 0 B 1 1 0 1 1 0 0 1 Selected LPT Clearance Valve Position X 1 1 0 1 1 0 0 1 ATC Transponder - System Address Label X See Attachment 11 3 2 6 3 2 7 3 3 0 3 3 1 3 2 3 3 2 4 3 2 5 ATTACHMENT 1-1LABEL CODES ARINC SPECIFICATION 429, PART 1 - Page 37 1 2 3 4 5 6 7 8 BNR BCD DISC SAL DataNotes & Cross Ref.

to Tables in Att.

6 Code No. (Octal) Eqpt. ID (Hex) Transmission Order Bit PositionParameter 0 0 4 1 1 0 1 1 0 1 0 Body Lateral Acceleration X0 0 5 1 1 0 1 1 0 1 0 Body Lateral Acceleration X0 2 F 1 1 0 1 1 0 1 0 A/O Heat Exchanger Valve Postion Feedback X0 3 8 1 1 0 1 1 0 1 0 Body Lateral Acceleration X0 3 F 1 1 0 1 1 0 1 0 A/O Heat Exchanger Valve Postion Feedback X 1 1 0 1 1 0 1 0 DADC - System Address Label X See Attachment 110 0 4 1 1 0 1 1 0 1 1 Body Normal Acceleration X0 0 5 1 1 0 1 1 0 1 1 Body Normal Acceleration X0 2 F 1 1 0 1 1 0 1 1 Acceleration Fuel Flow Limit X0 3 8 1 1 0 1 1 0 1 1 Body Normal Acceleration X0 3 F 1 1 0 1 1 0 1 1 Acceleration Fuel Flow Limit X0 0 4 1 1 0 1 1 1 0 0 Platform Heading X0 0 5 1 1 0 1 1 1 0 0 Platform Heading X0 2 F 1 1 0 1 1 1 0 0 Fuel Flow Command X0 3 8 1 1 0 1 1 1 0 0 Platform Heading X0 3 F 1 1 0 1 1 1 0 0 Fuel Flow Command X 1 1 0 1 1 1 0 0 CTU - System Address Label X See Attachment 110 0 2 1 1 0 1 1 1 0 1 Track Angle Rate X0 0 4 1 1 0 1 1 1 0 1 Track Angle Rate X0 0 5 1 1 0 1 1 1 0 1 Track Angle Rate X0 2 F 1 1 0 1 1 1 0 1 2.5 Bld Actuator Postion X0 3 8 1 1 0 1 1 1 0 1 Track Angle Rate X0 3 F 1 1 0 1 1 1 0 1 2.5 Bld Actuator Postion X0 5 6 1 1 0 1 1 1 0 1 Track Angle Rate X0 6 0 1 1 0 1 1 1 0 1 Track Angle Rate X1 0 A 1 1 0 1 1 1 0 1 Selected Variable Bleed Valve Position X1 0 B 1 1 0 1 1 1 0 1 Selected Variable Bleed Valve Position X0 0 2 1 1 0 1 1 1 1 0 Maximum Climb Angle X0 0 4 1 1 0 1 1 1 1 0 Inertial Pitch Rate X0 0 5 1 1 0 1 1 1 1 0 Inertial Pitch Rate X0 1 A 1 1 0 1 1 1 1 0 Engine Torque X0 2 F 1 1 0 1 1 1 1 0 N2 Corrected to Sta. 2.5 X0 3 8 1 1 0 1 1 1 1 0 Inertial Pitch Rate X0 3 F 1 1 0 1 1 1 1 0 N2 Corrected to Sta. 2.5 X1 0 A 1 1 0 1 1 1 1 0 Variable Bleed Value Position X1 0 B 1 1 0 1 1 1 1 0 Variable Bleed Value Position X0 0 2 1 1 0 1 1 1 1 1 EPR - Required for Level Flight X0 0 2 1 1 0 1 1 1 1 1 N1 - Required for Level Flight X0 0 4 1 1 0 1 1 1 1 1 Inertial Roll Rate X0 0 5 1 1 0 1 1 1 1 1 Inertial Roll Rate X0 1 A 1 1 0 1 1 1 1 1 Engine Rating X0 3 8 1 1 0 1 1 1 1 1 Inertial Roll Rate X1 0 A 1 1 0 1 1 1 1 1 HPT Clearance Valve Position X1 0 B 1 1 0 1 1 1 1 1 HPT Clearance Valve Position X0 0 3 1 1 1 0 0 0 0 0 EPR Actual X0 0 4 1 1 1 0 0 0 0 0 Inertial Yaw Rate X0 0 4 1 1 1 0 0 0 0 0 Track Angle Rate X0 0 5 1 1 1 0 0 0 0 0 Inertial Yaw Rate X0 1 A 1 1 1 0 0 0 0 0 EPR Actual X0 2 9 1 1 1 0 0 0 0 0 EPR Actual (Engine Direct) X0 2 F 1 1 1 0 0 0 0 0 EPR Actual X0 2 F 1 1 1 0 0 0 0 0 EPR Actual X0 3 3 1 1 1 0 0 0 0 0 EPR Actual X0 3 F 1 1 1 0 0 0 0 0 EPR Actual X1 3 A 1 1 1 0 0 0 0 0 N1 Take Off X1 4 0 1 1 1 0 0 0 0 0 Pressure Ratio (Pt/Ps) X 1 1 1 0 0 0 0 0 HF DATA Radio/Data #1 - System Address Label X See Attachment 11 3 3 6 3 3 7 3 4 0 3 3 2 3 3 3 3 3 4 3 3 5 ATTACHMENT 1-1LABEL CODES ARINC SPECIFICATION 429, PART 1 - Page 38 1 2 3 4 5 6 7 8 BNR BCD DISC SAL DataNotes & Cross Ref. to Tables in Att.

6 Code No. (Octal) Eqpt. ID (Hex) Transmission Order Bit PositionParameter 0 0 2 1 1 1 0 0 0 0 1 Target N1 X0 0 3 1 1 1 0 0 0 0 1 N1 Command X0 0 3 1 1 1 0 0 0 0 1 EPR Command X0 0 4 1 1 1 0 0 0 0 1 Grid Heading X0 1 A 1 1 1 0 0 0 0 1 N1 Command X0 1 A 1 1 1 0 0 0 0 1 EPR Command X0 2 9 1 1 1 0 0 0 0 1 N1 Command (Engine) X0 2 9 1 1 1 0 0 0 0 1 EPR Command (Engine) X0 2 F 1 1 1 0 0 0 0 1 N1 Command X0 2 F 1 1 1 0 0 0 0 1 EPR Command X0 3 8 1 1 1 0 0 0 0 1 Grid Heading X0 3 F 1 1 1 0 0 0 0 1 EPR Command X0 4 D 1 1 1 0 0 0 0 1 I/O S/W REV 1&2 X1 0 A 1 1 1 0 0 0 0 1 Command Fan Speed X1 0 B 1 1 1 0 0 0 0 1 Command Fan Speed X1 3 A 1 1 1 0 0 0 0 1 N1 Reference X1 4 0 1 1 1 0 0 0 0 1 Pressure Ratio (Ps/Pso) X0 0 2 1 1 1 0 0 0 1 0 N1 Bug Drive X0 0 3 1 1 1 0 0 0 1 0 N1 Limit X0 0 3 1 1 1 0 0 0 1 0 EPR Limit X0 1 A 1 1 1 0 0 0 1 0 N1 Maximum X0 1 A 1 1 1 0 0 0 1 0 EPR Maximum X0 2 9 1 1 1 0 0 0 1 0 N1 Limit (TCC) X0 2 9 1 1 1 0 0 0 1 0 EPR Limit (TOC) X0 2 F 1 1 1 0 0 0 1 0 Maximum Available EPR X0 3 B 1 1 1 0 0 0 1 0 N1 Limit X0 3 B 1 1 1 0 0 0 1 0 EPR Limit X0 3 F 1 1 1 0 0 0 1 0 Maximum Available EPR X0 4 D 1 1 1 0 0 0 1 0 S/W Rev-Tank X1 0 A 1 1 1 0 0 0 1 0 Maximum Allowed Fan Speed X1 0 B 1 1 1 0 0 0 1 0 Maximum Allowed Fan Speed X1 4 0 1 1 1 0 0 0 1 0 Air Density Ratio X0 0 3 1 1 1 0 0 0 1 1 N1 Derate X0 0 3 1 1 1 0 0 0 1 1 EPR Rate X0 1 A 1 1 1 0 0 0 1 1 N1 Demand X1 0 A 1 1 1 0 0 0 1 1 N1 Command vs.

TLA X1 0 B 1 1 1 0 0 0 1 1 N1 Command vs. TLA X0 1 A 1 1 1 0 0 1 0 0 N2 X0 1 C 1 1 1 0 0 1 0 0 N2 X0 2 9 1 1 1 0 0 1 0 0 N2 X0 2 F 1 1 1 0 0 1 0 0 N2 X0 3 3 1 1 1 0 0 1 0 0 N2 X0 3 F 1 1 1 0 0 1 0 0 N2 X0 4 D 1 1 1 0 0 1 0 0 Fuel Discretes X0 D 0 1 1 1 0 0 1 0 0 N2 X1 0 A 1 1 1 0 0 1 0 0 Selected Actual Core Speed X1 0 B 1 1 1 0 0 1 0 0 Selected Actual Core Speed X1 3 A 1 1 1 0 0 1 0 0 N2 Speed X 1 1 1 0 0 1 0 0 HF DATA Radio/Data #2 - System Address Label X See Attachment 110 0 2 1 1 1 0 0 1 0 1 NDB Effectivity X0 1 A 1 1 1 0 0 1 0 1 Exhaust Gas Temperature X0 1 C 1 1 1 0 0 1 0 1 Exhaust Gas Temperature X0 2 9 1 1 1 0 0 1 0 1 Exhaust Gas Temperature X0 2 F 1 1 1 0 0 1 0 1 Exhaust Gas Temperature X0 3 3 1 1 1 0 0 1 0 1 Exhaust Gas Temperature X0 3 F 1 1 1 0 0 1 0 1 Exhaust Gas Temperature X0 4 D 1 1 1 0 0 1 0 1 Discretes Status 1&3 X0 D 0 1 1 1 0 0 1 0 1 EGT X0 A 1 1 1 0 0 1 0 1 Selected Exhaust Gas Temperature (Total) X1 0 B 1 1 1 0 0 1 0 1 Selected Exhaust Gas Temperature (Total) X1 3 A 1 1 1 0 0 1 0 1 EGT Trimmed X 1 1 1 0 0 1 0 1 Remote Data Concentrator - System Address Label X 3 4 2 3 4 3 3 4 4 3 4 5 3 4 1 ATTACHMENT 1-1LABEL CODES ARINC SPECIFICATION 429, PART 1 - Page 39 1 2 3 4 5 6 7 8 BNR BCD DISC SAL DataNotes & Cross Ref. to Tables in Att. 6 Code No. (Octal) Eqpt. ID (Hex) Transmission Order Bit PositionParameter 0 0 3 1 1 1 0 0 1 1 0 N1 Actual X0 1 A 1 1 1 0 0 1 1 0 N1 Actual X0 2 F 1 1 1 0 0 1 1 0 N1 Actual X0 3 3 1 1 1 0 0 1 1 0 N1 Actual X0 3 F 1 1 1 0 0 1 1 0 N1 Actual X0 4 D 1 1 1 0 0 1 1 0 Cable Cap-Hi-Z X0 D 0 1 1 1 0 0 1 1 0 N1 X1 0 A 1 1 1 0 0 1 1 0 Selected Actual Fan Speed X1 0 B 1 1 1 0 0 1 1 0 Selected Actual Fan Speed X1 3 A 1 1 1 0 0 1 1 0 N1 Speed Actual X0 1 8 1 1 1 0 0 1 1 1 Antenna Control X0 2 9 1 1 1 0 0 1 1 1 Fuel Flow (Engine) X0 3 0 1 1 1 0 0 1 1 1 Sector Control X0 3 5 1 1 1 0 0 1 1 1 Antenna Control X0 D 0 1 1 1 0 0 1 1 1 Fuel Flow X0 A 1 1 1 0 0 1 1 1 LPT Clearance Valve Position X1 0 B 1 1 1 0 0 1 1 1 LPT Clearance Valve Position X1 3 A 1 1 1 0 0 1 1 1 Fuel Flow X0 3 1 1 1 0 1 0 0 0 Maintenance Data #1 X0 0 4 1 1 1 0 1 0 0 0 IRS Maintenance Discrete X0 0 6 1 1 1 0 1 0 0 0 Maintenance Data #1 X0 0 B 1 1 1 0 1 0 0 0 GPS Test Word (manufacturer specific) X0 1 8 1 1 1 0 1 0 0 0 Maintenance Data #1 X0 1 9 1 1 1 0 1 0 0 0 CFDS Bite Fault Summary Word for HFDR X0 1 A 1 1 1 0 1 0 0 0 Maintenance Data #1 X0 1 C 1 1 1 0 1 0 0 0 Maintenance Data #1 X0 2 3 1 1 1 0 1 0 0 0 Maintenance Data #1 X0 2 4 1 1 1 0 1 0 0 0 MU Output Data Word Failure Status X0 2 5 1 1 1 0 1 0 0 0 Maintenance Data #1 X0 2 7 1 1 1 0 1 0 0 0 Maintenance Data #1 X0 2 9 1 1 1 0 1 0 0 0 Maintenance Data #1 X0 2 F 1 1 1 0 1 0 0 0 Maintenance Data #1 X0 3 2 1 1 1 0 1 0 0 0 Maintenance Data #1 X0 3 5 1 1 1 0 1 0 0 0 Maintenance Data #1 X0 3 8 1 1 1 0 1 0 0 0 IRS Maintenance Word #1 X0 3 D 1 1 1 0 1 0 0 0 Maintenance Data #1 X0 3 E 1 1 1 0 1 0 0 0 Maintenance Data #1 X0 3 F 1 1 1 0 1 0 0 0 Maintenance Data #1 X0 4 0 1 1 1 0 1 0 0 0 Maintenance Data #1 X0 4 D 1 1 1 0 1 0 0 0 Maintenance Data FQIS 1-3 X0 5 0 1 1 1 0 1 0 0 0 VDR Fault Summary Word X0 5 3 1 1 1 0 1 0 0 0 CFDS Bite Fault Summary Word for HFDR X0 5 5 1 1 1 0 1 0 0 0 ILS Maintenance Word X1 0 A 1 1 1 0 1 0 0 0 Maintenance Data #1 X1 0 B 1 1 1 0 1 0 0 0 Maintenance Data #1 X1 1 4 1 1 1 0 1 0 0 0 Fuel Density X1 1 5 1 1 1 0 1 0 0 0 Maintenance Data #1 X1 4 0 1 1 1 0 1 0 0 0 Maintenance Data #1 X1 4 4 1 1 1 0 1 0 0 0 CDTI Fault Summary Word X2 4 1 1 1 1 0 1 0 0 0 Maintenance Data #1 X3 4 1 1 1 1 0 1 0 0 0 Maintenance Data #1 X 3 4 6 3 4 7 3 5 0 ATTACHMENT 1-1LABEL CODES ARINC SPECIFICATION 429, PART 1 - Page 40 1 2 3 4 5 6 7 8 BNR BCD DISC SAL DataNotes & Cross Ref. to Tables in Att. 6 Code No. (Octal) Eqpt. ID (Hex) Transmission Order Bit PositionParameter 0 0 6 1 1 1 0 1 0 0 1 Maintenance Data #2 X0 0 B 1 1 1 0 1 0 0 1 SRU Test Word (manufacturer specific) X0 1 A 1 1 1 0 1 0 0 1 Maintenance Data #2 X0 1 C 1 1 1 0 1 0 0 1 Maintenance Data #2 X0 2 4 1 1 1 0 1 0 0 1 MU Output Data Word Failure Status X0 2 5 1 1 1 0 1 0 0 1 Maintenance Data #2 X0 2 9 1 1 1 0 1 0 0 1 Maintenance Data #2 X0 2 E 1 1 1 0 1 0 0 1 Maintenance Data #2 X0 2 F 1 1 1 0 1 0 0 1 Maintenance Data #2 X0 3 1 1 1 1 0 1 0 0 1 Maintenance Data #2 X0 3 8 1 1 1 0 1 0 0 1 IRS Maintenance Word #2 X0 3 F 1 1 1 0 1 0 0 1 Maintenance Data #2 X0 4 D 1 1 1 0 1 0 0 1 Maintenance Data FQIS 1&3 X0 5 5 1 1 1 0 1 0 0 1 MMR Maintenance Word X1 0 A 1 1 1 0 1 0 0 1 Maintenance Data #2 X1 0 B 1 1 1 0 1 0 0 1 Maintenance Data #2 X1 1 4 1 1 1 0 1 0 0 1 Inner Tank 1 Probe Capacitance X1 4 0 1 1 1 0 1 0 0 1 Maintenance Data #2 X0 1 A 1 1 1 0 1 0 1 0 Maintenance Data #3 X0 1 C 1 1 1 0 1 0 1 0 Maintenance Data #2 X0 2 4 1 1 1 0 1 0 1 0 Maintenance Word X0 2 5 1 1 1 0 1 0 1 0 Maintenance Data #2 X0 2 E 1 1 1 0 1 0 1 0 Maintenance Data #2 X0 2 F 1 1 1 0 1 0 1 0 Maintenance Data #2 X0 3 F 1 1 1 0 1 0 1 0 Maintenance Data #2 X0 4 D 1 1 1 0 1 0 1 0 Maintenance Data FQIS 1-4 X0 5 5 1 1 1 0 1 0 1 0 MLS Bite Status X1 0 A 1 1 1 0 1 0 1 0 Maintenance Data #2 X1 0 B 1 1 1 0 1 0 1 0 Maintenance Data #2 X1 1 4 1 1 1 0 1 0 1 0 Center, ACT & RCT Probe Capacitance X1 4 0 1 1 1 0 1 0 1 0 Maintenance Data #3 Flight Count X0 1 A 1 1 1 0 1 0 1 1 Maintenance Data #4 X0 1 C 1 1 1 0 1 0 1 1 Maintenance Data #4 X0 2 5 1 1 1 0 1 0 1 1 Maintenance Data #4 X0 2 F 1 1 1 0 1 0 1 1 Maintenance Data #4 X0 3 8 1 1 1 0 1 0 1 1 IRS Maintenance Word #3 X0 3 D 1 1 1 0 1 0 1 1 Maintenance Data #4 X0 3 F 1 1 1 0 1 0 1 1 Maintenance Data #4 X0 4 D 1 1 1 0 1 0 1 1 Maintenance Data FQIS 1-4 X0 D 0 1 1 1 0 1 0 1 1 Vibration X1 0 A 1 1 1 0 1 0 1 1 Maintenance Data #4 X1 0 B 1 1 1 0 1 0 1 1 Maintenance Data #4 X1 1 4 1 1 1 0 1 0 1 1 Inner Tank 1 Probe Capacitance X0 0 2 1 1 1 0 1 1 0 0 Maintenance Data #5 X0 1 A 1 1 1 0 1 1 0 0 Maintenance Data #5 X0 1 C 1 1 1 0 1 1 0 0 Maintenance Data #5 X0 2 F 1 1 1 0 1 1 0 0 Maintenance Data #5 X0 3 D 1 1 1 0 1 1 0 0 N1 Vibration X0 3 F 1 1 1 0 1 1 0 0 Maintenance Data #5 X0 4 D 1 1 1 0 1 1 0 0 FQIS Tank ID X0 5 6 1 1 1 0 1 1 0 0 Maintenance Data #50 6 0 1 1 1 0 1 1 0 0 Maintenance Data #50 B 1 1 1 0 1 1 0 0 Maintenance Data #5 X1 0 A 1 1 1 0 1 1 0 0 Maintenance Data #5 X1 0 B 1 1 1 0 1 1 0 0 Maintenance Data #5 X0 0 B 1 1 1 0 1 1 0 1 GNSS Fault Summary X0 2 7 1 1 1 0 1 1 0 1 MLS Maintenance Data X0 3 8 1 1 1 0 1 1 0 1 IRS Maintenance Word #4 X0 3 D 1 1 1 0 1 1 0 1 N2 Vibration X0 4 D 1 1 1 0 1 1 0 1 Maintenance Data FQIS 2-4 XX X X 1 1 1 0 1 1 0 1 Acknowledgement X 6-5/Note 1 3 5 2 3 5 3 3 5 4 3 5 5 3 5 1 ATTACHMENT 1-1LABEL CODES ARINC SPECIFICATION 429, PART 1 - Page 41 1 2 3 4 5 6 7 8 BNR BCD DISC SAL DataNotes & Cross Ref. to Tables in Att. 6 Code No. (Octal) Eqpt. ID (Hex) Transmission Order Bit PositionParameter 0 3 D 1 1 1 0 1 1 1 0 N3 Vibration XX X X 1 1 1 0 1 1 1 0 Maintenance ISO #5 Message X 6-3/Note 1Y Y Y 1 1 1 0 1 1 1 0 BITE Status Word X Note 10 0 2 1 1 1 0 1 1 1 1 ISO Alphabet #5 Message X 6-30 1 7 1 1 1 0 1 1 1 1 ISO Alphabet #5 Message X0 2 4 1 1 1 0 1 1 1 1 ISO Alphabet #5 Message X0 3 5 1 1 1 0 1 1 1 1 TCAS Intruder Data File X0 3 7 1 1 1 0 1 1 1 1 ISO Alphabet #5 Message X0 3 D 1 1 1 0 1 1 1 1 BB Vibration X0 4 D 1 1 1 0 1 1 1 1 Maintenance Data FQIS 2-3 X0 5 6 1 1 1 0 1 1 1 1 ISO Alphabet #5 Message0 5 A 1 1 1 0 1 1 1 1 Part Number (Manufacturer - Specific) X0 6 0 1 1 1 0 1 1 1 1 ISO Alphabet #5 Message0 0 2 1 1 1 1 0 0 0 0 Flight Information X 6-330 0 4 1 1 1 1 0 0 0 0 Potential Vertical Speed X0 0 5 1 1 1 1 0 0 0 0 Potential Vertical Speed X0 3 8 1 1 1 1 0 0 0 0 Potential Vertical Speed X0 3 D 1 1 1 1 0 0 0 0 N1 Rotor Imbalance Angle X0 5 6 1 1 1 1 0 0 0 0 Flight Information X0 6 0 1 1 1 1 0 0 0 0 Flight Information X1 0 A 1 1 1 1 0 0 0 0 Throttle Rate of Change X1 0 B 1 1 1 1 0 0 0 0 Throttle Rate of Change X1 4 2 1 1 1 1 0 0 0 0 RAIM Status Word X 1 1 1 1 0 0 0 0 ACESS - System Address Label X See Attachment 110 0 4 1 1 1 1 0 0 0 1 Altitude (Inertial) X0 0 5 1 1 1 1 0 0 0 1 Altitude (Inertial) X0 3 8 1 1 1 1 0 0 0 1 Altitude (Inertial) X0 3 D 1 1 1 1 0 0 0 1 LPT Rotor Imbalance Angle (737 only) X1 0 A 1 1 1 1 0 0 0 1 Derivative of Thrust vs. N1 X1 0 B 1 1 1 1 0 0 0 1 Derivative of Thrust vs. N1 X 1 1 1 1 0 0 0 1 EFIS - System Address Label X See Attachment 110 0 4 1 1 1 1 0 0 1 0 Along Track Horizontal Acceleration X0 3 8 1 1 1 1 0 0 1 0 Along Track Horizontal Acceleration X1 0 A 1 1 1 1 0 0 1 0 Derivative of Thrust vs. TLA X1 0 B 1 1 1 1 0 0 1 0 Derivative of Thrust vs. TLA X1 1 5 1 1 1 1 0 0 1 0 Range Rate X 1 1 1 1 0 0 1 0 PSS - System Address Label X See Attachment 110 0 4 1 1 1 1 0 0 1 1 Cross Track Acceleration X0 3 8 1 1 1 1 0 0 1 1 Cross Track Acceleration X1 0 A 1 1 1 1 0 0 1 1 Corrected Thrust X1 0 B 1 1 1 1 0 0 1 1 Corrected Thrust X 1 1 1 1 0 0 1 1 System Address Label for CSS X See Attachment 110 0 4 1 1 1 1 0 1 0 0 Vertical Acceleration X0 0 5 1 1 1 1 0 1 0 0 Vertical Acceleration X0 3 8 1 1 1 1 0 1 0 0 Vertical Acceleration X1 3 A 1 1 1 1 0 1 0 0 N1 APR Rating X 1 1 1 1 0 1 0 0 AES - System Address Label X See Attachment 110 0 4 1 1 1 1 0 1 0 1 Inertial Vertical Velocity (EFI) X0 0 5 1 1 1 1 0 1 0 1 Inertial Vertical Velocity (EFI) X0 3 8 1 1 1 1 0 1 0 1 Inertial Vertical Velocity (EFI) X1 3 A 1 1 1 1 0 1 0 1 N1 Max Reverse X 1 1 1 1 0 1 0 1 Engine Indication Unit - System Address Label X See Attachment 110 0 4 1 1 1 1 0 1 1 0 North-South Velocity X 6-2-10 3 8 1 1 1 1 0 1 1 0 North-South Velocity X1 3 A 1 1 1 1 0 1 1 0 IGV Position X 1 1 1 1 0 1 1 0 Multicast - System Address Label X See Attachment 110 0 4 1 1 1 1 0 1 1 1 East-West Velocity X0 3 8 1 1 1 1 0 1 1 1 East-West Velocity X1 3 A 1 1 1 1 0 1 1 1 EGV Request X 1 1 1 1 0 1 1 1 Bridge - System Address Label X See Attachment 110 0 4 1 1 1 1 1 0 0 0 g X0 0 5 1 1 1 1 1 0 0 0 g X0 0 B 1 1 1 1 1 0 0 0 GNSS Height WGS-84 (HAE) X0 2 5 1 1 1 1 1 0 0 0 Decision Height Selected (EFI) X0 C 5 1 1 1 1 1 0 0 0 Decision Height Selected (EFI) X0 0 0 1 1 1 1 1 0 0 1 General Aviation Equipment Identifier X See Attachment 9B3 7 1 3 6 2 3 6 3 3 6 4 3 6 5 3 6 6 3 6 7 3 7 0 3 5 6 3 5 7 3 6 0 3 6 1 ATTACHMENT 1-1LABEL CODES ARINC SPECIFICATION 429, PART 1 - Page 42 1 2 3 4 5 6 7 8 BNR BCD DISC SAL DataNotes & Cross Ref. to Tables in Att. 6 Code No. (Octal) Eqpt. ID (Hex) Transmission Order Bit PositionParameter 0 0 5 1 1 1 1 1 0 1 0 Wind Direction - Magnetic X1 0 A 1 1 1 1 1 0 1 0 Actual Fan Speed X1 0 B 1 1 1 1 1 0 1 0 Actual Fan Speed X 1 1 1 1 1 0 1 0 Cabin Terminal #3 - System Address Label X See Attachment 110 0 5 1 1 1 1 1 1 0 0 North-South Velocity - Magnetic X1 0 A 1 1 1 1 1 1 0 0 Actual Core Speed X1 0 B 1 1 1 1 1 1 0 0 Actual Core Speed X 1 1 1 1 1 1 0 0 Cabin Terminal #4 - System Address Label X See Attachment 110 0 5 1 1 1 1 1 1 0 0 East-West Velocity - Magnetic X1 0 A 1 1 1 1 1 1 0 0 Left Thrust Reverser Position X1 0 B 1 1 1 1 1 1 0 0 Left Thrust Reverser Position X 1 1 1 1 1 1 0 0 Cabin Terminal #1 - System Address Label X See Attachment 110 0 4 1 1 1 1 1 1 0 1 Along Heading Acceleration X0 0 5 1 1 1 1 1 1 0 1 Along Heading Acceleration X0 3 3 1 1 1 1 1 1 0 1 Spare DC1 X0 3 8 1 1 1 1 1 1 0 1 Along Heading Acceleration X1 0 A 1 1 1 1 1 1 0 1 Right Thrust Reverser Position X1 0 B 1 1 1 1 1 1 0 1 Right Thrust Reverser Position XX X X 1 1 1 1 1 1 0 1 GPS Differential Correction Word A X 1 1 1 1 1 1 0 1 Cabin Terminal #2 - System Address Label X See Attachment 110 0 4 1 1 1 1 1 1 1 0 Cross Heading Acceleration X0 0 5 1 1 1 1 1 1 1 0 Cross Heading Acceleration X0 3 3 1 1 1 1 1 1 1 0 Spare DC2 X0 3 8 1 1 1 1 1 1 1 0 Cross Heading Acceleration XX X X 1 1 1 1 1 1 1 0 GPS Differential Correction Word B X0 3 0 1 1 1 1 1 1 1 1 Equipment Identification XX X X 1 1 1 1 1 1 1 1 Equipment Identification X 6-17/Note 2 3 7 6 3 7 7 3 7 2 3 7 3 3 7 4 3 7 5 [1] XXX or YYY is applicable to all Equipment IDs. [2] The preferred SSM encoding method for the Equipment Identification Word is according to the Discrete word guidelines. When this label was originally assigned, it was recognized as a non-BNR word. The SSM encoding was according to the BCD and DISC guidelines that were identical at that time. During development of Supplement 4, the SSM for DISC was revised to it current form to provide enhanced failure warning. When the SSM encoding was changed, some systems retained the BCD encoding for the Equipment Identification word and others changed to DISC encoding. There are ARINC standards that are still active that have the SSM for Equipment Identification designated as BCD. You will need to check with the equipment manufacturer to determine the SSM format.

[3] The Label does not adhere to ARINC 429 Standard Signal Format and contains both BCD and BRN bit encoding depending on the selected mode. ARINC SPECIFICATION 429, PART 1 - Page 43 ATTACHMENT 1-2 EQUIPMENT CODES c-5 Equip ID (Hex) Equipment Type Equip ID (Hex) Equipment Type 000 Not Used 03A Propulsion Discrete Interface Unit c-11 001 Flight Control Computer (701) 03B Autopilot Buffer Unit c-6 002 Flight Management Computer (702) 03C Tire Pressure Monitoring System c-8 003 Thrust Control Computer (703) 03D Airborne Vibration Monitor (737/757/767) c-9 004 Inertial Reference System (704) 03E Center of Gravity Control Computer 005 Attitude and Heading Ref. System (705) 03F Full Authority EEC-B c-7 006 Air Data System (706) 040 Cockpit Printer (740) c-11 007 Radio Altimeter (707) 041 Satellite Data Unit 008 Airborne Weather Radar (708) 042 009 Airborne DME (709) 043 c-5 00A FAC (A310) 044 c-10 00B Global Positioning System (743) 045 00C 046 CTU c-7 00D AIDS Data Management Unit 047 Digital Flight Data Recorder c-14 00E 048 00F 049 010 Airborne ILS Receiver (710) 04A Landing Gear Position Interface Unit 011 Airborne VOR Receiver (711) 04B Main Electrical System Controller 012 Airborne ADF System (712) 04C Emergency Electrical System Controller c-9 013 04D Fuel Qty. Indicating System (757/767) 014 04E Fuel Qty.

Indicating System (747) c-10 015 04F 016 Airborne VHF COM (716) 050 VDR (750) c-14 017 DEFDARS-AIDS (717) 051 018 ATC Transponder (718) 052 019 Airborne HF/SSB System (719) 053 HF Data Unit c-5 01A Electronic Supervisory Control [1] 054 01B Digital Slat/Flap Computer (A310) 055 Multi-Mode Receiver (MMR) (755) 01C Engine Parameter Digitizer (Engine) 056 GNSS Navigation Landing Unit (GNLU)(756) 01D A/P & F/D Mode Control Panel (757/767) 057 Cockpit Voice Recorder (CVR) (757) 01E Performance Data Computer (Boeing 737) 058 c-16 01F Fuel Quantity Totalizer 059 020 DFS System (720) 05A Fuel Quan. Indicating System (A320/A321) 021 05B Cargo Smoke Detection Unit (A320) 022 05C Cabin Pressure Unit (A320) 023 Ground Prox. Warning System (723) 05D Zone Controller (A320) 024 ACARS (724) / CMU Mark 2 (758) 05E Cargo Heat (A320) 025 Electronic Flt. Instruments (725) 05F CIDS (A320) c-10 026 Flight Warning Computer (726) 060 GNSS Navigation Unit (GNU) (760) c-16 027 Microwave Landing System (727) 061 High-Speed Data Unit (HSDU) c-17 028 062 029 ADDCS (729) and EICAS 063 02A Thrust Management Computer 064 02B Perf. Nav. Computer System (Boeing 737) 065 c-6 02C Digital Fuel Gauging System (A310) 066 c-5 02D EPR Indicator (Boeing 757) 067 c-6 02E Land Rollout CU/Landing C & LU 068 02F Full Authority EEC-A 069 c-7 030 Airborne Separation Assurance System 06A AMU (A320) 031 Chronometer (731) 06B Battery Charge Limiter (A320) c-10 032 Pass. Entertainment Tape Reproducer (732) 06C Flt. Cont. Data Concentrator (A320) 033 Propulsion Multiplexer (PMUX)(733) 06D Landing Gear Prox. Control (A320) c-6 034 Fault Isolation & Detection System (734) 06E Brake Steering Unit (A320) 035 TCAS (735) 06F Bleed Air (A320) 036 Radio Management System (736) 070 037 Weight and Balance System (737) 071 038 ADIRS (738) 072 c-10 039 MCDU (739) 073 [1] “Electronic Engine Control” and “Power Management Control” are two other names for equipment identified by “1A”. ARINC SPECIFICATION 429, PART 1 - Page 44 ATTACHMENT 1-2 EQUIPMENT CODES Equip ID (Hex) Equipment Type Equip ID (Hex) Equipment Type 074 0B0 Airborne ILS Controller (710) 075 0B1 Airborne VOR Controller (711) 076 0B2 Airborne ADF Controller (712) 077 0B3 079 0B4 07A APU Engine Control Unit (A320) 0B5 07B Engine Interface Unit (A320) 0B6 VHF COM Controller (716) 07C FADEC Channel A (A320) 0B7 07D FADEC Channel B (A320) 0B8 ATC Transponder Controller (718) 07E Centralized Fault Data Interface Unit 0B9 HF/SSB System Controller (719) c-10 07F Fire Detection Unit (A320) 0BA Power Supply Module (B747-400) c-11 080 0BB Flap Control Unit (B747-400) c-16 081 Flap Slat Electronics Unit (B767-400) 082 0BC Fuel System Interface Card (B747-400) 083 0BD Hydraulic Quantity Monitor Unit (B747-400) 084 0BE Hydraulic Interface Module (B747-400) 085 0BF Window Heat Control Unit (B747-400) c-11 086 0C0 087 0C1 088 0C2 PVS Control Unit c-11 089 0C3 GPWS Controller (723) c-10 08A Window Heat Computer (A320) 0C4 A429W SDU Controller c-17 08B Probes Heat Computer (A320) 0C5 EFI Controller (725) 08C Avionics Cooling Computer (A320) 0C6 c-10 08D Fuel Flow Indicator (B747) 0C7 MLS Controller (727) 08E Surface Position Digitizer (B747-400) 0C8 c-14 c-11 08F Vacuum System Controller 0C9 090 0CA Brake Temperature Monitor Unit (B747-400) 091 0CB Autostart (B747-400) 093 0CC Brake System Control Unit (B747-400) 094 0CD Pack Temperature Controller (B747-400) 095 0CE EICAS/EFIC Interface Unit (B747-400) 096 0CF Para Visual Display Computer (B747-400) 097 0D0 Engine Instrument System (B737) c-11 098 0D1 099 0D2 09A 0D3 Thermal Monitoring Unit (General) c-14 09B 0D4 09C 0D5 TCAS Control Panel c-14 09D 0D6 09E 0D7 09F 0D8 0A0 0D9 0A1 FCC Controller (701) 0DA Prox. Switch Electronics Unit (B747-400) 0A2 FMC Controller (702) 0DB APU Controller (B747-400) 0A3 Thrust Rating Controller (703) 0DC Zone Temperature Controller (B747-400) 0A4 IRS Controller (704) 0DD Cabin Pressure Controller (B747-400) 0A5 0DE Windshear Computer (Sperry) 0A6 0DF Equipment Cooling Card (B747-400) c-11 0A7 0E0 Crew Rest Temp. Controller (B747-400) 0A8 Airborne WXR Controller (708) 0E1 0A9 Airborne DME Controller (709) 0E2 0AA Generator Control Unit (A320) 0E3 0AB Air Supply Control & Test Unit (B747-400) 0E4 c-11 0AC Bus Control Unit (B747-400) 0E5 c-10 0AD ADIRS Air Data Module 0E6 0AE Yaw Damper Module (B747-400) 0E7 c-11 0AF Stabilizer Trim Module (B747-400) 0E8 ARINC SPECIFICATION 429, PART 1 - Page 45 ATTACHMENT 1-2 EQUIPMENT CODES Equip ID (Hex) Equipment Type Equip ID (Hex) Equipment Type 0E9 123 Ground Power Control Unit (A330/A340) 0EA Misc. Environment Control (B747) 124 Fuel Management Computer (A330/A340) 0EB Fuel Jettison Control Card (B747) 125 Center of Gravity Fuel Control Comp.(A330/A340) 0EC Advance Cabin Entertainment Serv. Sys. 126 Circuit breakers Monitoring Unit (A330/A340) 0ED Fuel System Controller (MD-11) 127 Electrical Contractor Management Unit (A330/A340) 0EE Hydraulic System Controller (MD-11) 128 Hydraulic Electrical Generator Control Unit (A330/A340) c-11 0EF Environmental System Controller (MD-11) 129 Hydraulic System Monitoring Unit (A330/A340) c-12 0F0 12A Cargo Bay Conditioning Card (B747) 0F1 12B Predictive Windshear System Sensor c-11 0F2 12C Angle of Attack Sensor c-14 0F3 12D Logic Drive Control Computer (B747/B767) 0F4 12E Cargo Control Logic Unit (B767) 0F5 12F Cargo Electronics Interface Unit (B767) 0F6 130 Load Management Unit (LMU) Airbus c-16 0F7 131 0F8 132 0F9 133 0FA Misc. System controller (MD-11) 134 0FB Anti-Skid System (MD-11) 135 0FC Cabin Pressure Control Sys. (MD-11) 136 Audio Management System c-11 0FD Air Condition Control System (MD-11) 137 0FE Pneumatic Control System (MD-11) 138 c-11 0FF Manifold Failure Detection System (MD-11) 139 100 13A Full Authority Engine Control (P&W) c-14 101 13B Audio Entertainment System (AES) Controller (Boeing) c-16 102 13C Boarding Music Machine (B777) 103 13D Passenger In Flight Info Unit (Airshow) 104 13E Video Interface Unit (B777) c-14 105 13F Camera Interface Unit (A340/B777) 106 140 Supersonic Air Data Computer c-16 107 141 Satellite RF Unit c-11 108 Electronic Engine Control (EEC) Channel A (B737-700) 142 ADS-B Link Display Processor Unit (LPDU) c-16 109 Elect Eng Control (EEC) Channel B (B737-700) 143 Vertical/Horizontal Gyro c-16 10A Full Authority Engine Control A (GE) 144 CDTI Display Unit c-17 10B Full Authority Engine Control B (GE) 145 10C APU Controller 146 10D Data Loader 147 10E Fire Detection Unit (MD-11) 148 c-11 10F Auto Brake Unit (MD-11) 149 110 Multiplexer PES (A-320) 14A Slide Slip Angle (SSA) c-17 111 14B c-14 112 TACAN Adapter Unit (TAU) 14C 113 Stall Warning Card (B747-400) 14D 114 Fuel Unit Management System (A330/A340) 14E 115 TACAN 14F 116 Eng Interface Vibration Monitoring Unit (A330/A340) 150 AIMS Gen. Pur. Bus #1 (B777) 117 Engine Control Unit Channel A (A330/A340) 151 AIMS Gen. Pur. Bus #2 (B777) 118 Engine Control Unit Channel B (A330/A340) 152 AIMS Digital Comm.

Mgmt. (B777) 119 Centralized Maintenance Computer (A330/A340) 153 AIMS Gen. Pur. Bus #3 (B777) c-12 11A Multi-Disk Drive Unit (A330/A340) 154 Central Maintenance Computer (B-777) 11B 155 AIMS EFIS Control Panel (B777) 11C 156 AIMS Display Unit (B777) 11D 157 AIMS Cursor Control Device (B777) c-14 c-17 11E Integrated Static Probe 158 AIMS General Purpose Bus #4 c-16 11F 159 c-17 120 Multifunction Air Data Probe 15A Flight Data Interface Unit (A330/A340) 121 15B Flight Control Unit (A330/A340) c-16 122 Ground Auxiliary Power Unit (A320/319/321) 15C Flight Control Primary Computer (A330/A340) c-12 ARINC SPECIFICATION 429, PART 1 - Page 46 ATTACHMENT 1-2 EQUIPMENT CODES Equip ID (Hex) Equipment Type Equip ID (Hex) Equipment Type 15D Flight Control Secondary Computer (A330/A340) 19F Cade Environment System c-16 15E Flight Mgmt Guidance Env Comp (A330/A340) 1E2 ADS-B LDPU Controller c-17 c-12 15F 200 Versatile Integrated Avionics Unit (B717/MD-10) 160 Special Fuel Quan. Sys.

(Boeing) 201 Electronic Spoiler Control Unit (B717) 161 202 Brake Control Unit (B717) 162 203 Pneumatic Overheat Detection Unit (B717) 163 204 Proximity Switch Electronics Unit (B717) 164 205 APU Electronic Control Unit (B717) 165 206 Aircraft Interface Unit (MD-10) 166 207 Fuel Quantity Gauging Unit (MD-10) c-16 167 Air Traffic Service Unit (Airbus) 168 Integ Standby Instr System (A340/330,A320/319/321) 169 Data Link Control and Display Unit (A340/330) c-16 16A Display Unit (A330/A340) 16B Display Management Computer (A330/A340) 16C Head-Up Display Computer (A330/A340) 241 High Power Amplifier c-11 16D ECAM Control Panel (A330/A340) c-12 16E Clock (A330/A340) 16F Cabin Interphone System (B777) c-14 170 Radio Tuning Panel (B777) c-17 171 Electronic Flight Bag 172 173 341 Satellite ACU c-11 174 175 176 177 178 179 17A Cabin Ventilation Controller (A330/A340) 17B Smoke Detection Control Unit (A330/A340) 17C Proximity Sensor Control Unit (A330/A340) c-12 17D 17E 17F 180 181 182 183 184 185 186 187 188 189 18A Audio Control Panel (A330/A340) 18B Cockpit Voice recorder (A330/A340) 18C Passenger Entertainment Sys Main MUX (A330/A340) 18D Passenger Entertainment Sys Audio Repro.(A330/A340) 18E Pre-recorded Announcement Music Repro (A330/A340) 18F Video Control Unit (A330/A340) c-11 ARINC SPECIFICATION 429, PART 1 - Page 47 ATTACHMENT 2 DATA STANDARDS TABLE 1 - BCD DATA Label Eqpt ID (Hex) Parameter Name Units Range (Scale) SigBits Pos Sense Reso-lution Min Transit Interval(msec) 2 Max Transit Interval (msec) 2 Max Trans- port Delay (msec) 3 Notes & Cross Ref. to Tables and Attachments 0 0 1 0 0 2 Distance to Go N.M. ±3999.9 5 0.1 100 200 6-25 0 5 6 Distance to Go N.M. ±3999.9 5 0.1 100 200 0 6 0 Distance to Go N.M. ±3999.9 5 0.1 100 200 0 0 2 0 0 2 Time to Go Min 0-399.9 4 0.1 100 200 6-25 0 5 6 Time to Go Min 0-399.9 4 0.1 100 200 0 6 0 Time to Go Min 0-399.9 4 0.1 100 200 1 1 5 Time to Station Min 0-399.9 4 0.1 50 50 0 0 3 0 0 2 Cross Track Distance N.M. 0-399.9 4 0.1 100 200 6-25 0 0 4 0 0 1 Runway Distance to Go Feet 0-79900 3 100.0 100 200 0 1 0 0 0 2 Present Position - Latitude Deg:Min 180N-180S 6 N 0.1 250 500 Section 2.1.2 0 0 4 Present Position - Latitude Deg:Min 180N-180S 6 N 0.1 250 500 Section 2.1.2 0 3 8 Present Position - Latitude Deg:Min 180N-180S 6 N 0.1 250 500 0 1 1 0 0 2 Present Position - Longitude Deg:Min 180E-180W 6 E 0.1 250 500 0 0 4 Present Position - Longitude Deg:Min 180E-180W 6 E 0.1 250 500 0 3 8 Present Position - Longitude Deg:Min 180E-180W 6 E 0.1 250 500 0 1 2 0 0 2 Ground Speed Knots 0-7000 4 1.0 250 500 6-25 0 0 4 Ground Speed Knots 0-7000 4 1.0 250 500 0 4 D Qty-LD SEL (LB) Lbs. 0-79999 5 1.0 0 0 5 Ground Speed Knots 0-7000 4 1.0 250 500 0 2 5 Ground Speed Knots 0-7000 4 1.0 125 250 0 3 8 Ground Speed Knots 0-7000 4 1.0 250 500 0 5 6 Ground Speed Knots 0-7000 4 1.0 250 500 0 6 0 Ground Speed Knots 0-7000 4 1.0 250 500 0 1 3 0 0 2 Track Angle - True Deg 0-359.9 4 0.1 250 500 6-25 0 0 4 Track Angle - True Deg 0-359.9 4 0.1 250 500 0 4 D Qty-Flt. Deck (LB) Lbs. 0-79999 5 1.0 0 3 8 Track Angle - True Deg 0-359.9 4 0.1 250 500 0 1 4 0 0 4 Magnetic Heading Deg 0-359.9 4 0.1 250 500 0 0 5 Magnetic Heading Deg 0-359.9 4 0.1 250 500 0 3 8 Magnetic Heading Deg 0-359.9 4 0.1 250 500 0 1 5 0 0 2 Wind Speed Knots 0-799 3 1.0 250 500 0 0 4 Wind Speed Knots 0-799 3 1.0 250 500 0 0 5 Wind Speed Knots 0-799 3 1.0 250 500 0 3 8 Wind Speed Knots 0-799 3 1.0 250 500 0 1 6 0 0 4 Wind Direction - True Deg 0-359 3 1.0 250 500 0 3 8 Wind Direction - True Deg 0-359 3 1.0 250 500 0 1 7 0 1 0 Selected Runway Heading Deg 0-359.9 4 0.1 250 500 0 4 D Total-Flt. Deck (LB) Lbs. 0-79999 5 1.0 0 5 5 Selected Runway Heading Deg 0-359.9 4 0.1 A 0 Selected Runway Heading Deg 0-359.9 4 0.1 167 333 0 B 0 Selected Runway Heading Deg 0-359.9 4 0.1 167 333 0 2 0 0 2 0 Selected Vertical Speed Ft/Min ±6000 4 1.0 100 200 6-25 0 4 D Tnk-LD SEL (LB) Lbs. 0-79999 5 1.0 0 A 1 Selected Vertical Speed Ft/Min ±6000 4 Up 1.0 100 200 0 2 1 0 0 2 Selected EPR EPR 0-3 4 0.001 100 200 0 0 2 Selected N1 RPM 0-3000 4 1 100 200 0 2 0 Selected EPR EPR 0-3 4 0.001 100 200 0 2 0 Selected N1 RPM 0-3000 4 1 100 200 0 A 1 Selected EPR EPR 0-3 3 0.001 100 200 ARINC SPECIFICATION 429, PART 1 - Page 48 ATTACHMENT 2 DATA STANDARDS TABLE 1 - BCD DATA Label Eqpt ID (Hex) Parameter Name Units Range (Scale) SigBits Pos Sense Reso-lution Min Transit Interval(msec) 2 Max Transit Interval (msec) 2 Max Trans- port Delay (msec) 3 Notes & Cross Ref. to Tables and Attachments 0 A 1 Selected N1 RPM 0-3000 4 1 100 200 0 2 2 0 2 0 Selected Mach Mach 0-4 4 0.001 100 200 0 4 D Qty-LD SEL (KG) Kg 0-79999 5 1.0 0 A 1 Selected Mach Mach 0-4 4 0.001 100 200 0 2 3 0 2 0 Selected Heading Deg 0-359 3 1.0 100 200 6-25 0 4 D Qty-Flt Deck (KG) Kg 0-79999 5 1.0 0 A 1 Selected Heading Deg 0-359 3 1.0 100 200 0 2 4 0 1 1 Selected Course #1 Deg 0-359 3 1.0 167 333 6-25 0 2 0 Selected Course #1 Deg 0-359 3 1.0 167 333 0 A 1 Selected Course #1 Deg 0-359 3 1.0 167 333 0 B 1 Selected Course #1 Deg 0-359 3 1.0 167 333 0 2 5 0 2 0 Selected Altitude Feet 0-50000 5 1.0 100 200 6-25 0 A 1 Selected Altitude Feet 0-50000 5 1.0 100 200 0 2 6 0 0 3 Selected Airspeed Knots 30-450 3 1.0 100 200 6-25 0 2 0 Selected Airspeed Knots 30-450 3 1.0 100 200 0 A 1 Selected Airspeed Knots 30-450 3 1.0 100 200 0 2 7 0 0 2 TACAN Selected Course Deg 0-359 3 1.0 167 333 0 1 1 Selected Course #2 Deg 0-359 3 1.0 167 333 0 2 0 Selected Course #2 Deg 0-359 3 1.0 167 333 0 4 D Total-Flt Deck (KG) Kg 0-79999 5 1.0 0 5 6 TACAN Selected Course Deg 0-359 3 1.0 167 333 0 6 0 TACAN Selected Course (BCD) Deg 0-359 3 1.0 167 333 0 A 1 Selected Course #2 Deg 0-359 3 1.0 167 333 0 B 1 Selected Course #2 Deg 0-359 3 1.0 167 333 0 3 0 0 2 0 VHF COM Frequency See Chapter 3 100 200 6-45 0 2 4 VHF COM Frequency See Chapter 3 100 200 0 4 D TNK-LD SEL (KG) Kg 0-79999 5 1.0 0 B 6 VHF COM Frequency See Chapter 3 100 200 0 3 1 0 2 0 Beacon Transponder Code See Chapter 3 100 200 6-46 0 B 8 Beacon Transponder Code See Chapter 3 100 200 0 3 2 0 1 2 ADF Frequency See Chapter 3 100 200 6-40 0 2 0 ADF Frequency See Chapter 3 100 200 0 B 2 ADF Frequency See Chapter 3 100 200 0 3 3 0 0 2 ILS Frequency See Chapter 3 167 333 6-44 0 1 0 ILS Frequency See Chapter 3 167 333 0 2 0 ILS Frequency See Chapter 3 167 333 0 5 6 ILS Frequency See Chapter 3 167 333 0 6 0 ILS Frequency See Chapter 3 167 333 0 B 0 ILS Frequency See Chapter 3 167 333 0 3 4 0 0 2 VOR/ILS Frequency See Chapter 3 167 333 6-44-1 0 0 6 Baro Correction (mb) #3 mb 745-1050 5 0.1 62.5 125 0 1 1 VOR/ILS Frequency See Chapter 3 167 333 0 2 0 VOR/ILS Frequency See Chapter 3 167 333 0 5 6 VOR/ILS Frequency See Chapter 3 167 333 0 6 0 VOR/ILS Frequency #1 See Chapter 3 167 333 0 B 0 VOR/ILS Frequency See Chapter 3 167 333 0 3 5 0 0 2 DME Frequency See Chapter 3 100 200 6-41 0 0 6 Baro Correction (ins of Hg) #3 ins Hg 22-31 5 0.001 62.5 125 0 0 9 DME Frequency See Chapter 3 100 200 0 2 0 DME Frequency See Chapter 3 100 200 ARINC SPECIFICATION 429, PART 1 - Page 49 ATTACHMENT 2 DATA STANDARDS TABLE 1 - BCD DATA Label Eqpt ID (Hex) Parameter Name Units Range (Scale) SigBits Pos Sense Reso-lution Min Transit Interval(msec) 2 Max Transit Interval (msec) 2 Max Trans- port Delay (msec) 3 Notes & Cross Ref. to Tables and Attachments 0 5 5 Paired DME Frequency MHz 108-135.9 4 0.05 0 5 6 DME Frequency See Chapter 3 100 200 0 6 0 DME Frequency See Chapter 3 100 200 0 A 9 DME Frequency See Chapter 3 100 200 0 3 6 0 0 2 MLS Frequency See Chapter 3 100 200 0 2 0 MLS Frequency See Chapter 3 100 200 0 5 5 MLS Channel Selection 500-600 3 1 0 5 6 MLS Frequency Channel See Chapter 3 100 200 0 6 0 MLS Frequency Channel See Chapter 3 100 200 0 C 7 MLS Frequency See Chapter 3 100 200 0 3 7 0 2 0 HF COM Frequency See Chapter 3 100 200 6-42 0 B 9 HF COM Frequency See Chapter 3 100 200 0 4 1 0 0 2 Set Latitude Deg/Min 180N/180S 6 N 0.1 250 500 0 0 4 Set Latitude Deg/Min 180N/180S 6 N 0.1 250 500 0 2 0 Set Latitude Deg/Min 180N/180S 6 N 0.1 250 500 0 5 6 Set Latitude Deg/Min 180N/180S 6 N 0.1 250 500 0 6 0 Set Latitude Deg/Min 180N/180S 6 N 0.1 250 500 0 A 4 Set Latitude Deg/Min 180N/180S 6 N 0.1 250 500 0 4 2 0 0 2 Set Longitude Deg/Min 180E/180W 6 E 0.1 250 500 0 0 4 Set Longitude Deg/Min 180E/180W 6 E 0.1 250 500 0 2 0 Set Longitude Deg/Min 180E/180W 6 E 0.1 250 500 0 5 6 Set Longitude Deg/Min 180E/180W 6 E 0.1 250 500 0 6 0 Set Longitude Deg/Min 180E/180W 6 E 0.1 250 500 0 A 4 Set Longitude Deg/Min 180E/180W 6 E 0.1 250 500 0 4 3 0 0 2 Set Magnetic Heading Deg 0-359 3 1.0 250 500 0 0 4 Set Magnetic Heading Deg 0-359 3 1.0 250 500 0 2 0 Set Magnetic Heading Deg 0-359 3 1.0 250 500 0 5 6 Set Magnetic Heading Deg 0-359 3 1.0 250 500 0 6 0 Set Magnetic Heading Deg 0-359 3 1.0 250 500 0 A 4 Set Magnetic Heading Deg 0-359 3 1.0 250 500 0 4 4 0 0 4 True Heading Deg 0-359.9 4 0.1 250 500 0 3 8 True Heading Deg 0-359.9 4 0.1 250 500 0 4 5 0 0 3 Minimum Airspeed Knots 0-259.9 4 0.1 62.5 125 0 4 6 0 3 3 Engine Serial No. (LSDs) 500 1000 6-15 1 0 A Engine Serial No. (LSDs) 500 1000 6-15 1 0 B Engine Serial No. (LSDs) 500 1000 6-15 0 4 7 0 2 0 VHF Com Frequency See Chap. 3 100 200 0 2 4 VHF Com Frequency See Chap. 3 100 200 0 3 3 Engine Serial No. (MSDs) 500 1000 6-16 1 0 A Engine Serial No. (MSDs) 500 1000 6-16 1 0 B Engine Serial No. (MSDs) 500 1000 6-17 0 B 6 VHF Com Frequency See Chap. 3 100 200 0 5 2 0 3 7 Long. Zero Fuel CG % MAC 0-100.00 5 0.01 100 200 0 5 3 0 0 5 Track Angle-Magnetic Deg 0-359 3 1.0 250 500 0 5 6 0 0 2 Estimated Time of Arrival Hr:Min 0-23.59.9 5 0.1 250 500 0 0 5 Wind Direction - Magnetic Deg 0-359 3 1.0 250 500 0 3 7 Gross Weight (Kilograms) 100 kg 0-19999 5 1.0 100 200 0 5 6 ETA (Active Waypoint) Hr:Min 0-23.59.9 5 0.1 250 500 0 6 0 ETA (Active Waypoint) Hr:Min 0-23.59.9 5 0.1 250 500 ARINC SPECIFICATION 429, PART 1 - Page 50 ATTACHMENT 2 DATA STANDARDS TABLE 1 - BCD DATA Label Eqpt ID (Hex) Parameter Name Units Range (Scale) SigBits Pos Sense Reso-lution Min Transit Interval(msec) 2 Max Transit Interval (msec) 2 Max Trans- port Delay (msec) 3 Notes & Cross Ref. to Tables and Attachments 0 6 0 0 2 5 S/G Hardware Part Number 4 6-36 0 3 7 Tire Loading (Left Body Main) % 0-299.9 4 0.1 100 200 0 6 1 0 2 5 S/G Software Config. Part No. 4 6-37 0 3 7 Tire Loading (Right Body Main) % 0-299.9 4 0.1 100 200 0 6 2 0 3 7 Tire Loading (Left Wing Main) % 0-299.9 4 0.1 100 200 0 6 3 0 3 7 Tire Loading (Right Wing Main) % 0-299.9 4 0.1 100 200 0 6 4 0 3 7 Tire Loading (Nose) % 0-299.9 4 0.1 100 200 0 6 5 0 0 3 Gross Weight 100 lb. 0-12000 5 1.0 100 200 0 3 7 Gross Weight 100 lb. 0-19999 5 1.0 100 200 0 6 6 0 0 2 Longitudinal Center of Gravity % MAC 0-100.00 5 0.01 500 1000 0 3 7 Longitudinal Center of Gravity % MAC 0-100.00 5 0.01 100 200 0 6 7 0 3 7 Lateral Center of Gravity % MAC 0-100.00 5 0.01 100 200 1 2 5 0 0 2 Universal Time Coordinate Hr-Min 0-23.59.9 4 0.1 100 200 6-25 0 0 B UTC Hr:Min 0-23:59.9 5 0.1 200 1200 0 3 1 Universal Time Coordinate Hr:Min 0-23.59.9 5 0.1 100 200 0 5 6 Universal Time Coordinate Hr-Min 0-23.59.9 4 0.1 100 200 0 6 0 Universal Time Coordinate (UTC) Hr-Min 0-23.59.9 4 0.1 100 200 1 3 5 0 5 A ACT 1 Fuel Quan. Display Kg/Lb 0-9999 4 100 100 200 1 3 6 0 5 A ACT 2 Fuel Quan. Display Kg/Lb 0-9999 4 100 100 200 1 3 7 0 5 A Center+Act1+Act2 FQ Display Kg/Lb 0-9999 4 100 100 200 1 4 0 0 5 A Actual Fuel Quan. Display Kg/Lb 0-9999 4 100 100 200 1 4 1 0 5 A Preselect Fuel Quan. Display Kg/Lb 0-9999 4 100 100 200 1 4 2 0 5 A Left Wing Fuel Quan. Display Kg/Lb 0-9999 4 100 100 200 1 4 3 0 5 A Center Wing Fuel Quan. Display Kg/Lb 0-9999 4 100 100 200 1 4 4 0 5 A Right Wing Fuel Quan. Display Kg/Lb 0-9999 4 100 100 200 1 5 5 0 2 7 MLS Selected GP Angle Deg 0-359.9 4 0.1 100 200 1 5 7 1 1 4 Trim Tank Probe Capacitance pf 0-400 4 1.0 1 6 3 0 3 7 Zero Fuel Weight (lb) Lbs. 0-19999 5 1.0 100 200 1 6 5 0 0 7 Radio Height Feet ±7999.9 5 0.1 25 200 6-25 1 7 0 0 2 5 Decision Height Selected (EFI) Feet ±7000 4 1.0 100 200 6-25 0 C 5 Decision Height Selected (EFI) Feet ±7000 4 1.0 100 200 2 0 0 0 0 2 Drift Angle Deg ±180 4 0.1 100 200 0 0 4 Drift Angle Deg ±180 4 0.1 100 200 0 0 5 Drift Angle Deg ±180 4 0.1 100 200 0 6 0 Drift Angle Deg ±180 4 0.1 100 200 ARINC SPECIFICATION 429, PART 1 - Page 51 ATTACHMENT 2 DATA STANDARDS TABLE 1 - BCD DATA Label Eqpt ID (Hex) Parameter Name Units Range (Scale) SigBits Pos Sense Reso-lution Min Transit Interval(msec) 2 Max Transit Interval (msec) 2 Max Trans- port Delay (msec) 3 Notes & Cross Ref. to Tables and Attachments 2 0 1 0 0 9 DME Distance N.M. -1-399.99 5 0.01 83.3 167 6-1-1 1 1 2 TACAN Distance N.M. 0-399.99 5 0.01 190 210 1 1 5 DME Distance N.M. 0-399.99 5 0.01 50 50 2 0 5 0 0 2 HF COM Freq (New Format) 0 B 9 HF COM Freq (New Format) 2 0 7 0 2 5 Operational Software Parts 4 6-37 2 3 0 0 0 6 True Airspeed Knots 100-599 3 1.0 250 500 6-25 0 3 8 True Airspeed Knots 100-599 3 1.0 250 500 2 3 1 0 0 6 Total Air Temperature Deg C -060+099 3 1.0 250 500 0 3 8 Total Air Temperature Deg C -060+099 3 1.0 250 500 1 1 4 Inner 2 Tank Probe Capacitance pf 0-400 4 1.0 2 3 2 0 0 4 Altitude Rate Ft/Min ±20000 4 Up 10.0 31.3 62.5 6-25 0 0 5 Altitude Rate Ft/Min ±20000 4 Up 10.0 31.3 62.5 0 0 6

Altitude Rate Ft/Min ±20000 4 Up 10.0 31.3 62.5 1 1 4 Inner 4 Tank Probe Capacitance pf 0-400 4 1.0 2 3 3 0 0 6 Static Air Temperature Deg C -099 to +060 3 1.0 250 500 6-25 0 3 8 Static Air Temperature Deg C -099 to +060 3 1.0 250 500 1 1 4 Right Outer Probe Capacitance pf 0-400 4 1.0 2 3 4 0 0 6 Baro Correction (mb) #1 mb 745-1050 5 0.1
62.5 125 0 3 8 Baro Correction (mb) #1 mb 745-1050 5 0.1 62.5 125 2 3 5 0 0 6 Baro Correction (ins of Hg) #1 ins Hg 22-31 5 0.001 62.5 125 6-25 0 3 8 Baro Correction (ins of Hg) #1 ins Hg 22-31 5 0.001 62.5 125 6-25 2 3 6 0 0 6 Baro Correction (mb) #2 mb 745-1050 5 0.1 62.5 125 0 3 8 Baro Correction (mb) #2 mb 745-1050 5 0.1 62.5 125 2 3 7
0 0 6 Baro Correction (ins of Hg) #2 ins Hg 22-31 5 0.001 62.5 125 0 3 8 Baro Correction (ins of Hg) #2 ins Hg 22-31 5 0.001 62.5 125 2 4 3 0 3 7 Zero Fuel Weight (kg) Kg 0-19999 5 1.0 100 200 2 6 0 0 0 2 Date/Flight Leg N/A 500 1000 0 0 B Date dd:mo:yr dd:mm:yr 6 4 0 3 1 Date N/A 100 200 6-18 0 5 6 Date/Flight Leg N/A 500 1000 0 6 0
Date/Flight Leg N/A 500 1000 0 A 2 Date/Flight Leg N/A 500 1000 2 6 1 0 0 2 Flight Number N/A 0-9999 4 1.0 500 1000 6-9 0 A 2 Flight Number N/A 0-9999 4 1.0 500 1000 0 5 6 Flight Number N/A 0-9999 4 1.0 500 1000 0 6 0 Flight Number N/A 0-9999 4 1.0 500 1000 2 7 2 0 5 A Fuel Density Kg/cu.m. 0-9999 4 0.0001 100 200 ARINC 429 P2 2 7 3 0
5 A Sensor Values Left Wing Tank pF 0-100 3 100 200 2 7 4 0 5 A Sensor Values Center Wing Tank pF 0-100 3 0.1 100 200 2 7 5 0 5 A Sensor Values Right Wing Tank pF 0-100 3 0.1 100 200 3 4 5 0 0 2 NDB Effectivity 1000 3 5 0 1 1 4 Fuel Density kg/l 0-.999 4 0.01 ARINC 429 P2 ARINC SPECIFICATION 429, PART 1 - Page 52 ATTACHMENT 2
DATA STANDARDS TABLE 1 - BCD DATA Label Eqpt ID (Hex) Parameter Name Units Range (Scale) SigBits Pos Sense Reso-lution Min Transit Interval(msec) 2 Max Transit Interval (msec) 2 Max Trans- port Delay (msec) 3 Notes & Cross Ref.

to Tables and Attachments 3 5 1 1 1 4 Inner Tank 1 Probe Capacitance pf 0-400 3 0.1 ARINC 429 P2 3 5 2 1 1 4 Center, ACT &RCT Probe Capac. pf 0-400 3 0.1 ARINC 429 P2 3 5 3 1 1 4 Inner Tank 3 Probe Capacitance pf 0-400 3 0.1 ARINC 429 P2 ARINC SPECIFICATION 429, PART 1 - Page 53 ATTACHMENT 2 DATA STANDARDS TABLE 2 - BNR
DATA Label Eqpt ID (Hex) Parameter Name Units Range (Scale) SigBits Pos Sense Resolution Min Transit Interval (msec) 2 Max Transit Interval (msec) 2 Max Trans- port Delay (msec) 3 Notes & Cross Ref.

to Tables and Attachments 0 0 5 0 D 0 Engine Discrete Bit 11-Chan. A/ Bit 12-Chan. B 0 2 5 0 4 D Load SEL Control NA 204700 11 100 0 3 4 0 2 5 VOR/ILS Frequency 125 250 0 3 5 0 2 5 DME Frequency 125 250 0 5 2 0 0 4 Body Pitch Acceleration Deg/Sec2 ± 64 15 0.002 50 Hz 117 Hz 0 3 8 Body Pitch Acceleration Deg/Sec2 ± 64 15 0.002 50 Hz
117 Hz 0 5 3 0 0 4 Body Roll Acceleration Deg/Sec2 ± 64 15 0.002 50 Hz 117 Hz 0 3 8 Body Roll Acceleration Deg/Sec2 ± 64 15 0.002 50 Hz 117 Hz 0 5 4 0 0 4 Body Yaw Acceleration Deg/Sec2 ± 64 15 0.002 50 Hz 117 Hz 0 3 7 Zero Fuel Weight (Kg) Kg 655360 15 20 100 200 0 3 8 Body Yaw Acceleration Deg/Sec2 ± 64 15 0.002 50 Hz 117 Hz 0 6 0
0 3 C Tire Pressure (Left Outer) PSIA 1024 10 1.0 50 250 0 6 1 0 0 2 ACMS Information 6-29 0 0 B Pseudo Range Meters ± 268435456 20 256 200 1200 0 3 C Tire Pressure (Left Inner) PSIA 1024 10 1.0 50 250 0 5 6 ACMS Information 0 6 0 ACMS Information 0 6 2 0 0 2 ACMS Information 6-29 0 0 B Pseudo Rang Fine Meters 256 11 0.125 200 1200
0 3 C Tire Pressure (Right Inner) PSIA 1024 10 1.0 50 250 0 5 6 ACMS Information 0 6 0 ACMS Information 0 6 3 0 0 2 ACMS Information 6-29 0 0 B Range Rate M/S ± 4096 20 0.0039 200 1200 0 3 C Tire Pressure (Right Outer) PSIA 1024 10 1.0 50 250 0 5 6 ACMS Information 0 6 0 ACMS Information 0 6 4 0 0 B Delta Range Meters ± 4096 20
0.0039 200 1200 0 3 C Tire Pressure (Nose) PSIA 1024 10 1.0 50 250 0 6 5 0 0 B SV Position X Meters ±67108864 20 64 200 1200 0 6 6 0 0 B SV Position X Fine Meters 64 14 0.0039 200 1200 0 7 0 0 0 2 Reference Airspeed (Vref) Knots 512 11 0.25 500 1000 1000 0 0 B SV Position X Meters ±67108864 20 64 200 1200 0 2 9 AC Frequency (Engine)
Hz 512 11 0.25 100 200 0 3 7 Hard Landing Magnitude #1 Lbs. 12 - 100 200 0 5 6 Reference Airspeed (Vref) Knots 512 11 0.25 500 1000 1000 0 6 0 Reference Airspeed (Vref) Knots 512 11 0.25 500 1000 1000 0 C C Brakes - Metered Hyd. Pres.

L (Normal) PSIG 4096 12 1 50 100 #1 & 2 coded in SDI 0 7 1 0 0 2 Take-Off Climb Airspeed (V2) Knots 512 11 0.25 500 1000 50 0 0 B SV Position Y Fine Meters 64 14 0.0039 200 1200 0 2 9 AC Frequency (Engine) Hz 512 11 0.25 100 200 0 3 3 VBV Deg 64 12 0.016 150 250 0 3 7 Hard Landing Magnitude #2 Lbs.

12 - 100 200 0 C C Brakes-Metered Hyd.Pres.L (alt.) PSIG 4096 12 1 50 100 #1 & 2 coded in SDI ARINC SPECIFICATION 429, PART 1 - Page 54 ATTACHMENT 2 DATA STANDARDS TABLE 2 - BNR DATA Label Eqpt ID (Hex) Parameter Name Units Range (Scale) SigBits Pos Sense Resolution Min Transit Interval (msec) 2 Max Transit Interval (msec)
2 Max Trans- port Delay (msec) 3 Notes & Cross Ref. to Tables and Attachments 0 7 2 0 0 2 Rotation Speed (VR) Knots 512 11 0.25 500 1000 1000 Revised by Supp 11 0 0 B SV Position Z Meters ±67108864 20 64 200 1200 0 1 C Stator Vane Angle Deg/180 ±180 11 0.1 100 200 0 2 9 AC Voltage (Engine) Volts 256 10 0.25 100 200 0 2 F Stator Vane
Angle Deg/180 ±180 11 0.1 100 200 0 3 3 Stator Vane Angle Deg 64 12 0.016 150 250 See Note [4] 0 C C Brakes-Metered Hyd.Pres.R (normal) PSIG 4096 12 1 50 100 #1 &2 coded in SDI 0 7 3 0 0 2 V1 (critical engine failure speed) Knots 512 11 0.25 100 200 0 0 B SV Position Z Fine Meters 64 14 0.0039 200 1200 0 1 C Oil Quantity cc 32768 8 128
100 200 0 2 9 Oil Quantity US Pint 128 9 0.25 100 200 0 A 2 V2 (critical engine failure speed) Knots 512 11 0.25 100 200 0 C C Brakes-Metered Hyd.Pres.R (alt.) PSIG 4096 12 1 50 100 #1 & 2 coded in SDI 0 D 0 Engine Oil Quantity US Pint 128 9 0.25 SDI 1=L/SDI 2=R 0 7 4 0 0 2 Zero Fuel Weight Lbs. 1310720 15 40 500 1000 1000 0 0 B UTC
Measure Time Seconds 10.0 20 9.536743μs 200 1200 0 2 C Zero Fuel Weight Lbs. 1310720 15 40 100 400 0 3 3 LP Compressor Bleed Pos. (3.0) Inches 4 10 0.004 100 200 See Note [5] 0 3 7 Zero Fuel Weight (lb) Lbs. 1310720 15 40 100 200 0 5 6 Zero Fuel Weight Lbs. 1310720 15 40 500 1000 1000 0 6 0 Zero Fuel Weight Lbs. 1310720 15 40 500
1000 1000 1 1 4 Zero Fuel Weight Lbs. 1310720 15 40 100 400 0 7 5 0 0 2 Gross Weight Lbs. 1310720 15 40 100 200 0 0 3 Gross Weight Lbs. 1310720 15 40 100 200 0 0 B Geodetic Altitude Feet 131072 17 1.0 500 1000 0 2 9 AC Voltage (Alt. Sources) Volts 256 10 0.25 100 200 0 2 C Gross Weight Lbs. 1310720 15 40 100 200 0 3 7 Gross Weight
Lbs. 1310720 15 40 100 200 0 3 E Gross Weight Lbs. 1310720 15 40 100 200 1 1 4 Aircraft Gross Weight Lbs. 1310720 15 40 100 400 0 7 6 0 0 B GPS Height Above Ref.Ellipsoid Feet 131072 17 1.0 25 50 0 0 B GNSS Altitude (Msl) Feet ±131072 20 0.125 200 1200 0 2 9 AC Voltage (Bus Bar) Volts 256 10 0.25 100 200 0 3 7 Longitudinal Center of
Gravity % MAC 163.84 14 0.01 100 200 0 3 E Longitudinal Center of Gravity % 164 14 0.01 100 200 1 1 4 Aircraft Longitudinal Center of Gravity Percent 163.84 14 0.01 100 200 0 7 7 0 - - Lateral Center of Gravity MLb-in 128 17 0.001 100 200 0 0 2 Target Airspeed Knots 512 11 0.25 100 200 0 0 B GPS Hor/Vert Deviation % F.S. 128 8 0.8 25 50
Revised by Supp 11 0 2 9 AC Load (Engine) % 256 8 1.0 100 200 0 3 7 Lateral Center of Gravity % MAC 131.072 17 0.01 100 200 0 5 6 Target Airspeed Knots 512 11 0.25 100 200 0 6 0 Target Airspeed Knots 512 11 0.25 100 200 1 1 4 Zero Fuel Center of Gravity Percent 163.84 14 0.01 100 200 1 0 0 0 0 1 Selected Course #1 Deg/180 ±180 12 0.05
167 333 6-27 0 0 2 Selected Course #1 Deg/180 ±180 12 0.05 167 333 0 1 1 Selected Course #1 Deg/180 ±180 12 0.05 167 333 0 2 0 Sleected Course #1 Deg/180 ±180 12 0.05 167 333 0 2 9 AC Load (Alt. Source) % 128 8 1.0 100 200 0 5 6 Selected Course #1 Deg/180 ±180 12 0.05 167 333 0 6 0 Selected Course #1 Deg/180 ±180 12 0.05 167 333
0 3 7 Gross Weight (Kilogram) Kilograms 655360 15 20 100 200 0 A 1 Selected Course #1 Deg/180 ±180 12 0.05 167 333 0 B 1 Selected Course #1 Deg/180 ±180 12 0.05 167 333 0 B B Outboard Flaps - PDU Deg/180 ±180 12 0.05 20 100 1 0 1 0 0 2 Selected Heading Deg/180 ±180 12 0.05 31.3 62.5 ARINC SPECIFICATION 429, PART 1 - Page 55
ATTACHMENT 2 DATA STANDARDS TABLE 2 - BNR DATA Label Eqpt ID (Hex) Parameter Name Units Range (Scale) SigBits Pos Sense Resolution Min Transit Interval (msec) 2 Max Transit Interval (msec) 2 Max Trans- port Delay (msec) 3 Notes & Cross Ref. to Tables and Attachments 0 0 B HDOP N/A 1024 15 0.031 200 1200 0 2 0 Selected
Heading Deg/180 ±180 12 0.05 31.3 62.5 0 2 5 Selected Heading Deg/180 ±180 12 0.05 125 250 0 2 9 DC Current (TRU) Amperes 256 8 1.0 100 200 0 5 A FQIC Lbs 4-65532 14 4 900 1100 0 A 1 Selected Heading Deg/180 ±180 12 0.05 31.3 62.5 0 B B Inboard Flaps - PDU Deg/180 ±180 12 0.05 20 100 1 1 4 C/G Target % 164 8 0.01 100 200 1 0 2 0
0 2 Selected Altitude Feet 65536 16 1.0 100 200 6-27 0 0 B VDOP N/A 1024 15 0.031 200 1200 0 2 0 Selected Altitude Feet 65536 16 1.0 100 200 0 2 9 DC Current (Battery) Amperes 256 8 1.0 100 200 0 5 6 Selected Altitude Feet 65536 16 1.0 100 200 0 6 0 Selected Altitude Feet 65536 16 1.0 100 200 0 A 1 Selected Altitude Feet 65536 16 1.0 100
200 1 0 3 0 0 1 Selected Airspeed Knots 512 11 0.25 100 200 6-27 0 0 2 Selected Airspeed Knots 512 11 0.25 100 200 0 0 3 Selected Airspeed Knots 512 11 0.25 100 200 0 0 B GNSS Track Angle Deg ±108 15 0.0055 200 1200 0 1 B Left/PDU Flap Deg/180 ±180 18 0.000687 100 200 0 2 0 Selected Airspeed Knots 512 11 0.25 100 200 0 2 9 DC
Voltage (TRU) Volts 128 9 0.25 100 200 0 5 6 Selected Airspeed Knots 512 11 0.25 100 200 0 6 0 Selected Airspeed Knots 512 11 0.25 100 200 0 A 1 Selected Airspeed Knots 512 11 0.25 100 200 0 B B Left Outboard Flap Position Deg/180 ±180 12 0.05 20 100 1 0 4 0 0 1 Selected Vertical Speed Ft/Min 16384 10 UP 16 100 200 6-27 0 0 2 Selected
Vertical Speed Ft/Min 16384 10 UP 16 100 200 0 1 B Right/PDU Flap Deg/180 ±180 18 0.000687 100 200 0 2 0 Selected Vertical Speed Ft/Min 16384 10 UP 16 100 200 0 2 9 DC Voltage (Battery) Volts 128 9 0.25 100 200 0 2 B Selected Vertical Speed Ft/Min 16384 14 UP 1 100 200 0 5 6 Selected Vertical Speed Ft/Min 16384 10 UP 16 100 200 0 6 0
Selected Vertical Speed Ft/Min 16384 10 UP 16 100 200 0 A 1 Selected Vertical Speed Ft/Min 16384 10 UP 16 100 200 0 B B Right Outboard Flap Position Deg/180 ±180 12 0.05 20 100 1 0 5 0 0 2 Selected Runway Heading Deg/180 ±180 11 0.1 167 333 0 1 0 Selected Runway Heading Deg/180 ±180 11 0.1 167 333 0 1 B Left/PDU Slat Deg/180
±180 18 0.000687 100 200 0 2 0 Selected Runway Heading Deg/180 ±180 11 0.1 167 333 0 2 9 Oil Temp. Input (IDG/CSD) Deg C 2048 12 0.5 100 200 0 5 5 Selected Runway Heading Deg ±180 11 0.1 0 5 6 Selected Runway Heading Deg/180 ±180 11 0.1 167 333 0 6 0 Selected Runway Heading Deg/180 ±180 11 0.1 167 333 0 A 1 Selected Runway
Heading Deg/180 ±180 11 0.1 167 333 0 B 0 Selected Runway Heading Deg/180 ±180 11 0.1 167 333 0 B B Left Inboard Flap Position Deg/180 ±180 12 0.05 20 100 1 0 6 0 0 2 Selected Mach Mach 4096 12 1 31.3 200 6-27 0 1 B Right/PDU Slat Deg/180 ±180 18 0.000687 100 200 0 2 0 Selected Mach Mach 4096 12 0.5 100 200 0 2 9 Oil Temp. Input
(IDG/CSD) Deg C 2048 12 0.5 100 200 0 5 6 Selected Mach Mach 4096 12 1 31.3 200 0 6 0 Selected Mach Mach 4096 12 1 31.3 200 0 A 1 Selected Mach Mach 4096 12 1 31.3 62.5 0 B B Right Inboard Flap Position Deg/180 ±180 12 0.05 20 100 1 0 7 0 0 2 Selected Cruise Altitude Feet 65536 16 UP 1 100 200 0 1 B Flap/Slat Lever Deg/180 ±180 18
0.000687 100 200 0 B B Flap Lever Position-median value Deg/180 ±180 18 0.000687 100 200 ARINC SPECIFICATION 429, PART 1 - Page 56 ATTACHMENT 2 DATA STANDARDS TABLE 2 - BNR DATA Label Eqpt ID (Hex) Parameter Name Units Range (Scale) SigBits Pos Sense Resolution Min Transit Interval (msec) 2 Max Transit Interval (msec) 2
Max Trans- port Delay (msec) 3 Notes & Cross Ref. to Tables and Attachments 0 3 7 Long. Zero Fuel Ctr of Gravity % MAC 163.84 14 0.01 100 200 0 5 6 Selected Cruise Altitude Feet 65536 16 UP 1 100 200 0 6 0 Selected Cruise Altitude Feet 65536 16 UP 1 100 200 1 1 0 0 0 1 Selected Course #2 Deg/180 ±180 12 0.05 167 333 0 0 2 Selected
Course #2 Deg/180 ±180 12 0.05 167 333 0 0 B GNSS Latitude Deg ±180 20 0.000172 200 1200 0 1 0 Selected Course #2 Deg/180 ±180 12 0.05 167 333 0 1 1 Selected Course #2 Deg/180 ±180 12 0.05 167 333 0 2 0 Selected Course #2 Deg/180 ±180 12 0.05 167 333 0 A 1 Selected Course #2 Deg/180 ±180 12 0.05 167 333 0 B 1 Selected Course
#2 Deg/180 ±180 12 0.05 167 333 0 B B Flap Lever Position - Center Deg/180 180 18 0.000687 80 160 1 1 1 0 0 B GNSS Longitude Deg ±180 20 0.000172 200 1200 1 1 2 0 0 2 Runway Length Feet 20480 11 10 250 500 0 0 B GNSS Ground Speed Knots 4096 15 0.125 200 1200 0 A 1 Selected EPR 4 12 0.001 100 200 0 A 1 Selected N1 RPM 4096 12
1 100 200 0 B B Flap Lever Position - Left Deg/180 ±180 18 0.000687 80 160 1 1 4 0 0 2 Desired Track Deg/180 ±180 12 0.05 100 200 6-27 0 2 9 Brake Temp. (Left Inner L/G) Deg C 2048 11 1 100 200 0 2 F Ambient Pressure PSIA 32 14 0.002 100 200 0 3 F Pamb Sensor PSIA 32 14 0.002 100 200 0 5 6 Desired Track Deg/180 ±180 12 0.05 100 200
0 6 0 Desired Track Deg/180 ±180 12 0.05 100 200 0 B B Flap Lever Position - Right Deg/180 ±180 18 0.000687 80 160 0 C C Wheel Torque Output Lb./Ft. 16384 12 4 50 100 No. 5 to 8 in SDI 1 0 A Selected Ambient Static Pressure PSIA 1.5-20.0 11 0.016 100 500 1 0 B Selected Ambient Static Pressure PSIA 1.5-20.0 11 0.016 100 500 1 3 A Ambient
Pressure PSIA 32 14 0.002 100 200 1 1 5 0 0 2 Waypoint Bearing Deg/180 ±180 12 0.05 31.3 62.5 0 2 9 Brake Temp. (Left Outer L/G) Deg C 2048 11 1 100 200 0 2 F Fuel Temperature Deg C 512 11 0.25 100 200 0 3 F Fuel Temperature Deg C 512 11 0.25 100 200 0 5 6 Waypoint Bearing Deg/180 ±180 12 0.05 31.3 62.5 0 6 0 Waypoint Bearing
Deg/180 ±180 12 0.05 31.3 62.5 0 B C Fuel Temperature Deg C 256 8 1 500 1000 0 C C Wheel Torque Output Lb./Ft. 16384 12 4 50 100 No. 1 to 4 in SDI – 6-26 1 1 6 0 0 2 Cross Track Distance N.M. 128 15 0.004 31.3 62.5 6-27 0 0 B Horizontal GLS Deviation Rectilinear Feet 24000 18 0.00915 100 0 2 9 Brake Temp. (Right Inner L/G) Deg C 2048 11
1 100 200 0 5 5 Horizontal GLS Deviation Rectilinear Feet 24000 18 0.00915 100 0 5 6 Cross Track Deviation N.M. 128 15 0.004 31.3 62.5 0 6 0 Cross Track Deviation N.M. 128 15 0.004 31.3 62.5 0 C C Wheel Torque Output Lb./Ft. 16384 12 4 50 100 No. 9 to 12 in SDI – 6-26 1 1 7 0 0 2 Vertical Deviation Feet 2048 11 1.0 31.3 62.5 6-27 0 0 B
Vertical GLS Deviation Rectilinear Feet 1024 14 0.0625 100 0 2 9 Brake Temp. (Right Outer L/G) Deg C 2048 11 1 100 200 0 5 5 Vertical GLS Deviation Rectilinear Feet 1024 14 0.0625 100 0 5 6 Vertical Deviation Feet 2048 11 1.0 31.3 62.5 0 6 0 Vertical Deviation Feet 2048 11 1.0 31.3 62.5 0 C C Wheel Torque Output Lb./Ft. 16384 12 4 50 100 No.
13 to 16 in SDI – 6-26 1 2 0 0 0 2 Range to Altitude N.M. 512 15 0.016 25 50 0 0 B GNSS Latitude Fine Deg 0.000172 11 8.38-E-8 200 1200 0 5 6 Range to Altitude N.M. 512 15 0.016 25 50 0 6 0 Range to Altitude N.M. 512 15 0.016 25 50 ARINC SPECIFICATION 429, PART 1 - Page 57 ATTACHMENT 2 DATA STANDARDS TABLE 2 - BNR DATA Label
Eqpt ID (Hex) Parameter Name Units Range (Scale) SigBits Pos Sense Resolution Min Transit Interval (msec) 2 Max Transit Interval (msec) 2 Max Trans- port Delay (msec) 3 Notes & Cross Ref. to Tables and Attachments 1 2 1 0 0 2 Horizontal Command Signal Deg/180 ±180 14 0.01 50 100 0 0 B GNSS Longitude Fine Degrees 0.000172 11 8.38-E-8 o
200 1200 0 2 5 Pitch Limit Deg/180 ±180 14 0.01 125 250 0 5 6 Horizontal Command Signal Deg/180 ±180 14 0.01 50 100 0 6 0 Horizontal Command Signal Deg/180 ±180 14 0.01 50 100 1 2 2 0 0 2 Vertical Command Signal Deg/180 ±180 12 0.05 500 100 0 5 6 Vertical Command Signal Deg/180 ±180 12 0.05 500 100 0 6 0 Vertical Command
Signal Deg/180 ±180 12 0.05 500 100 1 2 3 0 0 2 Throttle Command Deg/Sec 256 8 0.001 50 100 1 2 4 0 A 5 Client Device for GNSS Receiver Meters 8192 13 1 200 6-49 1 E 2 Horizontal Alarm Limit Meters 0-8190 13 1 800 1200 1 2 6 0 0 2 Vertical Deviation (wide) Feet 32768 15 above sel alt 1.0 31.3 62.5 0 5 6 Vertical Deviation Feet 32768 15
above sel alt 1.0 31.3 62.5 0 6 0 Vertical Deviation Feet 32768 15 above sel alt 1.0 31.3 62.5 1 2 7 0 0 2 Selected Landing Altitude Feet 65536 16 UP 1 100 200 0 1 B Slat Angle Deg/180 ±180 12 0.05 100 200 6-11 0 3 3 P14 PSIA 32 14 0.002 100 200 1 0 A Fan Discharge Static Pressure PSIA 1.5 - 30.0 11 0.016 100 500 1 0 B Fan Discharge Static
Pressure PSIA 1.5 - 30.0 11 0.016 100 500 1 E 2 Vertical Alarm Limit Meters 0-255 8 1 800 1200 6-50 1 3 0 0 0 B Aut Horiz Integ Limit N.M. 16 17 1.2E-4 200 1200 0 1 A Fan Inlet Total Temperature Deg C 128 11 0.06 100 200 0 1 C Fan Inlet Total Temperature Deg C 128 11 0.06 100 200 0 2 F Fan Inlet Total Temperature Deg C 128 11 0.06 100 200
0 3 5 Intruder Range 500 6-21 and ARINC 735 0 3 F Fan Inlet Total Temperature Deg C 128 11 0.06 100 200 1 0 A Selected Total Air Temperature Deg C -80 to 90 10 0.125 100 500 1 0 B Selected Total Air Temperature Deg C -80 to 90 10 0.125 100 500 1 3 A Inlet Temperature Deg C 128 11 0.0625 100 200 1 3 1 0 1 A Fan Inlet Total Pressure PSIA
32 13 0.004 100 200 0 1 C Fan Inlet Total Pressure PSIA 32 13 0.004 100 200 0 2 D Fan Inlet Total Pressure PSIA 32 13 0.004 100 200 0 2 F Fan Inlet Total Pressure PSIA 32 13 0.004 100 200 0 3 3 Fan Inlet Total Pressure PSIA 32 13 0.004 100 200 0 3 5 Intruder Altitude 500 6-22 and ARINC 735 1 3 A Inlet Pressure PSIA 32 13 0.004 100 200 1 3 2
0 1 A Exhaust Gas Total Pressure PSIA 32 13 0.004 100 200 0 1 C Exhaust Gas Total Pressure PSIA 32 13 0.004 100 200 0 3 3 Exhaust Gas Total Pressure PSIA 32 14 0.002 100 250 0 3 5 Intruder Bearing 500 6-23 and ARINC 735 1 3 3 0 0 B Aut Vert Integ Limit Feet 32,768 18 0.125 200 1200 0 1 A Thrust Lever Angle Deg/180 ±180 12 0.05 100 250
0 2 F Thrust Lever Angle Deg/180 ±180 12 0.05 25 50 0 3 F Thrust Lever Angle Deg/180 ±180 12 0.05 25 50 1 0 A Selected Throttle Lever Angle Deg 90 11 0.088 31.3 100 1 0 B Selected Throttle Lever Angle Deg 90 11 0.088 31.3 100 1 3 4 0 1 C Power Lever Angle Deg/180 ±180 12 0.05 100 200 1 0 A Throttle Lever Angle Deg ±128 11 0.088 500
1000 1 0 B Throttle Lever Angle Deg ±128 11 0.088 500 1000 ARINC SPECIFICATION 429, PART 1 - Page 58 ATTACHMENT 2 DATA STANDARDS TABLE 2 - BNR DATA Label Eqpt ID (Hex) Parameter Name Units Range (Scale) SigBits Pos Sense Resolution Min Transit Interval (msec) 2 Max Transit Interval (msec) 2 Max Trans- port Delay (msec) 3
Notes & Cross Ref. to Tables and Attachments 1 3 A Throttle Lever Angle Deg/180 ±180 12 0.05 25 50 1 3 5 0 1 C Engine Vibration #1 in/sec 8 12 0.002 100 200 0 2 9 Engine Fan Vibration % FS 128 7 1 100 200 1 3 6 0 0 B Vertical Figure of Merit Feet 32,768 18 0.125 200 1200 0 1 C Engine Vibration #2 in/sec 8 12 0.002 100 200 1 3 7 0 1 B Flap
Angle Deg/180 ±180 12 0.05 100 200 6-11 0 2 A Flap Angle Deg/180 ±180 12 0.05 100 200 6-11 0 2 F Thrust Reverser Position Feedback % 128 12 0.03 100 200 0 3 F Thrust Reverser Position Feedback % 128 12 0.03 100 200 1 0 A Selected Thrust Reverser Position % -5 to 105 11 0.063 62.5 250 1 0 B Selected Thrust Reverser Position % -5 to 105
11 0.063 62.5 250 1 4 0 Flap Angle Deg 180 12 0.05 62.5 200 6-11 1 4 0 0 0 1 Flight Director - Roll Deg/180 ±180 12 0.05 50 100 6-27 0 0 B UTC Fine Seconds 1 20 0.953674μs 200 1200 0 2 5 Flight Director - Roll Deg/180 ±180 10 0.02 125 250 1 4 1 0 0 1 Flight Director - Pitch Deg/180 ±180 12 0.05 50 100 0 0 B UTC Fine Fractions Seconds
0.9536743μs 10 0.931225ns 200 1200 0 2 5 Flight Director - Pitch Deg/180 ±180 10 0.02 125 250 1 4 2 0 0 2 Flight Director - Fast/Slow Knots 32 12 0.008 31.3 62.5 6-27 0 0 3 Flight Director - Fast/Slow Knots 32 12 0.008 31.3 62.5 0 2 5 Flight Director - Fast/Slow Knots 32 8 0.125 125 250 1 4 3 0 0 1 Flight Director - Yaw Deg/180 ±180 12 0.05 50
100 0 4 1 HPA Command Word See ARINC 741 2 4 1 HPA Response Word See ARINC 741 1 4 4 0 2 B Altitude Error Feet 8192 14 Above Cmd Alt 1.0 25 50 0 4 1 ACU/BSU Control Word See ARINC 741 3 4 1 ACU/BSU Response Word See ARINC 741 1 4 5 0 0 2 TACAN Control See Sec. 3.1.4 180 220 6-30 1 4 6 1 1 2 TACAN Control See Sec. 3.1.4 180
220 1 4 7 X X X TACAN Control Word 100 200 1 5 0 0 0 2 Universal Time Coordinate 6-12 0 0 B UTC Hr:Min:S ±23:59:59 17 1.0sec 200 1200 0 3 1 Universal Time Coordinate 100 200 6-12 0 5 6 Universal Time Coordinate 6-12 0 6 0 Universal Time Coordinate 6-12 1 5 1 0 0 2 Localizer Bearing (True) Deg/180 ±180 11 0.1 167 333 0 2 7 MLS Azimuth
Deviation 0 5 5 MLS AZ Deviation mV ± 2400 15 0.0732 0 5 6 Localizer Bearing (True) Deg/180 ±180 11 0.1 167 333 0 6 0 Localizer Bearing (True) Deg/180 ±180 11 0.1 167 333 1 5 2 0 2 7 MLS Elevation Deviation 0 3 8 Cabin Pressure mB 2048 16 0.03125 62.5 125 0 4 1 Open Loop Steering See ARINC 741 0 5 5 MLS GP Deviation mV ± 2400 15
0.0732 0 A D Cabin Pressure mB 2048 18 0.008 20 200 ARINC SPECIFICATION 429, PART 1 - Page 59 ATTACHMENT 2 DATA STANDARDS TABLE 2 - BNR DATA Label Eqpt ID (Hex) Parameter Name Units Range (Scale) SigBits Pos Sense Resolution Min Transit Interval (msec) 2 Max Transit Interval (msec) 2 Max Trans- port Delay (msec) 3 Notes
& Cross Ref. to Tables and Attachments 1 5 3 0 0 2 Maximum Altitude Feet 65536 16 Above S.L. 1 500 1000 100 0 4 1 Closed Loop Steering See ARINC 741 0 5 5 MLS Selected Azimuth Deg 0-359 9 1 1 5 4 0 0 2 Runway Heading (True) N.M. 512 16 0.008 83.3 167 0 2 7 MLS Auxiliary Data 0 5 5 MLS Max Selectable GP Deg ± 51.1 9 1 0 5 6 Runway
Heading (True) N.M. 512 16 0.008 83.3 167 0 6 0 Runway Heading (True) N.M. 512 16 0.008 83.3 167 1 5 5 0 5 5 MLS Selected Glide Path Deg ± 51.1 9 0.01 1 6 2 0 1 2 ADF Bearing Deg/180 ±180 12 0.05 31.3 62.5 0 2 5 ADF brg left/right Deg/180 ±180 12 0.05 125 250 SDI-01=left/SDI-10=right 0 2 9 Crew Oxygen Pressure PSI 4096 12 1 100 200
0 5 5 MLS Basic Data Word 5 N/A N/A N/A N/A 1 4 0 Density Altitude Feet 1131072 16 2 250 500 1 6 4 0 0 2 Minimum Descent Altitude (MDA) Feet 8192 16 0.125 500 1000 0 0 3 Target Height Feet 8192 16 0.125 500 1000 0 0 7 Radio Height Feet 8192 16 0.125 25 50 6-13/6-27 0 2 5 Radio Height Feet 8192 12 2.0 125 250 0 3 B Radio Height VDC
32 11 0.015 150 250 Per ARINC 522A 0 5 5 MLS ABS GP Angle Deg ± 41 15 0.00125 1 6 5 0 0 B Vertical Velocity Feet/Min ± 32768 15 1.0 200 1200 0 5 5 MLS ABS Azimuth Angle Deg ± 82 16 0.00125 1 6 6 0 0 7 RALT Check Point Dev Feet 512 10 0.5 * * 0 0 B North/South Velocity Knots ± 4096 15 0.125 200 1 6 7 0 0 2 EPU Estimate Position
Uncertainty (ANP) Actual Navigation Perf.

N.M. 0-128 16 0.00195 1 7 1 0 0 2 Required Navigation Performance (RNP) N.M. 0-128 16 0.001953 0 A 5 Vertical Alarm Limit (VAL) and SBAS System Identifier Meters 256 8 1 200 X X X Manu. Specific Status Word See Attachment 10 1 7 3 0 1 0 Localizer Deviation DDM 0.4 12 0.0001 33.3 66.6 6-6/6-27 0 2 5 Localizer Deviation DDM 0.4 10 0.0004
125 250 0 2 9 Hydraulic Quantity % 128 7 1 100 200 0 3 B Localizer Deviation Dots 4 11 0.002 150 250 0 5 5 Localizer Deviation DDM ± 0.4 12 0.0001 0 B D Hydraulic Quantity % 128 7 1 500 1000 0 D 0 Hydraulic Oil Quantity US Pint 128 9 0.25 SDI 1= A/SDI 2= B 1 7 4 0 0 3 Delayed Flap Approach Speed (DFA) Knots 512 11 0.25 100 200 0 0 B
East/West Velocity Knots ± 4096 15 0.125 200 1200 0 1 0 Glideslope Deviation DDM 0.8 12 0.0002 33.3 66.6 6-6/6-27 0 2 9 Hydraulic Pressure PSI 4096 12 1 100 200 0 3 B Glideslope Deviation Dots 4 11 0.0002 150 250 6-6/6-27 0 5 5 Glide Slope Deviation DDM ± 0.8 12 0.0002 0 D 0 Hydraulic Oil Pressure PSI 4096 12 1.0 SDI 1= A/SDI 2= B 1 7 5
0 0 3 Economical Speed Knots 1024 14 0.06 62.5 125 0 2 9 EGT (APU) Deg C 2048 11 1 100 200 0 3 3 Hydraulic Pump Case Drain Temp Deg C 256 12 0.06 100 200 1 7 6 0 0 3 Economical Mach Mach 4096 13 0.5 62.5 125 0 2 9 RPM (APU) % RPM 256 9 0.5 100 200 ARINC SPECIFICATION 429, PART 1 - Page 60 ATTACHMENT 2 DATA STANDARDS
TABLE 2 - BNR DATA Label Eqpt ID (Hex) Parameter Name Units Range (Scale) SigBits Pos Sense Resolution Min Transit Interval (msec) 2 Max Transit Interval (msec) 2 Max Trans- port Delay (msec) 3 Notes & Cross Ref. to Tables and Attachments 0 3 8 Left Static Pressure Uncorrected, mb mb 2048 18 0.008 20 200 0 5 A Fuel Temperature - Set to
Zero Deg. C 512 11 0.25 100 200 0 A D Static Pressure Left, Uncorrected, mb mb 2048 18 0.008 20 200 1 1 4 Left Outer Tank Fuel Temp & Advisory Warning Deg ± 512 11 0.25 1 7 7 0 0 3 Economical Flight Level Feet 131072 17 1.0 31.3 62.5 0 2 9 Oil Quantity (APU) US Pint 128 9 0.25 100 200 0 3 8 Right Static Pressure, Uncorrected, mb mb 2048
18 0.008 20 200 0 5 5 Distance to LTP/FTP Nmiles ± 512 16 0.007812 0 5 A Fuel Temp. Left Wing Tank Deg C 512 11 0.25 100 200 0 A D Static Pressure Right, Uncorrected, mb mb 2048 18 0.008 20 200 1 1 4 Inner Tank 1 Fuel Temp & Advisory Warning Deg C ± 512 11 0.25 2 0 0 1 1 4 Inner Tank 2 Fuel Temp & Advisory Warning Deg C ± 512 11
0.25 2 0 1 0 5 A Fuel Temp. Right Wing Tank Deg C 512 11 0.25 100 200 1 1 4 Inner Tank 3 Fuel Temp & Advisory Warning Deg C ± 512 11 0.25 1 4 0 Mach Maximum Operation (Mmo) Mach 4.096 12 0.001 62.5 125 1 4 2 Projected Future Latitude Deg ± 180 20 0.000172 150 400 2 0 2 0 0 2 Energy Management (clean) N.M. 512 15 0.016 100 200 0
0 9 DME Distance N.M. 512 16 0.008 83.3 167 6-7/6-27 0 5 A Fuel Temperature - Set to Zero Deg C 512 11 0.25 100 200 1 1 4 Inner Tank 4 Fuel Temp & Advisory Warning Deg C ± 512 11 0.025 1 4 0 Mach Rate M/minute 4.096 12 0.001 62.5 125 1 4 2 Projected Future Latitude Fine Deg 0.000172 11 2.E-32 150 400 2 0 3 0 0 2 Energy Management
Speed Brakes N.M. 512 15 0.016 100 200 0 0 6 Altitude (1013.25 mb) Feet 131072 17 1.0 31.3 62.5 6-24/6-27 0 1 8 Altitude Feet 131072 17 1.0 20 40 0 3 5 Own A/C Altitude Feet 131072 17 1.0 20 500 0 3 8 Altitude (1013.25 mb) Feet 131072 17 1.0 31.3 62.5 0 5 A Fuel Tank #6 Temperature Deg C 512 11 0.25 100 200 1 0 A Ambient Static Pressure
PSIA 1.5 to 20.0 11 0.016 500 1000 1 0 B Ambient Static Pressure PSIA 1.5 to 20.0 11 0.016 500 1000 1 1 4 Trim Tank Fuel Temp & Advisory Warning Deg C ± 512 11 0.25 1 4 0 Altitude Feet 131072 17 1 31.25 62.5 2 0 4 0 0 2 Utility Airspeed Knots 512 11 0.25 500 1000 50 0 0 6 Baro Corrected Altitude #1 Feet 131072 17 1.0 31.3 62.5 0 3 8 Baro
Corrected Altitude #1 Feet 131072 17 1.0 31.3 62.5 0 5 6 Baro Altitude Knots 512 11 0.25 500 1000 50 0 5 A Fuel Tank #7 Temperature Deg C 512 11 0.25 100 200 0 6 0 Baro Altitude Knots 512 11 0.25 500 1000 50 1 1 4 Right Outer Tank Fuel Temp & Advisory Warning Deg C ± 512 11 0.25 1 4 0 Baro Corrected Altitude Feet 131072 17 1 31.25
62.5 2 0 5 0 0 6 Mach Mach 4.096 16 0.0000625 62.5 125 6-27 0 1 A Mach Mach 4.096 16 0.0000625 62.5 125 6-27 0 3 8 Mach Mach 4.096 16 0.0000625 62.5 125 6-27 0 5 A Fuel Tank #8 Temperature Deg C 512 11 0.25 100 200 1 0 A Mach Number Mach 1 11 0.002 100 500 1 0 B Mach Number Mach 1 11 0.002 100 500 1 4 0 Mach Mach 4.096 16
0.00000625 62.5 125 ARINC SPECIFICATION 429, PART 1 - Page 61 ATTACHMENT 2 DATA STANDARDS TABLE 2 - BNR DATA Label Eqpt ID (Hex) Parameter Name Units Range (Scale) SigBits Pos Sense Resolution Min Transit Interval (msec) 2 Max Transit Interval (msec) 2 Max Trans- port Delay (msec) 3 Notes & Cross Ref. to Tables and
Attachments 2 0 6 0 0 6 Computed Airspeed Knots 1024 14 0.0625 62.5 125 6-27 0 1 8 Altitude (Variable Resolution) Feet Variable 15 Variable 31.3 62.5 6-20 0 3 8 Computed Airspeed Knots 1024 14 0.0625 62.5 125 0 C C Taxi Speed Knots 512 11 0.25 50 100 1 4 0 Computed Airspeed (CAS) Knots 1024 14 0.0625 62.5 125 2 0 7 0 0 6 Maximum
Allowable Airspeed Knots 1024 12 0.25 62.5 125 0 0 A Maximum Allowable Airspeed Knots 512 11 0.25 100 200 0 3 8 Maximum Allowable Airspeed Knots 1024 12 0.25 62.5 125 1 4 0 Airspeed Maximum Operating (VMO) Knots 1024 12 0.25 62.56 125 2 1 0 0 0 6 True Airspeed Knots 2048 15 0.0625 62.5 125 6-27 0 3 8 True Airspeed Knots 2048 15
0.0625 62.5 125 1 4 0 True Airspeed Knots 2048 15 0.0625 62.5 125 2 1 1 0 0 2 Total Air Temperature Deg C 512 11 0.25 250 500 6-27 0 0 3 Total Air Temperature Deg C 512 11 0.25 250 500 0 0 6 Total Air Temperature Deg C 512 11 0.25 250 500 0 1 A Total Air Temperature Deg C 512 11 0.25 250 500 0 3 8 Total Air Temperature Deg C 512 11
0.25 250 500 0 A D Total Air Temperature Indicated Deg C 512 12 0.125 250 500 1 0 A Total Fan Inlet Temperature Deg C -80 to 90 10 0.125 500 1000 1 0 B Total Fan Inlet Temperature Deg C -80 to 90 10 0.125 500 1000 1 4 0 Total Air Temperature (TAT) Deg C 512 12 0.125 250 500 1 4 2 Projected Future Longitude Deg ± 180 20 0.000172 250
500 2 1 2 0 0 4 Altitude Rate Ft/Min 32768 11 16 31.3 62.5 6-27 0 0 5 Altitude Rate Ft/Min 32768 11 16 31.3 62.5 0 0 6 Altitude Rate Ft/Min 32768 11 16 31.3 62.5 0 3 8 Altitude Rate Ft/Min 32768 11 16 31.3 62.5 0 3 B Altitude Rate Ft/Min 32768 11 16 150 250 1 4 0 Altitude Rate Ft/Min 32768 11 16 31.25 62.5 1 4 2 Projected Future Longitude Fine
Deg 0.000172 11 2E-32 Cir 150 400 2 1 3 0 0 2 Static Air Temperature Deg C 512 11 0.25 250 500 6-27 0 0 6 Static Air Temperature Deg C 512 11 0.25 250 500 0 3 8 Static Air Temperature Deg C 512 11 0.25 250 500 0 8 D Fuel Used Lbs.

262144 18 1 75 125 1 4 0 Static Air Temperature (SAT) Deg C 512 11 0.25 250 500 1 4 2 Vertical Time Interval Minute 265 min 10 0.25 min 500 2000 2 1 5 0 0 6 Impacted Pressure mb 512 14 0.03125 62.5 125 0 1 A Impact Pressure mb 512 14 0.03125 62.5 125 0 2 9 N1 Actual (EEC) % RPM 256 14 0.015 50 100 0 2 9 EPR Actual (EEC) 4 12 0.001
50 100 0 3 8 Impacted Pressure, Uncorrected, mb mb 512 14 0.03125 62.5 125 0 A D Impacted Pressure, Uncorrected, mb mb 512 16 0.008 20 40 1 4 0 Impact Pressure Subsonic mb 512 14 0.03125 62.5 125 2 1 7 0 0 2 Geometric Vertical Rate Ft/Min 20000 11 16 0 0 6 Static Pressure, Corrected (In.Hg.) in. Hg 64 16 0.001 62.5 125 0 2 9 N1 Limit
(EEC) % RPM 256 14 0.015 100 200 0 2 9 EPR Limit (EEC) 4 12 0.001 100 200 0 3 8 Static Pressure, Average, Corrected (In. Hg.) in. Hg 64 16 0.001 62.5 125 1 4 0 Static Pressure Corrected (In. Hg.) in.

Hg 64 16 0.001 62.5 125 2 2 0 0 6 Baro Corrected Altitude #2 Feet 131072 17 1.0 31.3 62.5 0 3 8 Baro Corrected Altitude #2 Feet 131072 17 1.0 31.3 62.5 1 4 0 Baro Corrected Altitude #2 Feet 131072 17 1 31.25 62.5 ARINC SPECIFICATION 429, PART 1 - Page 62 ATTACHMENT 2 DATA STANDARDS TABLE 2 - BNR DATA Label Eqpt ID (Hex)
Parameter Name Units Range (Scale) SigBits Pos Sense Resolution Min Transit Interval (msec) 2 Max Transit Interval (msec) 2 Max Trans- port Delay (msec) 3 Notes & Cross Ref.

to Tables and Attachments 2 2 1 0 0 6 Indicated Angle of Attack (Avg) Deg/180 ±180 12 0.05 31.3 62.5 0 3 8 Indicated Angle of Attack (Average) Deg/180 ±180 12 0.05 31.3 62.5 0 A D Indicated Angle of Attack Deg/180 ±180 14 0.01 31.3 200 1 2 C Indicated Angle of Attack (Avg.) Deg/180 ±180 12 0.05 31.3 62.5 1 4 0 Angle of Attack Indicated
Average Deg ±180 12 0.05 31.25 62.5 2 2 2 0 0 6 Indicated Angle of Attack (#1 Left) Deg/180 ±180 12 0.05 31.3 62.5 0 1 1 VOR Omnibearing Deg/180 ±180 12 0.05 50 100 1 1 2 TACAN Bearing Deg/180 ±180 12 0.05 180 220 1 1 5 Bearing Deg/180 ±180 11 0.1 50 50 1 2 C Indicated Angle of Attack (#1 Left) Deg/180 ±180 12 0.05 31.3 62.5 1 4 0
Angle of Attack, Indicated #1 Left Deg ±180 12 0.05 31.5 62.5 2 2 3 0 0 6 Indicated Angle of Attack (#1 Right) Deg/180 ±180 12 0.05 31.3 62.5 1 2 C Indicated Angle of Attack (#1 Right) Deg/180 ±180 12 0.05 31.3 62.5 1 4 0 Angle of Attack, Indicated #1 Right Deg ±180 12 0.05 31.5 62.5 2 2 4 0 0 6 Indicated Angle of Attack (#2 Left) Deg/180
±180 12 0.05 31.3 62.5 1 2 C Indicated Angle of Attack (#2 Left) Deg/180 ±180 12 0.05 31.3 62.5 1 4 0 Angle of Attack, Indicated #2 Left Deg ±180 12 0.05 31.5 62.5 2 2 5 0 0 2 Minimum Maneuvering Airspeed Knots 512 11 0.25 500 1000 50 0 0 6 Indicated Angle of Attack (#2 Right) Deg/180 ±180 12 0.05 31.3 62.5 0 2 B Compensated Altitude
Rate Ft/Min 32768 11 Increas-ing alt 16.0 31.3 62.5 0 5 6 Minimum Maneuvering Air Speed Knots 512 11 0.25 500 1000 0 6 0 Minimum Maneuvering Air Speed Knots 512 11 0.25 500 1000 1 2 C Indicated Angle of Attack (#2 Right) Deg/180 ±180 12 0.05 31.3 62.5 1 4 0 Angle of Attack, Indicated #2 Right Deg ±180 12 0.05 31.5 62.5 2 2 7 0 3 D
AVM Command 6-28 0 7 E BITE Command Word See ARINC 604 2 3 1 0 A D Total Air Temperature Deg C 512 12 0.125 20 200 2 3 3 0 0 2 ACMS Information 6-31 0 5 6 ACMS Information 0 6 0 ACMS Information 2 3 4 0 0 2 ACMS Information 6-31 0 5 6 ACMS Information 0 6 0 ACMS Information 2 3 5 0 0 2 ACMS Information 6-31 0 5 6 ACMS
Information 0 6 0 ACMS Information 2 3 6 0 0 2 ACMS Information 6-31 0 5 6 ACMS Information 0 6 0 ACMS Information 2 3 7 0 0 2 ACMS Information 0 0 B Horizontal Uncertainty Level N.M. 16 17 0.000122 1200 See ARINC 743A 0 5 6 ACMS Information 0 6 0 ACMS Information 2 4 1 0 0 2 Min. Airspeed for Flap Extension Knots 512 11 0.25 500
1000 50 0 0 6 Corrected Angle of Attack Deg/180 ±180 12 0.05 31.3 62.5 0 3 8 Corrected Angle of Attack Deg/180 ±180 12 0.05 31.3 62.5 0 4 D FQIS System Data 500 1024 6-35 0 5 6 Min. Airspeed for Flap Extension Knots 512 11 0.25 500 1000 0 6 0 Min. Airspeed for Flap Extension Knots 512 11 0.25 500 1000 1 4 0 Angle of Attack, Corrected Deg
±180 12 0.05 31.5 62.5 ARINC SPECIFICATION 429, PART 1 - Page 63 ATTACHMENT 2 DATA STANDARDS TABLE 2 - BNR DATA Label Eqpt ID (Hex) Parameter Name Units Range (Scale) SigBits Pos Sense Resolution Min Transit Interval (msec) 2 Max Transit Interval (msec) 2 Max Trans- port Delay (msec) 3 Notes & Cross Ref. to Tables and
Attachments 2 4 2 0 0 6 Total Pressure mb 2048 16 0.03125 62.5 125 0 1 A Total Pressure mb 2048 16 0.03125 62.5 125 0 3 8 Total Pressure mb 2048 16 0.03125 62.5 125 0 3 B Speed Deviation Dots 4 11 0.002 150 250 0 A D Total Pressure, Uncorrected, mb mb 2048 18 0.008 20 200 1 4 0 Total Pressure mb 2048 16 0.03125 62.5 125 2 4 3 X X X
Simulator to Avcs Control Word 33 100 See ARINC Rpt 610 2 4 4 0 1 C Fuel Flow (Engine Direct) Lbs/hr 32768 8 128.0 100 200 0 3 3 Fuel Flow (Wf) pph 32768 16 0.5 150 250 0 3 B Mach Error Mach 0.064 11 0.00003 150 250 0 8 D Fuel Flow Rate PPH 32768 16 0.5 75 125 1 0 A Fuel Mass Flow MSEC 256 15 0.008 31.3 100 1 0 B Fuel Mass Flow
MSEC 256 15 0.008 31.3 100 1 4 0 Angle of Attack, Normalized Ratio 2 11 0.001 62.5 125 2 4 5 0 0 2 Minimum Airspeed Knots 256 12 0.0625 62.5 125 0 0 3 Minimum Airspeed Knots 256 12 0.0625 62.5 125 0 0 A Minimum Airspeed Knots 512 13 0.0625 62.5 125 0 2 9 N3 (Engine) % RPM 256 14 0.015 50 100 0 3 8 Avg. Static Pres.

mb uncorrected mb 2048 16 0.03125 62.5 125 0 3 B EPR Error 4 12 0.001 150 250 0 A D Average Static Pressure mb Uncorrected mb 2048 16 0.03125 62.5 125 0 5 6 Minimum Airspeed Knots 256 12 0.0625 62.5 125 0 6 0 Minimum Airspeed Knots 256 12 0.0625 62.5 125 1 4 0 Static Pressure, Uncorrected mb 2048 16 0.03125 62.5 125 2 4 6 0 0 2
Control Maximum Speed (VCMAX) Knots 512 11 0.25 50 100 50 0 0 6 Average Static Pressure mb 2048 16 0.03 62.5 125 0 1 C N1 (Engine Direct) RPM 4096 12 1.0 100 200 0 2 9 N1 (Engine Direct) % RPM 256 14 0.015 50 100 0 3 8 Avg Static Pres mb Corrected mb 2048 16 0.03125 62.5 125 0 3 B Angle of Attack Error Deg/180 ±180 14 0.01 150
250 2 4 7 0 0 2 Control Min. Speed (VCMIN) Knots 512 11 0.25 50 100 50 0 0 B Horizontal Figure of Merit N.M. 16 18 6.1 E-5 200 1200 0 1 F Total Fuel Lbs. 655360 14 40 500 1000 0 2 C Total Fuel Lbs. 655360 14 40 500 1000 0 3 B Speed Error Knots 256 12 0.06 150 250 0 4 D Total Fuel Lbs. 655360 14 40 500 1000 0 5 6 Control Minimum Speed
(Vcmin) Knots 512 11 0.25 50 100 0 5 A Total Fuel Lbs. 655360 14 40 100 200 0 6 0 Control Minimum Speed (Vcmin) Knots 512 11 0.25 50 100 0 E B Fuel to Remain Lbs. 1638400 14 100 100 125 1 1 4 Fuel on Board Lbs. 655320 13 40 1 4 0 Airspeed Minimum Vmc Knots 512 11 0.25 62.5 125 2 5 0 0 0 2 Continuous N1 Limit % RPM 256 14 0.015 50
200 200 0 2 B Maximum Continuous EPR Limit 4 12 0.001 100 200 0 2 C Preselected Fuel Quantity Lbs. 655360 14 40 100 400 0 5 A Preselected Fuel Quantity Lbs. 655360 14 40 100 200 0 3 8 Indicated Side Slip Angle Deg/180 ±180 12 0.05 31.3 62.5 0 A D Indicated Side Slip Angle or AOS Deg/180 ±180 14 0.01 31.3 200 1 1 4 Preselected Fuel
Quantity Lbs. 655320 13 40 2 5 1 0 0 1 Distance to Go N.M. 4096 15 0.125 100 200 0 0 2 Distance to Go N.M. 4096 15 0.125 100 200 0 0 6 Baro Corrected Altitude #3 Feet 131072 17 1.0 31.3 62.5 0 1 A Flight Leg Counter 75 175 6-19 0 3 8 Baro Corrected Altitude #3 Feet 131072 17 1.0 31.3 62.5 2 5 2 0 0 1 Time to Go Min. 512 9 1.0 100 200 0 0 2
Time to Go Min. 512 9 1.0 100 200 ARINC SPECIFICATION 429, PART 1 - Page 64 ATTACHMENT 2 DATA STANDARDS TABLE 2 - BNR DATA Label Eqpt ID (Hex) Parameter Name Units Range (Scale) SigBits Pos Sense Resolution Min Transit Interval (msec) 2 Max Transit Interval (msec) 2 Max Trans- port Delay (msec) 3 Notes & Cross Ref. to
Tables and Attachments 0 0 6 Baro Corrected Altitude #4 Feet 131072 17 1.0 31.3 62.5 0 1 A EPR Idle 4 12 0.001 100 200 0 2 F EPR Idle Reference 4 12 0.001 100 200 0 3 8 Baro Corrected Altitude #4 Feet 131072 17 1.0 31.3 62.5 0 3 F EPR Idle Reference 4 12 0.001 100 200 0 E B Time Until Jettison Complete Minutes 64 6 1 500 1000 2 5 3 0 0 2
Go-Around N1 Limit % RPM 256 14 0.015 50 200 200 0 1 E Go-Around EPR Limit 4 12 0.001 100 200 0 3 8 Corrected Side Slip Angle Deg/180 ±180 12 0.05 31.3 62.5 2 5 4 0 0 2 Cruise N1 Limit % RPM 256 14 0.015 50 200 200 0 1 E Cruise EPR Limit 4 12 0.001 100 200 0 4 D Actual Fuel Quan (test) Lbs 262144 15 8 500 1000 1 3 A N1 Cruise % N1
Nom 256 14 0.015 100 200 1 4 0 Altitude Rate Ft/Min 131072 13 16 31.25 62.5 2 5 5 0 0 2 Climb N1 Limit % RPM 256 14 0.015 50 200 200 0 1 E Climb EPR Limit 4 12 0.001 100 200 0 2 F Maximum Climb EPR Rating N/A 4 12 0.001 100 200 0 3 F Maximum Climb EPR Rating N/A 4 12 0.001 100 200 0 4 D Fuel Quantity (gal) Gallons 32768 15 1.0
500 1000 0 8 E Spoiler Position Deg/180 +180 11 0.1 50 100 1 3 A N1 Climb % N1 Nom 256 14 0.015 100 200 1 4 0 Impact Pressure mb 4096 17 0.03125 62.5 125 2 5 6 0 0 2 Time For Climb Min. 512 9 1 100 200 0 0 A V Stick Shaker Knots 512 11 0.25 100 200 0 2 C Fuel Quantity (Tanks) #1 Lbs. 131072 15 4 500 1000 0 5 6 Time for Climb Min. 512
9 1 100 200 0 5 A Fuel Quantity-Left Outer Cell Lbs.

131072 15 4 100 200 Zero for A-321 0 6 0 Time for Climb Min. 512 9 1 100 200 1 1 4 Left Outer Tank Fuel Quantity Lbs. 131072 15 4 1 4 0 Equivalent Airspeed Knots 1024 14 0.0625 62.5 125 2 5 7 0 0 2 Time For Descent Min. 512 9 1 100 200 0 2 C Fuel Quantity (Tanks) #2 Lbs. 131072 15 4 500 1000 0 5 6 Time for Descent Min.
512 9 1 100 200 0 5 A Fuel Quantity Left W/T Tank Lbs. 131072 15 4 100 200 0 6 0 Time for Descent Min. 512 9 1 100 200 1 1 4 Fuel Quantity (Tanks) #2 Lbs. 131072 15 4 500 1000 1 4 0 Total Pressure (High Range) mb 4096 17 0.03125 62.5 125 2 6 0 0 2 C Fuel Quantity (Tanks) #3 Lbs. 131072 15 4 500 1000 0 5 A Fuel Quantity Center Tank Lbs.
131072 15 4 100 200 0 3 3 T5 Deg C 1024 12 0.25 150 250 See Note [5] 1 0 A LP Turbine Discharge Temp Deg C -55 to 850 11 0.50 100 500 1 0 B LP Turbine Discharge Temperature Deg C -55 to 850 11 0.50 100 500 1 1 4 Collector Cell 1 and 2 Fuel Quantity Lbs. 131072 15 4 2 6 1 0 2 C Fuel Quantity (Tanks) #4 Lbs. 131072 15 4 500 1000 0 3 3
P49 PSIA 128 14 0.008 150 250 0 5 A Fuel Qty Right I/C or W/T Tank Lbs.

131072 15 4 100 200 1 0 A LP Turbine Inlet Pressure PSIA 2-120 11 0.125 100 500 1 0 B LP Turbine Inlet Pressure PSIA 2-120 11 0.125 100 500 1 1 4 Fuel on Board at Engine Start Lbs. 131072 15 4 1 4 4 Range Ring Radius NM 512 15 1/64 800 1200 6-52 2 6 2 0 0 2 Documentary Data 500 1000 6-14 0 0 A Predicitive Airspeed Variation Knots 256 10
0.25 100 200 0 1 C LP Compressor Exist Pres. (PT3) PSIA 64 13 0.008 100 200 0 2 C Fuel Quantity (Tanks) #5 Lbs. 131072 15 4 500 1000 0 3 3 LP Compressor Exist Pressure PSIA 64 14 0.004 150 250 0 4 D T/U Cap-L Tank 1-4 PF 655.35 16 0.01 TBD TBD ARINC SPECIFICATION 429, PART 1 - Page 65 ATTACHMENT 2 DATA STANDARDS TABLE 2
- BNR DATA Label Eqpt ID (Hex) Parameter Name Units Range (Scale) SigBits Pos Sense Resolution Min Transit Interval (msec) 2 Max Transit Interval (msec) 2 Max Trans- port Delay (msec) 3 Notes & Cross Ref.

to Tables and Attachments 0 5 A Fuel Quantity-Right Outer Cell Lbs. 131072 15 4 100 200 1 0 A HP Compressor Inlet Total Pres. PSIA 2-50 11 0.032 100 500 1 0 B HP Compressor Inlet Total Pres. PSIA 2-50 11 0.032 100 500 1 1 4 Center Tank Fuel Quantity Lbs. 131072 15 4 1 4 4 Display Range NM 512 14 1/32 800 1200 6-51 2 6 3 0 0 2 Min.
Airspeed for Flap Retraction Knots 512 11 0.25 500 1000 50 0 0 A Min. Airspeed for Flap Retraction Knots 512 11 0.25 100 200 0 1 C LP Compressor Exit Temperature 256 12 0.06 100 200 0 2 C Fuel Quantity (Tanks) #6 Lbs 131072 15 4 500 1000 0 3 3 LP Compressor Exit Temperature Deg C 256 12 0.063 150 250 0 4 D T/U Cap-L Tank 5-8 PF
655.35 16 0.01 TBD TBD 0 5 6 Min. Airspeed for Flap Retraction Knots 512 11 0.25 500 1000 0 6 0 Min. Airspeed for Flap Retraction Knots 512 11 0.25 500 1000 1 0 A Selected Compressor Inlet Temperature (Total) Deg C -55 to 160 11 0.125 100 500 1 0 B Selected Compressor Inlet Temp (Total) Deg C -55 to 160 11 0.125 100 500 1 1 4 Collector
Cell 3 and 4 Fuel Quantity Lbs. 131072 15 4 2 6 4 0 0 2 Time To Touchdown Min. 2048 11 1 100 200 145 0 0 A Min. Airspeed for Slats Retraction Knots 512 11 0.25 100 200 0 1 C HP Compressor Exit Pressure 512 14 0.03 100 200 0 2 C Fuel Quantity (Tanks) #7 Lbs. 131072 15 4 500 1000 0 2 F Burner Pressure PSIA 512 14 0.03 100 200 0 4 D T/U
Cap-L Tank 9-12 PF 655.35 16 0.01 TBD TBD 0 3 3 HP Compressor Exit Pressure PSIA 512 14 0.03 150 250 0 3 F Burner Pressure PSIA 512 14 0.03 100 200 0 5 6 Time to Touchdown Min. 2048 11 1 100 200 0 6 0 Time to Touchdown Min.
2048 11 1 100 200 1 0 A Selected Compressor Dischg Pres. PSIA 5-600 11 1.00 62.5 250 1 0 B Selected Compressor Dischg Pres. PSIA 5-600 11 1.00 62.5 250 1 3 A Burner Pressure PSIA 512 14 0.031 100 200 2 6 5 0 0 2 Min.

Buffet Airspeed Knots 512 11 0.25 50 100 50 0 0 4 Integrated Vertical Acceleration Ft/Sec ±256 20 UP 0.000244 20 0 0 A Maneuvering Airspeed Knots 512 11 0.25 100 200 0 1 C HP Compressor Exit Temp (TT4.5) 1024 12 0.25 100 200 0 2 C Fuel Quantity (Tanks) #8 Lbs. 131072 15 4 500 1000 0 3 3 HP Compressor Exit Temperature Deg C 1024 12
0.25 150 250 0 3 8 Integrated Vertical Acceleration Ft/Sec ±256 20 UP 0.000244 20 0 4 D T/U Cap-L Tank 13-14 PF 655.35 16 0.01 TBD TBD 0 5 6 Min. Buffet Airspeed Knots 512 11 0.25 50 100 0 6 0 Min. Buffet Airspeed Knots 512 11 0.25 50 100 1 0 A Selected Compressor Dischg Temp Deg C -55 to 650 11 0.50 100 500 1 0 B Selected Compressor
Dischg Temp Deg C -55 to 650 11 0.50 100 500 1 1 4 Inner Tank 3 Fuel Quantity Lbs. 131072 15 4 2 6 6 0 4 D T/U Cap-C Tank 1-4 PF 655.35 16 0.01 TBD TBD 1 1 4 Inner Tank 2 Fuel Quantity Lbs. 131072 15 4 2 6 7 0 0 2 Maximum Maneuver Airspeed Knots 512 11 0.25 500 1000 50 0 0 A Predictive Max. Maneuver Speed Knots 512 11 0.25 100 200
0 2 B Throttle Position Command Deg/180 ±180 12 0.05 50 100 0 4 D T/U Cap-C Tank 5-8 PF 655.35 16 0.01 TBD TBD 0 3 3 Spare T/C Deg C 256 12 0.063 150 250 0 5 6 Max. Maneuver Airspeed Knots 512 11 0.25 500 1000 0 6 0 Max. Maneuver Airspeed Knots 512 11 0.25 500 1000 1 0 A HP Compressor Inlet Temp. (total) Deg C -55 to 160 11 0.125
500 1000 1 0 B HP Compressor Inlet Temperature Deg C -55 to 160 11 0.125 500 1000 1 1 4 Inner Tank 4 Fuel Quantity Lbs.

131072 15 4 2 7 0 0 4 D T/U Cap-C Tank 9 PF 655.35 16 0.01 TBD TBD 1 1 5 Stored TACAN Control Word 25 50 See ARINC 429P2 ARINC SPECIFICATION 429, PART 1 - Page 66 ATTACHMENT 2 DATA STANDARDS TABLE 2 - BNR DATA Label Eqpt ID (Hex) Parameter Name Units Range (Scale) SigBits Pos Sense Resolution Min Transit Interval
(msec) 2 Max Transit Interval (msec) 2 Max Trans- port Delay (msec) 3 Notes & Cross Ref. to Tables and Attachments 2 7 1 0 4 D T/U Cap-A Tank 1-4 PF 655.35 16 0.01 TBD TBD 2 7 2 0 4 D T/U Cap Tank 5-8 PF 655.35 16 0.01 TBD TBD 2 7 3 0 4 D T/U Cap-A Tank 9-11 PF 655.35 16 0.01 TBD TBD 2 7 4 0 4 D T/U Cap-R Tank 1-4 PF 655.35 16 0.01
TBD TBD 2 7 5 0 4 D T/U Cap-R Tank 5-8 PF 655.35 16 0.01 TBD TBD 2 7 6 0 0 1 FCC to Simulator Control Word 50 150 Used only in simulator 0 0 2 FMC to Simulator Control Word 33 100 Used only in simulator 0 0 3 TCC to Simulator Control Word 50 150 Used only in simulator 0 4 D T/U Cap-R Tank 9-12 PF 655.35 16 0.01 TBD TBD 2 7 7 0 4 D
T/U Cap-R Tank 13-14 PF 655.35 16 0.01 TBD TBD 3 0 0 1 0 A ECU Internal Temperature Deg C -55 to 125 11 0.125 500 1000 1 0 B ECU Internal Temperature Deg C -55 to 125 11 0.125 500 1000 3 0 1 1 0 A Demanded Fuel Metering Valve Pos % 100 11 0.063 62.5 250 1 0 B Demanded Fuel Metering Valve Pos % 100 11 0.063 62.5 250 3 0 2 1 0 A
Demanded Variable Stator Vane Pos % 100 11 0.063 100 500 1 0 B Demanded Variable Stator Vane Pos % 100 11 0.063 100 500 3 0 3 1 0 A Demanded Variable Bleed Valve Pos % 100 11 0.063 100 500 1 0 B Demanded Variable Bleed Valve Pos % 100 11 0.063 100 500 3 0 4 1 0 A Demanded HPT Clearance Valve Pos % 100 11 0.063 250 1000 1 0 B
Demanded HPT Clearance Valve Pos % 100 11 0.063 250 1000 3 0 5 1 0 A Demanded LPT Clearance Valve Pos % 100 11 0.063 250 1000 1 0 B Demanded LPT Clearance Valve Pos % 100 11 0.063 250 1000 3 1 0 0 0 2 Present Position - Latitude Deg/180 0-180N/ 0-180S 20 0.000172 100 200 6-27 0 0 4 Present Position - Latitude Deg/180 0-180N/ 0-
180S 20 0.000172 100 200 0 2 9 Aileron Position Deg/180 ±180 11 0.088 50 100 0 3 8 Present Position - Latitude Deg/180 0-180N/ 0-180S 20 0.000172 100 200 0 4 D Comp Cap-Tank PF 327.67 15 0.01 TBD TBD 0 5 6 Present Position Latitude Deg/180 0-180N/ 0-180S 20 0.000172 100 200 0 6 0 Present Position Latitude Deg/180 0-180N/ 0-180S 20
0.000172 100 200 1 1 4 Right Outer Tank Fuel Quantity Lbs. 131068 15 4 3 1 1 0 0 2 Present Position - Longitude Deg/180 0-180E/ 0-180W 20 0.000172 100 200 0 0 4 Present Position - Longitude Deg/180 0-180E/ 0-180W 20 0.000172 100 200 0 2 9 Aileron Trim Deg/180 ±180 11 0.088 50 100 0 3 8 Present Position - Longitude Deg/180 0-180E/ 0-
180W 20 0.000172 100 200 0 3 B Control Wheel Roll Force Lbs. 64 10 0.0625 150 250 ARINC SPECIFICATION 429, PART 1 - Page 67 ATTACHMENT 2 DATA STANDARDS TABLE 2 - BNR DATA Label Eqpt ID (Hex) Parameter Name Units Range (Scale) SigBits Pos Sense Resolution Min Transit Interval (msec) 2 Max Transit Interval (msec) 2 Max
Trans- port Delay (msec) 3 Notes & Cross Ref. to Tables and Attachments 0 5 6 Present Position Longitude Deg/180 0-180E/ 0-180W 20 0.000172 100 200 0 6 0 Present Position Longitude Deg/180 0-180E/ 0-180W 20 0.000172 100 200 1 1 4 Trim Tank Fuel Quantity Lbs. 131072 15 4 3 1 2 0 0 2 Ground Speed Knots 4096 15 0.125 25 50 0 0 4 Ground
Speed Knots 4096 15 0.125 25 50 0 0 5 Ground Speed Knots 4096 15 0.125 25 50 0 2 9 Rudder Position Deg/180 ±180 11 0.088 50 100 0 3 8 Ground Speed Knots 4096 15 0.125 25 50 0 5 6 Ground Speed Knots 4096 15 0.125 25 50 0 5 A Fuel Quantity ACT 1 Lbs. 131072 15 4 100 200 0 6 0 Ground Speed Knots 4096 15 0.125 25 50 1 1 4 Additional
Center Tank (Act 1) Fuel Quantity Lbs. 131072 15 4 3 1 3 0 0 2 Track Angle - True Deg/180 ±180 12 0.05 25 50 0 0 4 Track Angle - True Deg/180 ±180 15 0.0055 25 50 0 2 5 Track Angle - True Deg/180 ±180 10 0.2 125 250 0 2 9 Rudder Trim Deg/180 ±180 11 0.088 50 100 0 3 8 Track Angle - True Deg/180 ±180 15 0.0055 25 50 0 5 6 Track Angle -
True Deg/180 ±180 12 0.05 25 50 0 5 A Fuel Quantity ACT 2 Lbs. 131072 15 4 100 200 0 6 0 Track Angle - True Deg/180 ±180 12 0.05 25 50 1 1 4 Additional Center Tank (Act 2) Fuel Quantity Lbs. 131072 15 4 3 1 4 0 0 2 Stabilizer Pos Indication (B747-400) Deg/180 ±180 12 TE Down0.05 25 50 50 0 0 4 True Heading Deg/180 ±180 15 0.0055 25 50
0 2 5 True Heading Deg/180 ±180 10 0.2 125 250 0 2 9 Elevator Position Deg/180 ±180 11 0.088 50 100 0 3 8 True Heading Deg/180 ±180 15 0.0055 25 50 0 3 B Control Wheel Pitch Force Lbs.

64 10 0.0625 150 250 1 1 4 Rear Center tank (RCT) Fuel Quantity Lbs. 131072 15 4 3 1 5 0 0 1 Stabilizer Position Deg/180 ±180 12 TE Down0.05 25 50 0 0 2 Wind Speed Knots 256 8 1.0 50 100 0 0 4 Wind Speed Knots 256 8 1.0 50 100 0 0 5 Wind Speed Knots 256 8 1.0 50 100 0 2 9 Stabilizer Position Deg/180 ±180 11 TE Down0.088 50 100 0 3 8
Wind Speed Knots 256 8 1.0 50 100 0 5 6 Wind Speed Knots 256 8 1.0 50 100 0 6 0 Wind Speed Knots 256 8 1.0 50 100 0 A 1 Stabilizer Position Deg/180 ±180 12 TE Down0.05 25 50 3 1 6 0 0 2 Wind Direction (True) Deg/180 +180 12 CW from north 0.05 25 50 50 0 0 4 Wind Angle Deg/180 ±180 8 0.7 50 100 0 2 9 Oil Temperature (Engine) Deg C
2048 12 0.5 100 200 0 3 8 Wind Angle Deg/180 ±180 8 0.7 50 100 0 5 6 Wind Direction (True) Deg/180 +180 12 CW from north 0.05 25 50 50 ARINC SPECIFICATION 429, PART 1 - Page 68 ATTACHMENT 2 DATA STANDARDS TABLE 2 - BNR DATA Label Eqpt ID (Hex) Parameter Name Units Range (Scale) SigBits Pos Sense Resolution Min Transit
Interval (msec) 2 Max Transit Interval (msec) 2 Max Trans- port Delay (msec) 3 Notes & Cross Ref. to Tables and Attachments 0 6 0 Wind Direction (True) Deg/180 +180 12 CW from north 0.05 25 50 50 1 0 A Engine Oil Temperature Deg C -55 to 170 11 1.00 250 1000 1 0 B Engine Oil Temperature Deg C -55 to 170 11 1.00 250 1000 0 D 0 Engine Oil
Temperature Deg C 2048 12 0.5 SDI 1=L SDI 2 =R 3 1 7 0 0 2 Track Angle - Magnetic Deg/180 ±180 12 0.05 25 50 0 0 4 Track Angle - Magnetic Deg/180 ±180 15 0.0055 25 50 0 0 5 Track Angle - Magnetic Deg/180 ±180 15 0.0055 25 50 0 2 5 Track Angle - Magnetic Deg/180 ±180 10 0.2 125 250 0 2 9 Oil Pressure (Engine) PSI 4096 12 1 50 100 0
3 8 Track Angle - Magnetic Deg/180 ±180 15 0.0055 25 50 0 5 6 Track Angle Magnetic Deg/180 ±180 12 0.05 25 50 0 6 0 Track Angle Magnetic Deg/180 ±180 12 0.05 25 50 0 D 0 Engine Oil Pressure PSI 4096 14 0.25 SDI 1 = L/SDI 2 = R 3 2 0 0 0 4 Magnetic Heading Deg/180 ±180 15 0.0055 25 50 0 0 5 Magnetic Heading Deg/180 ±180 15 0.0055
25 50 0 2 5 Magnetic Heading Deg/180 ±180 10 0.2 125 250 0 3 5 Own A/C Magnetic Heading Deg/180 ±180 15 0.0055 25 500 See ARINC 735 0 3 8 Magnetic Heading Deg/180 ±180 15 0.0055 25 50 0 4 D Density-Tank Lb/Gal 8.191 13 0.001 TBD TBD 3 2 1 0 0 2 Drift Angle Deg/180 ±180 12 0.05 25 50 0 0 4 Drift Angle Deg/180 ±180 11 0.09 25 50
0 0 5 Drift Angle Deg/180 ±180 11 0.09 25 50 0 3 8 Drift Angle Deg/180 ±180 12 0.05 25 50 0 5 6 Drift Angle Deg/180 ±180 12 0.05 25 50 0 6 0 Drift Angle Deg/180 ±180 12 0.05 25 50 1 0 A Exhaust Gas Temperature (Total) Deg C -55 to 1100 11 1.00 500 1000 1 0 B Exhaust Gas Temperature (Total) Deg C -55 to 1100 11 1.00 500 1000 3 2 2 0 0 2
Flight Path Angle Deg/180 +180 12 0.05 25 50 0 0 4 Flight Path Angle Deg/180 ±180 12 0.05 25 50 0 0 5 Flight Path Angle Deg/180 ±180 12 0.05 25 50 0 3 8 Flight Path Angle Deg/180 ±180 12 0.05 25 50 0 5 6 Flight Path Angle Deg/180 +180 12 0.05 25 50 0 6 0 Flight Path Angle Deg/180 +180 12 0.05 25 50 1 0 A Total Compressor Discharge
Temp Deg C -55 to 650 11 0.50 500 1000 1 0 B Total Compressor Discharge Temp Deg C -55 to 650 11 0.50 500 1000 3 2 3 0 0 2 Geometric Altitude Feet 50000 17 1 0 0 4 Flight Path Acceleration g 4 12 0.001 10 20 6-27 0 0 5 Flight Path Acceleration g 4 12 0.001 10 20 0 3 8 Flight Path Acceleration g 4 12 0.001 10 20 0 5 6 Geometric Altitude Feet
50000 17 1 0 6 0 Geometric Altitude Feet 50000 17 1 1 0 A Variable Stator Vane Position % -5 to 105 11 0.063 500 1000 1 0 B Variable Stator Vane Position % -5 to 105 11 0.063 500 1000 3 2 4 0 0 4 Pitch Angle Deg/180 ±180 14 0.01 10 20 0 0 5 Pitch Angle Deg/180 ±180 14 0.01 10 20 0 2 5 Pitch Angle Deg/180 ±180 10 0.2 125 250 0 3 8 Pitch
Angle Deg/180 ±180 14 0.01 10 20 0 4 D Tank VSO Quantity Gal. 32768 15 1.0 TBD TBD See Att. 6 for SDI encoding 0 5 A Effective Pitch Angle Deg./180 ±180 14 0.01 1 0 A Selected Fuel Metering Valve Pos % -5 to 105 11 0.063 62.5 250 1 0 B Selected Fuel Metering Valve Pos % -5 to 105 11 0.063 62.5 250 ARINC SPECIFICATION 429, PART 1 -
Page 69 ATTACHMENT 2 DATA STANDARDS TABLE 2 - BNR DATA Label Eqpt ID (Hex) Parameter Name Units Range (Scale) SigBits Pos Sense Resolution Min Transit Interval (msec) 2 Max Transit Interval (msec) 2 Max Trans- port Delay (msec) 3 Notes & Cross Ref. to Tables and Attachments 1 1 4 Effective Pitch Angle Deg ±180 13 0.02 3 2 5 0 0
4 Roll Angle Deg/180 ±180 14 0.01 10 20 0 0 5 Roll Angle Deg/180 ±180 14 0.01 10 20 0 1 A Engine Control Trim Feedback 0 2 5 Roll Angle Deg/180 ±180 10 0.2 125 250 0 2 F Stator Vane Feedback Inches 4 12 0.001 100 200 0 3 8 Roll Angle Deg/180 ±180 14 0.01 10 20 0 3 F Stator Vane Feedback Inches 4 12 0.001 100 200 0 5 A Effective Roll
Angle Deg/180 ±180 14 0.01 1 0 A Selected Variable Stator Vane Pos % -5 to 105 11 0.063 62.5 250 1 0 B Selected Variable Stator Vane Pos % -5 to 105 11 0.063 62.5 250 1 1 4 Effective Roll Angle Deg ±180 13 0.02 3 2 6 0 0 4 Body Pitch Rate Deg/Sec 128 13 0.015 10 20 0 0 5 Body Pitch Rate Deg/Sec 128 13 0.015 10 20 0 3 8 Body Pitch Rate
Deg/Sec 128 13 0.015 10 20 0 4 D Uplift Quantity Lbs 1638400 14 100 TBD TBD 1 0 A Compressor Discharge Static Press PSIA 5-600 11 1.00 500 1000 1 0 B Compressor Discharge Static Press PSIA 5-600 11 1.00 500 1000 3 2 7 0 0 4 Body Roll Rate Deg/Sec 128 13 0.015 10 20 0 0 5 Body Roll Rate Deg/Sec 128 13 0.015 10 20 0 3 8 Body Roll Rate
Deg/Sec 128 13 0.015 10 20 0 4 D Uplift Density Lbs/Gal 8.181 13 0.001 TBD TBD 1 0 A Fuel Metering Valve Position % -5 to 105 11 0.063 500 1000 1 0 B Fuel Metering Valve Position % -5 to 105 11 0.063 500 1000 3 3 0 0 0 4 Body Yaw Rate Deg/Sec 128 13 0.015 10 20 0 0 5 Body Yaw Rate Deg/Sec 128 13 0.015 10 20 0 2 F HC/TC Cooling Valve
Pos. Feedback % 128 12 OPEN 0.03 100 200 0 3 8 Body Yaw Rate Deg/Sec 128 13 0.015 10 20 0 3 F HC/TC Cooling Valve Pos. Feedback % 128 12 OPEN 0.03 100 200 1 0 A Selected HPT Clearance Valve Position % -5 to 105 11 0.063 250 1000 1 0 B Selected HPT Clearance Valve Pos % -5 to 105 11 0.063 250 1000 3 3 1 0 0 4 Body Longitudinal
Acceleration g 4 12 0.001 10 20 0 0 5 Body Longitudinal Acceleration g 4 12 0.001 10 20 0 2 F LTC Cooling Valve Pos. Feedback % 128 12 OPEN 0.03 100 200 0 3 8 Body Longitudinal Acceleration g 4 12 0.001 10 20 0 3 F LTC Cooling Valve Pos. Feedback % 128 12 OPEN 0.03 100 200 1 0 A Selected LPT Clearance Valve Pos % -5 to 105 11 0.063
250 1000 1 0 B Selected LPT Clearance Valve % -5 to 105 11 0.063 250 1000 3 3 2 0 0 4 Body Lateral Acceleration g 4 12 0.001 10 20 0 0 5 Body Lateral Acceleration g 4 12 0.001 10 20 0 2 F A/O Heat Xchr Valve Pos. Feedback % 128 12 OPEN 0.03 100 200 0 3 8 Body Lateral Acceleration g 4 12 0.001 10 20 0 3 F A/O Heat Xchr Valve Pos. Feedback
% 128 12 OPEN 0.03 100 200 3 3 3 0 0 4 Body Normal Acceleration g 4 12 0.001 10 20 0 0 5 Body Normal Acceleration g 4 12 0.001 10 20 0 2 F Acceleration Fuel Flow Limit Lb/Hr 32768 12 8 100 200 0 3 8 Body Normal Acceleration g 4 12 0.001 10 20 0 3 F Acceleration Fuel Flow Limit Lb/Hr 32768 12 8 100 200 3 3 4 0 0 4 Platform Heading
Deg/180 ±180 11 0.09 20 40 0 0 5 Platform Heading Deg/180 ±180 11 0.09 20 40 0 2 F Fuel Flow Command Lb/Hr 32768 12 8 100 200 ARINC SPECIFICATION 429, PART 1 - Page 70 ATTACHMENT 2 DATA STANDARDS TABLE 2 - BNR DATA Label Eqpt ID (Hex) Parameter Name Units Range (Scale) SigBits Pos Sense Resolution Min Transit
Interval (msec) 2 Max Transit Interval (msec) 2 Max Trans- port Delay (msec) 3 Notes & Cross Ref. to Tables and Attachments 0 3 8 Platform Heading Deg/180 ±180 11 0.09 20 40 0 3 F Fuel Flow Command Lb/Hr 32768 12 8 100 200 3 3 5 0 0 2 Track Angle Rate Deg/Sec 32 11 0.015 10 20 0 0 4 Track Angle Rate Deg/Sec 32 11 0.015 10 20 0 0 5
Track Angle Rate Deg/Sec 32 11 0.015 10 20 0 2 F 2.5 BLD Actuator Position % 128 12 0.031 100 200 0 3 8 Track Angle Rate Deg/Sec 32 11 0.015 10 20 0 3 F 2.5 BLD Actuator Position % 128 12 0.031 100 200 0 5 6 Track Angle Rate Deg/Sec 32 11 0.015 10 20 0 6 0 Track Angle Rate Deg/Sec 32 11 0.015 10 20 1 0 A Selected Variable Bleed Valve
Pos % -5 to 105 11 0.063 100 500 1 0 B Selected Variable Bleed Valve Pos % -5 to 105 11 0.063 100 500 3 3 6 0 0 2 Max Climb Angle Deg 32 15 Climb 0.001 100 200 0 0 4 Inertial Pitch Rate Deg/Sec 128 13 0.015 10 20 0 0 5 Inertial Pitch Rate Deg/Sec 128 13 0.015 10 20 0 1 A Engine Torque % 256 12 0.063 100 200 0 2 F N2 Corrected to Sta 2.5 %
128 12 0.031 100 200 0 3 8 Inertial Pitch Rate Deg/Sec 128 13 0.015 10 20 0 3 F N2 Corrected to Sta 2.5 % 128 12 0.031 100 200 1 0 A Variable Bleed Valve Position % -5 to 105 11 0.063 500 1000 1 0 B Variable Bleed Valve Position % -5 to 105 11 0.063 500 1000 3 3 7 0 0 2 EPR - Required For Level Flight Ratio ±4 12 0.001 100 200 Engine Types:
P&W 0 0 2 N1 - Required For Level Flight % RPM ±256 15 0.015 Engine Types: GE 0 0 4 Inertial Roll Rate Deg/Sec 128 13 0.015 10 20 0 0 5 Inertial Roll Rate Deg/Sec 128 13 0.015 10 20 0 1 A Engine Rating % 0-256 12 0.063 100 200 0 3 8 Inertial Roll Rate Deg/Sec 128 13 0.015 10 20 1 0 A HPT Clearance Valve Position % -5 to 105 11 0.063 500
1000 1 0 B HPT Clearance Valve Position % -5 to 105 11 0.063 500 1000 3 4 0 0 0 3 EPR Actual 4 12 0.001 100 200 0 0 4 Inertial Yaw Rate Deg/Sec 128 13 0.015 10 20 0 0 4 Track Angle Grid Deg ± 180 15 0.0055 20 110 0 0 5 Inertial Yaw Rate Deg/Sec 128 13 0.015 10 20 0 1 A EPR Actual 4 12 0.001 100 200 0 2 9 EPR Actual (Engine Direct) 4 12
0.001 50 100 0 2 D EPR Actual 4 12 0.001 100 200 0 2 F EPR Actual 4 12 0.001 25 50 0 3 3 EPR Actual 4 12 0.001 100 200 0 3 F EPR Actual 4 12 0.001 25 50 1 3 A N1 Take Off % N1Nom 256 14 0.015 25 50 1 4 0 Pressure Ratio (Pt/Ps) Ratio 16 14 0.001 62.5 125 3 4 1 0 0 2 Target N1 % RPM 256 14 0.015 100 200 0 0 3 N1 Command % RPM 256 14
0.015 100 200 0 0 3 EPR Command 4 12 0.001 100 200 0 0 4 Grid Heading Deg ± 180 15 0.0055 20 110 0 1 A N1 Command % RPM 256 14 0.015 100 200 0 1 A EPR Command 4 12 0.001 100 200 0 2 9 N1 Command (Engine) % RPM 256 14 0.015 50 100 0 2 9 EPR Command (Engine) 4 12 0.001 50 100 0 2 F N1 Command % RPM 256 14 0.015 25 50
0 2 F EPR Command 4 12 0.001 25 50 0 3 8 Grid Heading Deg ± 180 15 0.0055 20 110 0 3 F EPR Command 4 12 0.001 100 200 0 4 D I/O S/W REV 1&2 (1) 16 N/A TBD TBD 1 0 A Command Fan Speed % 117.5 13 0.032 31.3 100 ARINC SPECIFICATION 429, PART 1 - Page 71 ATTACHMENT 2 DATA STANDARDS TABLE 2 - BNR DATA Label Eqpt ID
(Hex) Parameter Name Units Range (Scale) SigBits Pos Sense Resolution Min Transit Interval (msec) 2 Max Transit Interval (msec) 2 Max Trans- port Delay (msec) 3 Notes & Cross Ref.

to Tables and Attachments 1 0 B Command Fan Speed % 117.5 13 0.032 31.3 100 1 3 A N1 Reference % N1Nom 256 14 0.015 25 50 1 4 0 Pressure Ratio (Ps/Pso) Ratio 4 12 0.001 62.5 125 3 4 2 0 0 2 N1 Bug Drive % RPM 256 14 0.015 100 200 0 0 3 N1 Limit % RPM 256 14 0.015 100 200 0 0 3 EPR Limit 4 12 0.001 100 200 0 1 A N1 Maximum %
RPM 256 14 0.015 100 200 0 1 A EPR Maximum 4 12 0.001 100 200 0 2 9 N1 Limit (TCC) % RPM 256 14 0.015 100 200 0 2 9 EPR Limit (TOC) 4 12 0.001 100 200 0 2 F Maximum Available EPR 4 12 0.001 100 200 0 3 B EPR Limit 4 12 0.001 150 250 0 3 B N1 Limit % RPM 256 14 0.015 150 250 0 3 F Maximum Available EPR 4 12 0.001 100 200 0 4
D S/W REV-Tank (1) 16 N/A TBD TBD 1 0 A Max Allowed Fan Speed % 117.5 13 0.032 100 500 1 0 B Max Allowed Fan Speed % 117.5 13 0.032 100 500 1 4 0 Air Density Ratio Ratio 4 12 0.001 250 500 3 4 3 0 0 3 N1 Derate % RPM 256 14 0.015 100 200 0 0 3 EPR Rate 4 12 0.001 100 200 0 1 A N1 Demand % RPM 256 12 0.063 20 50 1 0 A N1
Command vs.

TLA % 117.5 13 0.032 31.3 100 1 0 B N1 Command vs. TLA % 117.5 13 0.032 31.3 100 3 4 4 0 1 A N2 % RPM 256 14 0.015 50 100 0 1 C N2 % RPM 256 14 0.015 50 100 0 2 9 N2 % RPM 256 14 0.015 50 100 0 2 F N2 % RPM 256 14 0.015 25 50 0 3 3 N2 % RPM 256 14 0.015 50 200 0 3 F N2 % RPM 256 14 0.015 25 50 1 0 A Selected Actual Core
Speed % 128 12 0.063 31.3 100 1 0 B Selected Actual Core Speed % 128 12 0.063 31.3 100 1 3 A N2 Speed % N1Nom 256 14 0.015 25 50 0 D 0 N2 % RPM 256 13 0.03 SDI 1 = L/SDI 2 = R 3 4 5 0 1 A Exhaust Gas Temperature Deg C 2048 12 0.5 100 200 0 1 C Exhaust Gas Temperature Deg C 2048 12 0.5 100 200 0 2 9 Exhaust Gas Temperature Deg C
2048 12 0.5 50 100 0 2 F Exhaust Gas Temperature Deg C 2048 12 0.5 25 50 0 3 3 Exhaust Gas Temperature Deg C 2048 12 0.5 100 200 0 3 F Exhaust Gas Temperature Deg C 2048 12 0.5 25 50 1 0 A Selected Exhaust Gas Temp (Total) Deg C -55 to 1100 11 1.00 62.5 250 1 0 B Selected Exhaust Gas Temp (Total) Deg C -55 to 1100 11 1.00 62.5 250
1 3 A EGT Trimmed Deg C 2048 12 0.5 25 50 0 D 0 EGT Deg C 2048 12 0.5 SDI 1 = L/SDI 2 = R 3 4 6 0 0 3 N1 Actual % RPM 256 14 0.015 100 200 0 1 A N1 Actual % RPM 256 14 0.015 100 200 0 2 F N1 Actual % RPM 256 14 0.015 25 50 0 3 3 N1 Actual % RPM 256 14 0.015 50 200 0 3 F N1 Actual % RPM 256 14 0.015 25 50 0 4 D Cable Cap-Hi-Z
PF 65535 15 2.0 100 200 1 0 A Selected Actual Fan Speed % 128 12 0.063 31.3 100 1 0 B Selected Actual Fan Speed % 128 12 0.063 31.3 100 1 3 A N1 Speed Actual % N1Nom 256 14 0.015 25 50 0 D 0 N1 % RPM 256 13 0.03 SDI 1 = L/SDI 2 = R 3 4 7 0 2 9 Fuel Flow (Engine) Lbs/Hr 32768 12 8 50 100 1 0 A LPT Clearance Valve Position % -5 to
105 11 0.063 500 1000 ARINC SPECIFICATION 429, PART 1 - Page 72 ATTACHMENT 2 DATA STANDARDS TABLE 2 - BNR DATA Label Eqpt ID (Hex) Parameter Name Units Range (Scale) SigBits Pos Sense Resolution Min Transit Interval (msec) 2 Max Transit Interval (msec) 2 Max Trans- port Delay (msec) 3 Notes & Cross Ref. to Tables and
Attachments 1 0 B LPT Clearance Valve Position % -5 to 105 11 0.063 500 1000 1 3 A Fuel Flow Lbs/Hr 32768 14 2 50 100 0 D 0 Fuel Flow Lbs/Hr 32768 12 8 SDI 1 = L/SDI 2 = R 3 5 2 1 4 0 Maintenance Flight Controller Flights 524, 287 19 1 3 5 3 0 D 0 Vibration Scalar 5.12 8 0.02 SDI 1 = L/SDI 2 = R 3 5 4 0 3 D N1 Vibration Scalar 5.12 9 0.01 Bit
11-Chan. A Bit 12-Chan. B 3 5 5 0 3 D N2 Vibration Scalar 5.12 9 0.01 Bit 11-Chan. A Bit 12-Chan. B 3 5 6 0 3 D N2 Vibration Scalar 5.12 9 0.01 Bit 11-Chan. A Bit 12-Chan. B 3 5 7 0 3 D BB Vibration Scalar 5.12 9 0.01 Bit 11-Chan.

A Bit 12-Chan. B 3 6 0 0 0 2 Flight Information 6-33 0 0 4 Potential Vertical Speed Ft/Min 32768 15 1.0 10 20 0 0 5 Potential Vertical Speed Ft/Min 32768 15 1.0 25 50 0 3 8 Potential Vertical Speed Ft/Min 32768 15 1.0 10 20 0 3 D N1 Rotor Imbalance Angle Deg. ±180 9 1.0 Bit 11-Chan. A Bit 12-Chan. B 0 5 6 Flight Information 6-33 0 6 0 Flight
Information 6-33 1 0 A Throttle Rate of Change Deg/Sec ±16 9/9 1.00 31.3 100 See Notes [6] & [7] 1 0 B Throttle Rate of Change Deg/Sec ±16 9/9 1.00 31.3 100 See Notes [6] & [7] 1 4 2 RAIM Status Word N.M. 16 13 0.00195 3 6 1 0 0 4 Altitude (Inertial) Feet 131072 20 0.125 20 40 0 0 5 Altitude (Inertial) Feet 131072 18 0.5 20 40 0 3 8 Altitude
(Inertial) Feet 131072 20 0.125 20 40 0 3 D LPT Rotor Imbalance Angle (737 only) Deg. ±180 9 1.0 Bit 11-Chan. A Bit 12-Chan. B 1 0 A Derivative of Thrust vs. N1 DFN/%N1 2000 11 2.0 62.5 250 See Note [6] 1 0 B Derivative of Thrust vs. N1 DFN/%N1 2000 11 2.0 62.5 250 See Note [6] 3 6 2 0 0 4 Along Track Horizontal Acceleration g 4 12 0.001 10
20 0 3 8 Along Track Horizontal Acceleration g 4 12 0.001 10 20 1 0 A Derivative of N1 vs. TLA % N1/Deg 12 11 0.008 62.5 250 See Note [6] 1 0 B Derivative of N1 vs. TLA % N1/Deg 12 11 0.008 62.5 250 See Note [6] 1 1 5 Range Rate Knots ±8192 13 1.0 50 50 3 6 3 0 0 4 Cross Track Acceleration g 4 12 0.001 10 20 0 3 8 Cross Track Acceleration g
4 12 0.001 10 20 1 0 A Corrected Thrust LBF 64000 11 64.0 62.5 250 See Note [6] 1 0 B Corrected Thrust LBF 64000 11 64.0 62.5 250 See Note [6] 3 6 4 0 0 4 Vertical Acceleration g 4 12 0.001 10 20 0 0 5 Vertical Acceleration g 4 12 0.001 10 20 1 3 A N1 APR Rating % N1Nom 256 14 0.015 100 200 0 3 8 Vertical Acceleration g 4 12 0.001 10 20 3 6
5 0 0 4 Inertial Vertical Velocity (EFI) Ft/Min 32768 15 1.0 20 40 0 0 5 Inertial Vertical Velocity (EFI) Ft/Min 32768 15 1.0 20 40 1 3 A N1 Max Reverse % N1Nom 256 14 0.015 100 200 0 3 8 Inertial Vertical Velocity (EFI) Ft/Min 32768 15 1.0 20 40 ARINC SPECIFICATION 429, PART 1 - Page 73 ATTACHMENT 2 DATA STANDARDS TABLE 2 - BNR
DATA Label Eqpt ID (Hex) Parameter Name Units Range (Scale) SigBits Pos Sense Resolution Min Transit Interval (msec) 2 Max Transit Interval (msec) 2 Max Trans- port Delay (msec) 3 Notes & Cross Ref. to Tables and Attachments 3 6 6 0 0 4 North-South Velocity Knots 4096 15 0.125 50 100 6-2-1 1 3 A IGV Position Deg/180 ±180 12 0.05 100 200
0 3 8 North-South Velocity Knots 4096 15 0.125 50 100 3 6 7 0 0 4 East-West Velocity Knots 4096 15 0.125 100 200 1 3 A IGV Request Deg/180 ±180 12 0.05 100 200 0 3 8 East-West Velocity Knots 4096 15 0.125 100 200 3 7 0 0 0 4 g 9 8 13 UP 0.001 100 200 110 0 0 5 g 9 8 13 UP 0.001 100 200 110 0 0 B GNSS Height WGS-84 (HAE) Feet ±
131.072 20 0.125 1200 0 2 5 Decision Height Selected (EFI) Feet 8192 16 0.125 100 200 0 C 5 Decision Height Selected (EFI) Feet 16384 17 0.125 100 200 3 7 1 X X X Gen Aviation Equip. Identifier 3 7 2 0 0 5 Wind Direction-Magnetic Deg/180 ±180 9 0.35 50 100 1 0 A Actual Fan Speed % 128 12 0.063 500 1000 1 0 B Actual Fan Speed % 128 12
0.063 500 1000 3 7 3 0 0 5 North-South Velocity-Magnetic Knots 4096 15 0.125 100 200 1 0 A Actual Core Speed % 128 12 0.063 500 1000 1 0 B Actual Core Speed % 128 12 0.063 500 1000 3 7 4 0 0 5 East-West Velocity-Magnetic Knots 4096 15 0.125 100 200 1 0 A Left Thrust Reverser Position % -5+105 11 0.063 500 1000 1 0 B Left Thrust
Reverser Position % -5+105 11 0.063 500 1000 3 7 5 0 0 4 Along Heading Acceleration Gs 4 18 1.53E-5 50 110 0 0 5 Along Heading Acceleration g 4 12 0.001 10 20 0 3 3 Spare DC1 VDC 16 12 0.004 150 250 0 3 8 Along Heading Acceleration Gs 4 18 1.53E-5 50 110 1 0 A Right Thrust Reverser Position % -5 to 105 11 0.063 500 1000 1 0 B Right
Thrust Reverser Position % -5 to 105 11 0.063 500 1000 X X X GPS Differential Correction, Word A See ARINC 743A 3 7 6 0 0 4 Cross Heading Acceleration Gs 4 18 1.53E-5 50 110 0 0 5 Cross Heading Acceleration g 4 12 0.001 10 20 0 3 3 Spare DC2 VDC 16 12 0.004 150 250 0 3 8 Cross Heading Acceleration Gs 4 18 1.53E-5 50 110 X X X GPS
Differential Correction, Word B See ARINC 743A ARINC SPECIFICATION 429, PART 1 - Page 74 ATTACHMENT 2 DATA STANDARDS TABLE 2 - BNR DATA [1] The number entered into the Range Column for each parameter that is not angular in nature is the nearest whole binary number greater than the parameter range required.

As explained in the Commentary following Section 2.1.6 of this document, the weight of the most significant bit of the twos complement fractional notation binary word will be one half this value, and the actual maximum value of the parameter capable of being encoded will be the number in the range column less one least significant bit value. The numbers entered in the RANGE column for angular parameters are the actual degree ranges required.

The way in which these parameters are encoded is also explained in the Commentary following Section 2.1.6. [2] Transmit intervals and the number of parameters to be transmitted are prime factors in bus loading. The interval for transmission of parameters should fall between the minimum and maximum specified intervals and nominally should be near the center of the range at equal intervals between transmissions. When heavy bus loading dictates a shift from the center of the range, the shift should be toward the maximum transmit interval. When words with like labels and with different SDI codes are transmitted, each of those words is considered a unique item of information. The guidance given in this document for transmit intervals should be applied to those words as if each word were identified by a different label.

[3] Maximum transport delay is the worst case total delay between an input function and the output response. COMMENTARY Since the nature of the data varies, the definition of transport delay will differ depending on the application. In the case of a sampling system, a sample is complete when the 32-bit word constituting the output data is complete. In the case of a system involving filtering, transport delay is the phase slope of the transfer function across the frequency band of interest.

There can be situations in which it is necessary to define which portions of an equipment are included in the transport delay term. Such definitions should appear in individual equipment Characteristics when needed. [4] The values shown in parentheses are the preferred data standards for stator vane angle. However, a considerable portion of existing equipment use the other (non-parenthesized) values. Users should verify the data standards of the equipment they are or will be using.

[5] These labels can provide data in a degraded accuracy mode. See Section 2.1.5.1 and 2.1.5.2. [6] Optionally transmitted. [7] Binary packed word consisting of: Word 1 = Bits 11-19 (Range = 16) Word 2 = Bits 20-28 (Range = 16) c-4 c-5 c-7 c-12 c-4 ARINC SPECIFICATION 429, PART 1 - Page 75 ATTACHMENT 3 VOLTAGE LEVELS A B G RCVRA B G XMTR AC VO LT S XMTR OUTPUT STATES RCVR INPUT STATES HI NULL LO HI NULL LO ABV +10 -10 +11 +9 +13 +6.5 +2.5 -2.5 -6.5 -13 -9 -11 +0.5-0.5 c-4 c-4 ARINC SPECIFICATION 429, PART 1 - Page 76 ATTACHMENT 4 INPUT/OUTPUT CIRCUIT STANDARDS OUTPUT (SYSTEM) CAPABILITY Total System *Resistance Total System *Capacitance System Capacitance Unbalance 400 to 8,000 ohms 1,000 to 30,000 pF Not defined but unbalance due to aircraft interwiring should be held to a minimum UTILIZATION DEVICE STANDARDS RI > 12,000 ohms CI < 50 pF RH or RG > 12,000 ohms CH and CG < 50 pF The total differential input impedance of the receiver should be limited to the values specified in Section 2.2.4.2. This drawing describes total system characteristics rather than individual component parameters.

NOTES: * Includes aircraft interwiring ** Shields to be grounded in aircraft at both ends of all “breaks.” c-16 c-4 c-4 OTHER DEVICES TOTALSYSTEM OUTPUTCAPABILITY TRANSMITTING UNIT UTILIZATION DEVICE +E /2 -E /2 o o R /2 R /2 s s Eo CH CG RI RH RG CI ** ** ** **** ARINC SPECIFICATION 429, PART 1 - Page 77 ATTACHMENT 5 INTERNATIONAL STANDARDS ORGANIZATION CODE #5 The ISO Alphabet No. 5 seven-unit code set is reproduced in the table below with the BCD subset outlined in column 3: STANDARD CODE BIT 7 BIT 6 BIT 5 0 0 0 0 0 1 0 1 0 0 1 1 1 0 0 1 0 1 1 1 0 1 1 1 BIT 4 BIT 3 BIT 2 BIT 1 Column Row 0 1 2 3 4 5 6 7 0 0 0 0 NUL DLE SP 0 @ P ` p 0 0 0 1 1 SOH DC1 ! 1 A Q a q 0 0 1 0 2 STX DC2 " 2 B R b r 0 0 1 1 3 ETX DC3 # 3 C S c s 0 1 0 0 4 EOT DC4 $ 4 D T d t 0 1 0 1 5 ENQ NAK % 5 E U e u 0 1 1 0 6 ACK SYN & 6 F V f v 0 1 1 1 7 BEL ETB ′ 7 G W g w 1 0 0 0 8 BS CAN (8 H X h x 1 0 0 1 9 HT EM) 9 I Y i y 1 0 1 0 10 LF SUB * : J Z j z 1 0 1 1 11 VT ESC + ; K [k { 1 1 0 0 12 FF FS ′ < L \ l | 1 1 0 1 13 CR GS - = M] m } 1 1 1 0 14 SO RS • > N ∧ n ∼ 1 1 1 1 15 SI US / ? O _ o DEL NOTE: b8 is used as a parity bit. ARINC SPECIFICATION 429, PART 1 - Page 78 ATTACHMENT 6 GENERAL WORD FORMATS AND ENCODING EXAMPLES 6.1. General Word Formats TABLE 6-1 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 P [5] SSM [4] DATA PAD DISCRETES MSB [3] [2] LSB SDI [1] LABEL Generalized BCD Word Format TABLE 6-1-1 P SSM BCD CH #2 BCD CH #2 BCD CH #3 BCD CH #4 BCD CH #5 SDI 8 7 6 5 4 3 2 1 0 0 0 4 0 2 1 1 0 8 0 4 1 2 0 1 1 8 0 4 1 2 1 1 1 8 1 4 0 2 0 1 0 8 0 4 1 2 1 1 0 0 0 1 0 0 0 0 0 0 0 1 Example 2 5 7 8 6 DME DISTANCE (201) BCD Word Format Example (No Discretes) TABLE 6-2 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 P [5] SSM [4] DATA PAD DISCRETES MSB [3] [2] LSB SDI [1] LABEL Generalized BNR Word Format TABLE 6-2-1 8 7 6 5 4 3 2 1 P 31 30 SSM 29 1/2 1/4 1/8 1/16 1/32 1/64 1/128 etc 11PAD SDI LABEL 0 1 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 0 1 1 1 1 1 Example: 512 Knots (i.e., 1/8 x 4096 where 4096 is entry in range column of Table 2, Att. 2) N-S VELOCITY (366) BNR Word Format Example (No Discretes) TABLE 6-3 P SSM (01) “STX” UNIT ADDRESS WORD COUNT LABEL (357) 32 31 30 29 23 22 17 16 BNR EQUIV. 9 8 1 Alpha Numeric (ISO Alphabet No. 5) Message – Initial Word Format P SSM (01) “STX” SPARES (Zeroes) WORD COUNT LABEL (356) 32 31 30 29 23 22 17 16 BNR EQUIV.

9 8 1 Alpha Numeric (ISO Alphabet No. 5) Maintenance Data –Initial Word Format P SSM (00) “DATA CH #3” DATA CH #2 DATA CH #1 LABEL (356, 357) 32 31 30 29 P 23 22 L 16 15 A 9 8 1 Alpha Numeric (ISO Alphabet No. 5) Data – Intermediate Word Format P SSM (10) “DATA CH #3” DATA CH #2 DATA CH #1 LABEL (356, 357) 32 31 30 29 (BNR ZEROES) 23 22 A 16 15 H 9 8 1 Alpha Numeric (ISO Alphabet No. 5) Data – Final Word Format (Taken together, the following example shows encoding of the word ALPHA into three successive data words) c-4 ARINC SPECIFICATION 429, PART 1 - Page 79 ATTACHMENT 6 GENERAL WORD FORMATS AND ENCODING EXAMPLE TABLE 6-4 DISCRETES P SSM (00) SDI LABEL (See Below) 32 31 30 29 MSB [2] LSB 11 10 9 8 1 LABEL USAGE SUBGROUP 155 – 161 Maintenance 270 – 276 Discretes 350 – 354 Maintenance Discrete Word Format TABLE 6-5 ACKNOWLEDGEMENT WORD COUNT P SSM (01) (FORMAT NOT DEFINED) LABEL (355) 32 31 30 29 17 16 BNR EQUIV. 9 8 1 Acknowledgement Word – Initial Word Format TABLE 6-5-1 ACKNOWLEDGEMENT P SSM (00) (FORMAT NOT DEFINED) LABEL (355) 32 31 30 29 9 8 1 Acknowledgement Word – Intermediate Word Format TABLE 6-5-2 ACKNOWLEDGEMENT P SSM (10) (FORMAT NOT DEFINED) LABEL (355) 32 31 30 29 9 8 1 Acknowledgement Word – Final Word Format TABLE 6-6 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 P [5] SSM [4] DATA PADS * [3] SDI [1] LABEL (173/174) * Bit No. 11 takes on the binary state “one” to annunciate that the ILS receiver is in the “tune inhibit” condition. ILS Localizer/Glideslope Deviation Word TABLE 6-7 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 P [5] SSM [4] DATA FIELD ** * SDI [1] LABEL (202) * Bit No. 11 is assigned to a memory on/off annunciation function (see Section 4.7 of ARINC 709) ** Bit No. 12 is set to “1” when data is for a foreground station in frequency scanning mode. 0 1 0 0 0 0 0 1 DME Distance Word TABLE 6-8 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 DATE Day Month SSM x10 x1 x10 x1 FLIGHT LEG PAD [3] SDI [1] LABEL (260) 2 1 8 4 2 1 1 8 4 2 1 8 4 2 1 P A R I T Y 0 0 1 0 0 0 1 1 0 1 0 0 0 0 1 0 1 0 0 0 0 0 0 0 0 0 1 1 0 1 Example 2 3 0 8 5 0 6 2 Date/Flight Leg Word c-4 c-6 ARINC SPECIFICATION 429, PART 1 - Page 80 ATTACHMENT 6 GENERAL WORD FORMATS AND ENCODING EXAMPLES TABLE 6-9 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 FLIGHT NUMBER x1000 x100 x10 x1 SSM 8 4 2 1 8 4 2 1 8 4 2 1 8 4 2 1 PAD SDI LABEL (261) P A R I T Y 0 0 0 0 0 0 0 0 0 0 1 0 0 0 1 0 1 1 1 0 0 0 0 0 1 0 0 0 1 1 0 1 Example 0 1 1 7 1 6 2 Flight Number Word TABLE 6-10 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 P [5] SSM [4] MSB DATA LSBPAD [3] [6] SDI [1] LABEL (222) [6] Marker Beacon Output Discrete Bits Bit State Discrete Bit Discrete Grounded Discrete Open 400 Hz 1300 Hz 3000 Hz 11 12 13 1 1 1 0 0 0 VOR Omnibearing TABLE 6-11 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 P [5] SSM [4] MSB DATA LSB PAD LEVER POSITION SDI [1] LABEL (127/137) Bit Lever 11 12 13 14 15 Position 1 (Cruise) Position 2 Position 3 Position 4 Position 5 (Landing) 1 0 0 0 0 0 1 0 0 0 0 0 1 0 0 0 0 0 1 0 0 0 0 0 1 Slat/Flap Angle Word TABLE 6-12 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 P [5] SSM [4] HOURS 0-24 MINUTES 0-60 SECONDS 0-60 * SDI LABEL (150) *Bit 11 of label 150 should be encoded with a “1” when the GNSS system clock is being used as the source of time. Otherwise, bit 11 should be encoded as “0”. UTC Binary Word TABLE 6-13 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 LABEL (164) P [5] SSM [4] DATA PAD FTI SDI [1] 0 0 1 0 1 1 1 0 Note: When Bit 11 (Functional Test Inhibit) is a “1”, a functional test should not be performed. 4 6 1 Radio Height Word c-4 c-16 c-4 ARINC SPECIFICATION 429, PART 1 - Page 81 ATTACHMENT 6 GENERAL WORD FORMATS AND ENCODING EXAMPLE TABLE 6-14 32 31 30 29 28 27 26 25 24 23 22 21 20 1 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 DOCUMENTARY DATA 4 2 1 4 2 1 4 2 1 4 2 1 4 2 1 4 2 1 LABEL (262) P [5] SSM [4] Code 1 Code 2 Code 3 Code 4 Code 5 Code 6 PAD SDI [1] 0 1 0 0 1 1 0 1 Documentary Data Word [1] Source/Destination Identifier (SDI) Field The purpose of the SDI field is explained in Section 2.1.4 of this document, as are also the limitations on its use. When the SDI function is not required, this field may be occupied by binary zero or valid data pad bits. [2] Discretes As discussed in Section 2.3.1.2 of this document, unused bits in a word may be assigned to discrete functions, one bit per variable. Bit #11 of the word should be the first to be so assigned, followed by bit #12 and so on, in ascending numerical order, until the data field is reached. In the absence of discretes, unused bit positions should be occupied by binary zero or valid data pad bits.

[3] Pad All bit positions not used for data or discrete should be filled with binary zero or valid data pad bits. Section 2.1.2 of this document refers. [4] Sign/Status Matrix (SSM) Section 2.1.5 of this document describes the functions of the sign/status matrix and the ways in which the bits constituting it are encoded. [5] Parity Bit This bit is encoded to render word parity odd. Section 2.3.4 of this document refers. ARINC SPECIFICATION 429, PART 1 - Page 82 ATTACHMENT 6 GENERAL WORD FORMATS AND ENCODING EXAMPLES TABLE 6-15 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 P SSM PAD 3rd Digit 2nd Digit LSD PAD SDI LABEL (046) 1 0 0 0 0 0 0 1 1 0 0 1 0 0 1 0 0 1 0 0 0 0 0 0 0 0 1 1 0 0 1 0 0 Example 6 4 9 6 4 0 Engine Serial Number (3LDs) TABLE 6-16 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 P SSM PAD MSD 5th Digit 4th Digit PAD SDI LABEL (047) 0 0 0 0 0 0 0 0 0 0 0 0 1 1 0 0 1 0 0 0 0 0 0 0 1 1 1 0 0 1 0 0 Example 0 3 2 7 4 0 Engine Serial Number (3 MSDs) TABLE 6-17 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 P SSM SPARE MSD LSD SDI LABEL (377) 1 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 1 1 0 1 0 0 1 1 1 1 1 1 1 1 1 1 0 D 7 7 3 Equipment Identifier Word (Example provided for 10D code) c-17 ARINC SPECIFICATION 429, PART 1 - Page 83 ATTACHMENT 6 GENERAL WORD FORMATS AND ENCODING EXAMPLE TABLE 6-18 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 SSM DATE Day Month Year x10 x1 x10 x1 x10 x1 2 1 8 4 2 1 1 8 4 2 1 8 4 2 1 8 4 2 1 SDI LABEL (260 031) Chronometer Output Only P A R I T Y 0 0 1 0 0 0 1 1 0 1 0 0 0 1 0 0 0 0 1 0 1 0 0 0 0 0 0 1 1 0 1 Example 2 3 0 8 8 5 0 6 2 TABLE 6-19 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 4096-65535 LEGS P SSM (00) D PRIMARY COUNTER 0-4096 FLIGHT LEGS MSB LSB MSB LSB PAD SDI LABEL (251 01A) Electronic Supervisory Control Flight Leg Counter TABLE 6-20 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 P SSM (00) ALTITUDE MSB LSB SEE BELOW SDI LABEL (206 018) Transponder Bits 13 12 11 Range Bits Used App. Resolution 0 0 0 0 1 1 0 0 1 1 0 0 0 1 0 1 0 1 65536 65536 65536 51200 81920 51200 15 14 13 12 14 10 4 8 16 25 10 100 Altitude (Variable Reduction) ARINC SPECIFICATION 429, PART 1 - Page 84 ATTACHMENT 6 GENERAL WORD FORMATS AND ENCODING EXAMPLES TCAS INTRUDER RANGE WORD TABLE 6-21 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 P SSM [5] INTRUDER RANGE [3] [4] INTRUDER SENSE LVL[2] INTRUDER NUMBER [1] SDI LABEL (130) 0 1 1 0 0 0 0 1 0 1 0 1 0 0 0 1 0 0 0 1 0 1 0 0 0 0 0 1 1 0 1 0 MSB LSB MSB LSB MSB LSB LSB MSB 5.25 NM 2 5 0 3 1 Note 1: Maximum number of intruders is 31. Note 2: Intruder Sensitivity Level Status Bits Meaning 18 17 16 0 0 0 0 1 1 1 1 0 0 1 1 0 0 1 1 0 1 0 1 0 1 0 1 Not Reported SL = 1 SL = 2 SL = 3 SL = 4 SL = 5 SL = 6 SL = 7 Note 3: Maximum range is 127-15/16 nautical miles. Note 4: Intruder range may be reported in the form of horizontal range when intruder is available.

Note 5: Sign Status Matrix (SSM) [BNR] Bits Meaning 31 30 0 0 1 1 0 1 0 1 Failure Warning No Computed Data Functional Data Normal Operation ARINC SPECIFICATION 429, PART 1 - Page 85 ATTACHMENT 6 GENERAL WORD FORMATS AND ENCODING EXAMPLE TCAS INTRUDER ALTITUDE WORD TABLE 6-22 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 P SSM [5] [4] RELATIVE ALTITUDE [3] I.V.S. [2] FUTURE SPARE INTRUDER NUMBER [1] SDI LABEL (131) 0 1 1 0 0 0 1 1 0 0 1 0 0 0 0 0 0 0 0 0 1 0 1 0 0 1 0 0 1 1 0 1 0 S MSB LSB MSB LSB LSB MSB 2500 FT LEVEL 5 1 3 1 Note 1: Maximum number of intruders is 31.

Note 2: Sense of Intruders VERTICAL RATE (Z SINT) Bits Meaning 21 20 0 0 1 1 0 1 0 1 No Vertical Rate (Level Flight) Climbing Descending No Data Note 3: Binary, Two’s Complement Range = ± 12700 Ft. Note 4: The No Computed Data Report of the SSM field applies to relative altitude (Bits 29-22) only.

See Note 5.

Note 5: Sign Status Matrix (SSM) [BNR] Bits Meaning 31 30 0 0 1 1 0 1 0 1 Failure Warning No Computed Data Functional Data Normal Operation ARINC SPECIFICATION 429, PART 1 - Page 86 ATTACHMENT 6 GENERAL WORD FORMATS AND ENCODING EXAMPLES TCAS INTRUDER BEARING WORD TABLE 6-23 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 P SSM [5] [4] BEARING [3] DISPLAY MATRIX [2] INTRUDER NUMBER [1] SDI LABEL (132) 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 1 0 1 1 0 1 0 S MSB LSB MSB LSB MSB LSB LSB MSB 0 NO THREAT 1 2 3 1 Note 1: Maximum number of intruders is 31. Note 2: Display Matrix Bits Meaning 18 17 16 0 0 0 0 1 1 1 1 0 0 1 1 0 0 1 1 0 1 0 1 0 1 0 1 No Threat Traffic Advisory Resolution Advisory Proximate Traffic Not Used Not Used Not Used Not Used Note 3: Binary, Fractional Binary; Range = -180 to +180 Degrees Note 4: The No Computed Data report in the SSM field applies to bearing information (Bits 29-19) only. See Note 5.

Note 5: Sign Status Matrix (SSM) [BNR] Bits Meaning 31 30 0 0 1 1 0 1 0 1 Failure Warning No Computed Data Functional Data Normal Operation ARINC SPECIFICATION 429, PART 1 - Page 87 ATTACHMENT 6 GENERAL WORD FORMATS AND ENCODING EXAMPLE TRANSPONDER ALTITUDE/TCAS OWN AIRCRAFT ALTITUDE TABLE 6-24 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 P SSM [2] S ALTITUDE ALT[1] PAD LABEL (203) 0 1 1 0 0 0 1 0 1 0 0 1 0 0 1 0 0 0 0 1 1 0 0 0 1 1 0 0 0 0 0 1 MSB LSB LSB MSB 21059 1 3 0 2 S = Sign Bit see Section 2.1.5.2 of this Document.

Note 1: Altitude Resolution Bits Meaning 11 0 1 1 Ft 100 Ft Note 2: Sign Status Matrix (SSM) [BNR] Bits Meaning 31 30 0 0 1 1 0 1 0 1 Failure Warning No Computed Data Functional Data Normal Operation ARINC SPECIFICATION 429, PART 1 - Page 88 ATTACHMENT 6 GENERAL WORD FORMATS AND ENCODING EXAMPLES Table 6-25 BCD DATA ENCODING EXAMPLES Bit No. 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 DATA FIELD [1] MSC LSC LABEL PARAMETER (Label) SSM 4 2 1 8 4 2 1 8 4 2 1 8 4 2 1 8 4 2 1 SDI 1 2 4 1 2 4 1 2 Distance To Go (001) +2750.4 NM 1 0 0 0 1 0 0 1 1 1 0 1 0 1 0 0 0 0 0 1 0 0 0 0 1 0 0 0 0 0 0 0 0 Time To Go (002) +145.3 Min. 0 0 0 0 0 1 0 1 0 0 0 1 0 1 0 0 1 1 P P P P 0 0 0 1 0 0 0 0 0 0 0 Cross Track Distance (003) 225.6 NM 1 0 0 0 1 0 0 0 1 0 0 1 0 1 0 1 1 0 P P P P 0 0 1 1 0 0 0 0 0 0 0 Ground Speed (012) 650 Knots 1 0 0 0 0 0 0 1 1 0 0 1 0 1 0 0 0 0 P P P P 0 0 0 1 0 1 0 0 0 0 Track Angle (True) (013) 165.5 Deg. 1 0 0 0 0 0 1 0 1 1 1 0 0 1 0 1 0 1 0 1 P P P P P 0 0 1 1 0 1 0 0 0 0 Selected Vertical Speed (020) -2200 Ft/Min 0 1 1 0 1 0 0 0 1 0 0 0 0 0 0 0 0 0 0 P P P P 0 0 0 0 0 0 0 1 0 0 0 Selected EPR (021) 2.05 0 0 0 0 0 1 0 0 0 0 0 0 0 1 0 1 P P P P P P P P 0 0 0 1 0 0 0 1 0 0 0 Selected N1 (021) 2750 RPM 1 0 0 0 1 0 0 1 1 1 0 1 0 1 0 0 0 0 P P P P 0 0 1 0 0 0 1 0 0 0 Selected Mach (022) 0.850 Mach 0 0 0 0 0 0 0 0 1 0 0 0 0 1 0 1 0 0 0 0 P P P P 0 0 0 1 0 0 1 0 0 0 Selected Heading (023) 177 Deg. 1 0 0 0 0 1 0 1 1 1 0 1 1 1 P P P P P P P P P 0 0 1 1 0 0 1 0 0 0 Selected Course (024) 154 Deg. 1 0 0 0 1 0 0 1 0 1 0 1 0 0 P P P P P P P P P 0 0 0 1 0 1 0 0 0 Selected Altitude (025) 41000 Ft. 0 0 0 1 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 1 0 1 0 0 0 Selected Airspeed (026) 423 Knots 0 0 0 1 0 0 0 0 0 1 0 0 0 1 1 P P P P P P P P 0 0 0 1 1 0 1 0 0 0 Universal Time Constant (125) 1545.5 Hr. 1 0 0 0 0 1 0 1 0 1 0 1 0 0 0 1 0 1 0 1 0 1 0 0 1 0 1 0 1 0 1 0 Radio Height (165) 2450.5 Ft. 0 0 0 0 1 0 0 1 0 0 0 1 0 1 0 0 0 0 0 1 0 1 0 0 1 0 1 0 1 1 1 0 Decision Height Selected (170) 200 Ft. 0 0 0 0 1 0 0 0 0 0 0 0 0 0 P P P P P P P P 0 0 0 0 0 1 1 1 1 0 DME Distance (201) 257.86 NM 0 0 0 0 1 0 0 1 0 1 0 1 1 1 1 0 0 0 0 1 1 0 0 0 1 0 0 0 0 0 0 1 True Airspeed (230) 565 Knots 0 0 0 1 0 1 0 1 1 0 0 1 0 1 P P P P P P P P 0 0 0 0 0 1 1 0 0 1 Total Air Temp. (231) -025 Deg. C [2] 0 1 1 0 0 0 0 0 1 0 0 1 0 1 P P P P P P P P 0 0 1 0 0 1 1 0 0 1 Altitude Rate (232) -15250 Ft/Min 1 1 1 0 0 1 0 1 0 1 0 1 0 0 1 0 0 1 0 1 0 0 0 0 0 0 1 1 0 0 1 Static Air Temp. (233) +013 Deg. C [2] 1 0 0 0 0 0 0 0 0 1 0 0 1 1 P P P P P P P P 0 0 1 1 0 1 1 0 0 1 Baroset (ins Hg) (235) 29.92 ins Hg 0 0 0 0 1 0 1 0 0 1 1 0 0 1 0 0 1 0 P P P P 0 0 1 0 1 1 1 0 0 1 NOTES: [1] “P” denotes pad “zero” or valid data, see Section 2.1.2. Note possible use of pad bits for discrete functions per Section 2.3.1.2. [2] Because of the actual maximum value of the most significant character of these quantities exceeds 7, it cannot be encoded in the most significant character position of the BCD word. For this reason, each quantity has been given an “artificial” MSC of zero and its actual MSC encoded in the next most significant character position of the BCD word. ARINC SPECIFICATION 429, PART 1 - Page 89 ATTACHMENT 6 GENERAL WORD FORMATS AND ENCODING EXAMPLE Table 6-25-1 BCD ENCODING OF LATITUDE AND LONGITUDE Bit No. 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1DATA FIELD MSC LSC LABEL PARAMETER (Label) SSM 1 8 4 2 1 8 4 2 1 8 4 2 1 8 4 2 1 8 4 2 1 8 4 2 1 1 2 4 1 2 4 1 2 Present Position (Lat.) N 75 Deg 59.9' (010) 1 0 0 0 0 1 1 1 0 1 0 1 0 1 0 1 1 0 0 1 1 0 0 1 0 0 0 1 0 0 0 0 Present Position (Long) W 169 Deg 25.8' (011) 0 1 1 1 0 1 1 0 1 0 0 1 0 0 1 0 0 1 1 0 0 0 1 0 0 1 0 0 0 0 (See Commentary following Section 2.1.2 of this document for further information.) c-4 ARINC SPECIFICATION 429, PART 1 - Page 90 ATTACHMENT 6 GENERAL WORD FORMATS AND ENCODING EXAMPLES TABLE 6-26 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 Bit Nos. MSB LS B DATA Wheel 747 Nos. DC-10 PAR ITY B NR B CD SPARES 512 256 128 64 32 16 8 4 2 1 SPA RE SPA RE DIF F. L OW TH RE SHO LD LO W WH EE L F AU LT SY ST EM FA UL T WH EE L LA BE L LABEL REF. ARINCOCT. 1 1 1 0 0 0 1 0 1 1 0 0 1 0 115 2 2 1 0 0 1 1 0 1 1 0 0 1 0 115 13 3 1 0 0 0 1 1 1 1 0 0 1 0 117 14 4 1 0 0 1 1 1 1 1 0 0 1 0 117 3 5 1 0 1 0 1 0 1 1 0 0 1 0 115 4 6 1 0 1 1 1 0 1 1 0 0 1 0 115 15 7 1 0 1 0 1 1 1 1 0 0 1 0 117 16 8 1 0 1 1 1 1 1 1 0 0 1 0 117 5 9 1 0 0 0 0 0 1 1 0 0 1 0 114 9 10 1 0 0 0 0 1 1 1 0 0 1 0 116 6 1 0 0 1 0 0 1 1 0 0 1 0 114 7 1 0 1 0 0 0 1 1 0 0 1 0 114 8 1 0 1 1 0 0 1 1 0 0 1 0 114 10 1 0 0 1 0 1 1 1 0 0 1 0 116 11 1 0 1 0 0 1 1 1 0 0 1 0 116 12 1 0 1 1 0 1 1 1 0 0 1 0 116 BITS 10 9 NL NR 00 01 NL NR 00LO (061) RO (063) LO (061) RO (063) LI (060) RI (062) LI (060) RI (062) 1 2 00 01 3 4 10 11 5 6 87 00 01 10 11 9 10 1211 00 01 10 11 13 14 1615 00 10 01 11 1 2 5 6 00 01 10 11 3 4 7 8 9 10 00 00 01 01 00 01 10 11 747NOSE (064) DC-10NOSE (064) ARINC SPECIFICATION 429, PART 1 - Page 91 ATTACHMENT 6 GENERAL WORD FORMATS AND ENCODING EXAMPLE TABLE 6-26-1 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 Bit Nos. MSB LS B DATA Wheel 747 Nos. DC-10 PAR ITY B NR B CD SPARES 512 256 128 64 32 16 8 4 2 1 PR ED ICT DIF F.T EM P. WA RM HO T BR AK E F AU LT SY ST EM WH EE L LA BE L LABEL REF. ARINC OCT. 1 1 1 0 0 0 1 0 1 1 0 0 0 0 115 2 2 1 0 0 1 1 0 1 1 0 0 1 0 115 13 3 1 0 0 0 1 1 1 1 0 0 1 0 117 14 4 1 0 0 1 1 1 1 1 0 0 1 0 117 3 5 1 0 1 0 1 0 1 1 0 0 1 0 115 4 6 1 0 1 1 1 0 1 1 0 0 1 0 115 15 7 1 0 1 0 1 1 1 1 0 0 1 0 117 16 8 1 0 1 1 1 1 1 1 0 0 1 0 117 5 9 1 0 0 0 0 0 1 1 0 0 1 0 114 9 10 1 0 0 0 0 1 1 1 0 0 1 0 116 6 1 0 0 1 0 0 1 1 0 0 1 0 114 7 1 0 1 0 0 0 1 1 0 0 1 0 114 8 1 0 1 1 0 0 1 1 0 0 1 0 114 10 1 0 0 1 0 1 1 1 0 0 1 0 116 11 1 0 1 0 0 1 1 1 0 0 1 0 116 12 1 0 1 1 0 1 1 1 0 0 1 0 116 BITS 10 9 LO (115) RO (117) LO (115) RO (117) LI (114) RI (116) LI (114) RI (116) 1 2 00 01 3 4 10 11 5 6 87 00 01 10 11 9 10 1211 00 01 10 11 13 14 1615 00 10 01 11 1 2 5 6 00 01 10 11 3 4 7 8 9 10 00 00 01 01 00 01 10 11 747 DC-10 ARINC SPECIFICATION 429, PART 1 - Page 92 ATTACHMENT 6 GENERAL WORD FORMATS AND ENCODING EXAMPLES Table 6-27 BNR DATA ENCODING EXAMPLES Bit No. 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1LABEL PARAMETER (Label) P SSM DATA FIELD [1] SDI 1 2 4 1 2 4 1 2Selected Course (100) 0 Deg. [3] 0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 P P P P P P 0 0 0 0 0 0 0 0 0 1 0 Selected Heading (101) 150 Deg. [3] 0 1 1 0 1 1 0 1 0 1 0 1 0 1 0 1 P P P P P P P 0 0 1 0 0 0 0 0 1 0 Selected Altitude (102) 41000 Ft. 1 1 1 0 1 0 1 0 0 0 0 0 0 0 0 1 0 1 0 0 0 P P 0 0 0 1 0 0 0 0 0 1 0 Selected Airspeed (103) 423.0 Knots 0 1 1 0 1 1 0 1 0 0 1 1 1 0 0 P P P P P P P P 0 0 1 1 0 0 0 0 0 1 0 Selected Vertical Speed (104) -2200 Ft/Min [2] 1 1 1 1 1 1 0 1 1 1 0 1 1 0 P P P P P P P P 0 0 0 0 0 1 0 0 0 1 0 Selected Mach (106) 800 m Mach 1 1 1 0 0 0 1 1 0 0 1 0 0 0 0 0 P P P P P P 0 0 0 1 1 0 0 0 1 0 Desired Track (114) 275 Deg. [3] 0 1 1 1 1 1 0 0 0 0 1 1 1 0 0 1 0 P P P P P P 0 0 0 0 0 1 1 0 0 1 0 Cross Track Distance (116) 51.0 NM 1 1 1 0 0 1 1 0 0 1 1 0 0 0 0 0 0 0 0 P P P 0 0 0 1 1 1 0 0 1 0 Vertical Deviation (117) 600 Ft. 0 1 1 0 0 1 0 0 1 0 1 1 0 0 0 P P P P P P P 0 0 1 1 1 1 0 0 1 0 Flight Director Roll (140) +30 Deg. 1 1 1 0 0 0 1 0 1 0 1 0 1 0 1 0 1 0 1 1 P P P P P P 0 0 0 0 0 0 0 0 1 1 0 Flight Director Pitch (141) -10 Deg.

[2] 1 1 1 1 1 1 1 1 1 0 0 0 1 1 1 0 0 P P P P P P P P 0 0 1 0 0 0 0 1 1 0 Fast/Slow (142) +15 Knots 0 1 1 0 0 1 1 1 1 0 0 0 0 0 0 0 0 P P P P P P P P 0 0 0 1 0 0 0 1 1 0 UTC (150) (18:57:20) 0 1 1 0 1 0 0 1 0 1 1 1 0 0 1 0 1 0 1 0 0 0 0 0 0 0 0 0 0 1 0 1 1 0 Radio Height (164) 2450 Ft. 0 1 1 0 0 1 0 0 1 1 0 0 1 0 0 1 0 0 0 0 P 0 0 0 0 0 0 1 0 1 1 1 0 Localizer Deviation (173) +0.021 DDM 1 1 1 0 0 0 0 0 1 1 0 1 1 0 0 0 P P P P P P P 0 0 1 1 0 1 1 1 1 0 Glide Slope Deviation (174) -0.125 DDM [2] 1 1 1 1 1 1 1 0 1 1 0 0 0 0 0 0 0 0 P P P P P P 0 0 0 0 1 1 1 1 1 0 DME Distance (202) 257.86 NM 0 1 1 0 1 0 0 0 0 0 0 0 0 1 1 1 0 1 1 1 0 P 0 0 0 0 1 0 0 0 0 0 1 Altitude (29.92) (203) 45000 Ft. 0 1 1 0 0 1 0 1 0 1 1 1 1 1 1 1 0 0 1 0 0 0 P 0 0 1 1 0 0 0 0 0 1 Mach (205) 0.8325 Mach 0 1 1 0 0 0 1 1 0 1 0 0 0 0 0 0 0 1 0 0 0 P P 0 0 1 0 1 0 0 0 0 1 Computed Airspeed (206) 425 Knots 1 1 1 0 0 1 1 0 1 0 1 0 0 1 0 0 0 0 0 P P P P 0 0 0 1 1 0 0 0 0 0 1 True Airspeed (210) 565 Knots 0 1 1 0 0 1 0 0 0 1 1 0 1 0 1 0 0 0 0 0 P P P 0 0 0 0 0 0 1 0 0 0 1 Static Air Temp (213) +13 Deg. C 0 1 1 0 0 0 0 0 0 0 1 1 0 1 0 0 P P P P P P 0 0 0 1 1 0 1 0 0 0 1 Total Air Temp (211) -25 Deg. C [2] 0 1 1 1 1 1 1 1 1 0 0 1 1 1 1 0 0 P P P P P P P P P 0 0 1 0 0 1 0 0 0 1 Altitude Rate (212) -15250 Ft/Min [2] 0 1 1 1 1 0 0 0 1 0 0 1 0 0 0 0 0 0 0 1 1 1 P P P P P P P P 0 0 0 1 0 1 0 0 0 1 Present Pos. Lat. (310) N 81.5 Deg 1 1 1 0 0 1 1 1 0 0 1 1 1 1 1 1 0 1 0 1 0 1 0 0 0 0 0 0 0 1 0 0 1 1 Present Pos. Long. (311) W 100.25 0 1 1 1 0 1 1 1 0 0 0 1 0 1 1 0 1 1 0 0 0 0 0 0 0 1 0 0 1 0 0 1 1 Ground Speed (312) 650 Knots 1 1 1 0 0 0 1 0 1 0 0 0 1 0 1 0 0 0 0 P P P 0 0 0 1 0 1 0 0 1 1 Flight Path Accel (323) +2.50 g 0 1 1 0 1 0 1 0 0 0 0 0 0 0 1 0 1 0 0 P P P P 0 0 1 1 0 0 1 0 1 1 NOTES: [1] “P” denotes pad “zero” or valid data, see Section 2.1.2. Note possible use of pad bits for discrete functions per Section 2.3.1.2. [2] Negative values are encoded as the two’s complements of positive values and the negative sign is annunciated in the sign/status matrix. [3] Angles in the range 0 to 180o are encoded as positive numbers.

Angles in the range 180o to 360o are subtracted from 360o and the resulting number encoded as a negative value per note 2. Arc minutes and seconds are encoded as decimal degrees. ARINC SPECIFICATION 429, PART 1 - Page 93 ATTACHMENT 6 GENERAL WORD FORMATS AND ENCODING EXAMPLE TABLE 6-28 AVM Command Word – Label 227 03D 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 P Command/Control Bits AVM Hex (Equipment) ID = 03D Hex PADS SDI Label (227) 0 0 0 0 0 0 1 1 1 1 0 1 1 1 1 1 0 1 0 0 1 Bits Meaning 10 9 0 0 Engine 4 (or All Call) {not used on 757} 0 1 Engine 1 (or Engine 1 and 2) 1 0 Engine 2 1 1 Engine 3 (or Engine 3 and 4) Bits Parameter 31 30 29 28 27 26 25 0 0 0 0 0 0 0 Not Used 0 0 0 0 0 0 1 Unit Self Test 0 0 0 0 0 1 0 Use Accelerometer A** 0 0 0 0 0 1 1 Use Accelerometer B** 0 0 0 0 1 0 0 PAD 0 0 0 0 1 0 1 Erase Fault History 0 0 0 0 1 1 0 Erase Flight History* 0 0 0 0 1 1 1 Read Fault History 0 0 0 1 0 0 0 Read Flight History* 0 0 1 0 0 1 0 Reserved* * 737 Only ** 757 Only ARINC SPECIFICATION 429, PART 1 - Page 94 ATTACHMENT 6 GENERAL WORD FORMATS AND ENCODING EXAMPLES ACMS INFORMATION ORIGIN AND DESTINATION TABLE 6-29 Label 061 002 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 P SSM ORIGIN CHAR #3 ORIGIN CHAR #2 ORIGIN CHAR #1 OCTAL LABEL 061 Label 062 002 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 P SSM DESTINATION CHAR #1 ISO #5 CHAR “SPACE” ORIGIN CHAR #4 OCTAL LABEL 062 Label 063 002 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 P SSM DESTINATION CHAR #4 DESTINATION CHAR #3 DESTINATION CHAR #2 OCTAL LABEL 063 NOTE: All characters are expressed in ISO #5 format, as defined in Specification 429. ARINC SPECIFICATION 429, PART 1 - Page 95 ATTACHMENT 6 GENERAL WORD FORMATS AND ENCODING EXAMPLE TABLE 6-30 TACAN Control - Label 145 002 RANGE 126 RESOLUTION 1.0 RATE 5Hz ± 10% Bit No. Description 1 0 2 1 1 3 1 4 0 5 0 4 6 1 7 0 8 1 5 9-10 SDI 11-13 Pad Zero 14 VOR/TAC Select (TAC=1, VOR=0) 15 TACAN Select (TAC 1=1, TAC 2=0) 16 Pad Zero 17-20 BCD Units Chan Cont (LSB=17) 21-24 Hex Tens Chan Cont (LSB=24) 25 Pad Zero 26 X/Y Mode (X=1, Y=0) 27-28 Mode Cont (see Table A) 29 Pad Zero 30-31 SSM (see Table B) 32 Parity (Odd) Table A – Mode Control Table B – SSM Bits Description 27 28 0 0 REC 0 1 A/A REC 1 0 T/R 1 1 A/A T/R Bits Description 30 31 0 0 Valid 0 1 Functional Test 1 0 No Computed Data 1 1 Not Used ARINC SPECIFICATION 429, PART 1 - Page 96 ATTACHMENT 6 GENERAL WORD FORMATS AND ENCODING EXAMPLES ACMS INFORMATION FLIGHT NUMBER TABLE 6-31 Label 233 EQ ID 002 MSB LSB MSB LSB 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 P SSM PAD ZERO CHAR #2 PAD ZEROCHAR #1 SDI OCTAL LABEL 233 Label 234 EQ ID 002 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 P SSM PAD ZERO CHAR #4 PAD ZEROCHAR #3 SDI OCTAL LABEL 234 Label 235 EQ ID 002 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 P SSM PAD ZERO CHAR #6 PAD ZEROCHAR #5 SDI OCTAL LABEL 235 Label 236 EQ ID 002 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 P SSM PAD ZERO CHAR #8 PAD ZEROCHAR #7 SDI OCTAL LABEL 236 Sign Matrix for BNR Bit 31 30 Meaning 0 0 Failure Warning 0 1 No Computed data 1 0 Functional Test 1 1 Normal Operation

.... TABLE 6-32 Label 233 EQ ID 018 MSB LSB MSB LSB 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 P SSM PAD ZERO CHAR #2 PAD ZEROCHAR #1 SDI OCTAL LABEL 233 Label 234 EQ ID 018 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 P SSM PAD ZERO CHAR #4 PAD ZEROCHAR #3 SDI OCTAL LABEL 234 Label 235 EQ ID 018 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 P SSM PAD ZERO CHAR #6 PAD ZEROCHAR #5 SDI OCTAL LABEL 235 Label 236 EQ ID 018 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 P SSM PAD ZERO CHAR #8 PAD ZEROCHAR #7 SDI OCTAL LABEL 236 Sign Matrix for BCD NOTE: The following information is provided in order to clarify the confusion that existed in the Industry in regards to definition of the SSM for Label 233-236. It is expected that Flight ID will be sourced from FMC EQ ID of 002. Alternative implementation may include Mode “S” XPDR EQ ID 018. In this case the user cautioned that the SSM will be BCD format. See ARINC Characteristic 718A, “Mark 4 Air Traffic Control Transponder (ATCRB/MODE S)”, Attachment 3A for more detailed information. Bit 31 30 Meaning 0 0 Valid 0 1 No Computed data 1 0 Functional Test 1 1 Failure Warning c-16 ARINC SPECIFICATION 429, PART 1 - Page 97 ATTACHMENT 6 GENERAL WORD FORMATS AND ENCODING EXAMPLE TABLE 6-33 Label 360-002 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 “STX” BINARY WORD COUNT P 0 1 0 0 0 0 0 1 0 PAD ZERO 0 1 0 0 0 1 1 1 OCTAL LABEL 360 INITIAL WORD 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 P 0 0 FLIGHT NUMBER CHAR #3 FLIGHT NUMBER CHAR #2 FLIGHT NUMBER CHAR #1 OCTAL LABEL 360 INTERMEDIATE WORD (SECOND) 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 P 0 0 FLIGHT NUMBER CHAR #6 FLIGHT NUMBER CHAR #5 FLIGHT NUMBER CHAR #4 OCTAL LABEL 360 INTERMEDIATE WORD (THIRD) 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 P 0 0 ORIGIN CHAR #1 FLIGHT NUMBER CHAR #8 FLIGHT NUMBER CHAR #7 OCTAL LABEL 360 INTERMEDIATE WORD (FOURTH) 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 P 0 0 ORIGIN CHAR #4 ORIGIN CHAR #3 ORIGIN CHAR #2 OCTAL LABEL 360 INTERMEDIATE WORD (FIFTH) 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 P 0 0 DESTINATION CHAR #3 DESTINATION CHAR #2 DESTINATION CHAR #1 OCTAL LABEL 360 INTERMEDIATE WORD (SIXTH) 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 P 0 0 PAD ZEROS PAD ZEROS DESTINATION CHAR #4 OCTAL LABEL 360 INTERMEDIATE WORD (SEVENTH) NOTE: All characters are expressed in ISO #5 format, as defined in Attachment 5.

ARINC SPECIFICATION 429, PART 1 - Page 98 ATTACHMENT 6 GENERAL WORD FORMATS AND ENCODING EXAMPLES TABLE 6-34 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 P 0 SUBSYSTEM SAL MSB SUBSYSTEM ID (LABEL 172) ARINC SPECIFICATION 429, PART 1 - Page 99 ATTACHMENT 6 GENERAL WORD FORMATS AND ENCODING EXAMPLE TABLE 6-35 FQIS System Data - Label 241 04D LABEL: 241 EQPT ID: 04D PARAMETER NAME: FQIS System Data UNITS: (See Below) RANGE (SCALE): (See Below) SIGNIFICANT DIGITS: (See Below) RESOLUTION: (See Below) MIN TRANS INTERVAL (msec): 500 MAX TRANS INTERVAL (msec): 1024 SOURCE DESTINATION IDENTIFIER: 01 – LEFT MAIN TANK 10 – RIGHT MAIN TANK 11 – CENTER TANK Label 241 is transmitted approximately once per second.

The data encoding depends on the sequence which it is transmitted. Label 241 transmitting sequence, as defined below, starts with the left main tank data followed by the right main tank and then the center tank. Once all the tank data has been transmitted (63 words of data), the sequence will repeat with word number 1, left main tank, and so on.

To determine the data that is transmitted at any specific time requires knowing where in the following sequence the word is taken.

LABEL 241 WORD SEQUENCE Sig. Word Signal Units Range Dig. Res Data 1 LEFT MAIN TANK NO. 1 pF 319.922 12 .078125 BNR 2 LEFT MAIN TANK NO.

2 pF 319.922 12 .078125 BNR 3 LEFT MAIN TANK NO. 3 pF 319.922 12 .078125 BNR 4 LEFT MAIN TANK NO. 4 pF 319.922 12 .078125 BNR 5 LEFT MAIN TANK NO. 5 pF 319.922 12 .078125 BNR 6 LEFT MAIN TANK NO. 6 pF 319.922 12 .078125 BNR 7 LEFT MAIN TANK NO. 7 pF 319.922 12 .078125 BNR 8 LEFT MAIN TANK NO. 8 pF 319.922 12 .078125 BNR 9 LEFT MAIN TANK NO. 9 pF 319.922 12 .078125 BNR 10 LEFT MAIN TANK NO. 10 pF 319.922 12 .078125 BNR 11 LEFT MAIN TANK NO. 11 pF 319.922 12 .078125 BNR 12 LEFT MAIN TANK NO. 12 pF 319.922 12 .078125 BNR 13 LEFT MAIN TANK NO. 13 pF 319.922 12 .078125 BNR 14 LEFT MAIN TANK NO. 14 pF 319.922 12 .078125 BNR 15 LEFT MAIN BITE CAP. NO.

1 pF 319.922 12 .078125 BNR 16 LEFT MAIN COMPENSATOR pF 319.922 12 .078125 BNR 17 LOAD SELECT 10,000 Lb 0-90000 1 10000 BCD 18 LOAD SELECT 1,000 Lb 0-9000 1 1000 BCD 19 LOAD SELECT 100 Lb 0-900 1 100 BCD 20 NO DATA TRANSMITTED DURING THIS WORD 21 LEFT MAIN FUEL DENSITY Lb/Gal 8.000 12 .000977 BNR (1) 22 RIGHT MAIN TANK NO. 1 pF 319.922 12 .078125 BNR 23 RIGHT MAIN TANK NO. 2 pF 319.922 12 .078125 BNR 24 RIGHT MAIN TANK NO. 3 pF 319.922 12 .078125 BNR 25 RIGHT MAIN TANK NO. 4 pF 319.922 12 .078125 BNR 26 RIGHT MAIN TANK NO.

5 pF 319.922 12 .078125 BNR 27 RIGHT MAIN TANK NO. 6 pF 319.922 12 .078125 BNR 28 RIGHT MAIN TANK NO. 7 pF 319.922 12 .078125 BNR 29 RIGHT MAIN TANK NO. 8 pF 319.922 12 .078125 BNR 30 RIGHT MAIN TANK NO. 9 pF 319.922 12 .078125 BNR 31 RIGHT MAIN TANK NO. 10 pF 319.922 12 .078125 BNR 32 RIGHT MAIN TANK NO. 11 pF 319.922 12 .078125 BNR 33 RIGHT MAIN TANK NO. 12 pF 319.922 12 .078125 BNR 34 RIGHT MAIN TANK NO.

13 pF 319.922 12 .078125 BNR 35 RIGHT MAIN TANK NO. 14 pF 319.922 12 .078125 BNR 36 RIGHT MAIN COMPENSATOR pF 319.922 12 .078125 BNR 37 RIGHT MAIN BITE CAP. NO. 2 pF 319.922 12 .078125 BNR 38 LOAD SELECT 10,000 Lb 0-90000 1 10000 BCD 39 LOAD SELECT 1,000 Lb 0-9000 1 1000 BCD 40 LOAD SELECT 100 Lb 0-900 1 100 BCD 41 NO DATA TRANSMITTED DURING THIS WORD 42 RIGHT MAIN DENSITY Lb/Gal 8.000 12 .000977 BNR 43 CENTER TANK NO. 1 pF 319.922 12 .078125 BNR 44 CENTER TANK NO.

2 pF 319.922 12 .078125 BNR 45 CENTER TANK NO. 3 pF 319.922 12 .078125 BNR 46 CENTER TANK NO. 4 pF 319.922 12 .078125 BNR ARINC SPECIFICATION 429, PART 1 - Page 100 ATTACHMENT 6 GENERAL WORD FORMATS AND ENCODING EXAMPLES TABLE 6-35 (cont’d) LABEL 241 WORD SEQUENCE (cont’d) Sig. Word Signal Units Range Dig. Res Data 47 CENTER TANK NO. 5 pF 319.922 12 .078125 BNR 48 CENTER TANK NO. 6 pF 319.922 12 .078125 BNR 49 CENTER TANK NO. 7 pF 319.922 12 .078125 BNR 50 CENTER TANK NO. 8 pF 319.922 12 .078125 BNR 51 CENTER TANK NO. 9 pF 319.922 12 .078125 BNR 52 CENTER COMPENSATOR pF 319.922 12 .078125 BNR 53 CENTER BITE CAP. NO. 3 pF 319.922 12 .078125 BNR 54 NO DATA TRANSMITTED DURING THIS WORD 55 NO DATA TRANSMITTED DURING THIS WORD 56 NO DATA TRANSMITTED DURING THIS WORD 57 NO DATA TRANSMITTED DURING THIS WORD 58 NO DATA TRANSMITTED DURING THIS WORD 59 LOAD SELECT 10,000 Lb 0-90000 1 10000 BCD 60 LOAD SELECT 1,000 Lb 0-9000 1 1000 BCD 61 LOAD SELECT 100 Lb 0-900 1 100 BCD 62 NO DATA TRANSMITTED DURING THIS WORD 63 CENTER TANK DENSITY Lb/Gal 8.000 12 .000977 BNR NOTES: (1) Add 4 Lb/Gal adjustment to density data, i.e., 0000 = 4.0 Lb/Gal, FFF = 8.0 Lb/Gal. FQIS (EQ ID 04D) SDI Encoding for Labels 012, 013, 020, 022, 023, 030, 255, 310, 320, 324, 342, 346, 354 Bits Data 9 10 0 0 Aux 1 1 Center 1 0 Left 0 1 Right FQIS (EQ ID 04D) SDI Encoding for Labels 156, 157, 160 Bits Data 9 10 0 0 #1 1 0 #2 0 1 #3 1 1 #4 ARINC SPECIFICATION 429, PART 1 - Page 101 ATTACHMENT 6 GENERAL WORD FORMATS AND ENCODING EXAMPLE TABLE 6-36 S/G HARDWARE PART NO. – Label 060 025 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 P SSM BCD CHARACTER *** RESERVED SDI OCTAL LABEL 060 Bit Status Bit No. Function 1 0 10 SDI (Indicates Sequence ID)* 11 RESERVED (Own P/N) 12 RESERVED (Position ID)** 13 RESERVED (Position ID)** Own P/N Other P/N * Refer to Table 1 below ** Refer to Table 2 below *** Unused Characters (Digits) are Pad Zero Table 1 Table 2 Bits 10 9 Sequence ID 0 1 1 0 1 1 First Three Digits Next Four Digits Last Three Digits Bits 13 12 Position ID 0 0 1 0 1 1 0 1 Left Center As Left Center As Right Right ARINC SPECIFICATION 429, PART 1 - Page 102 ATTACHMENT 6 GENERAL WORD FORMATS AND ENCODING EXAMPLES TABLE 6-37 S/G SOFTWARE PART NO. – Label 061 025 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 P SSM BCD CHARACTER *** RESERVED SDI OCTAL LABEL 061 Bit Status Bit No. Function 1 0 10 SDI (Indicates Sequence ID)* 11 RESERVED (Own P/N) 12 RESERVED (Position ID)** 13 RESERVED (Position ID)** Own P/N Other P/N * Refer to Table 1 below ** Refer to Table 2 below *** Unused Characters (Digits) are Pad Zero Table 1 Table 2 Bits 10 9 Sequence ID 0 1 1 0 1 1 First Three Digits Next Four Digits Last Three Digits Bits 13 12 Position ID 0 0 1 0 1 1 0 1 Left Center As Left Center As Right Right ARINC SPECIFICATION 429, PART 1 - Page 103 ATTACHMENT 6 GENERAL WORD FORMATS AND ENCODING EXAMPLE TABLE 6-37 OP. SOFTWARE PART NO. – Label 207 025 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 P SSM BCD CHARACTER *** RESERVED SDI OCTAL LABEL 207 Bit Status Bit No Function 1 0 10 SDI (Indicates Sequence ID)* 11 RESERVED (Own P/N) 12 RESERVED (Position ID)** 13 RESERVED (Position ID)** Own P/N Other P/N * Refer to Table 1 below ** Refer to Table 2 below *** Unused Characters (Digits) are Pad Zero Table 1 Table 2 Bits 10 9 Sequence ID 0 1 1 0 1 1 First Three Digits Next Four Digits Last Three Digits Bits 13 12 Position ID 0 0 1 0 1 1 0 1 Left Center As Left Center As Right Right ARINC SPECIFICATION 429, PART 1 - Page 104 ATTACHMENT 6 GENERAL WORD FORMATS AND ENCODING EXAMPLES TABLE 6-38 Tank Unit Data – Label 241 160 Word Number SDI DESCRIPTION UNITS 1 1 Tank Unit #1 pF2 1 Tank Unit #2 pF3 1 Tank Unit #3 pF4 1 Tank Unit #4 pF5 1 Tank Unit #5 pF6 1 Tank Unit #6 pF7 1 Tank Unit #7 pF8 1 Tank Unit #8 pF9 1 Tank Unit #9 pF 10 1 Tank Unit #10 pF11 1 Tank Unit #11 pF12 1 Tank Unit #12 pF13 1 Tank Unit #13 pF14 1 Tank Unit #14 pF15 1 BITE Capacitor pF16 1 Compensator pF17 1 Load Select Lbs.18 1 Load Select Lbs.19 1 Load Select Lbs.20 1 Undefined -21 1 Fuel Density Lbs/Gal22 2 Tank Unit #1 pF23 2 Tank Unit #2 pF24 2 Tank Unit #3 pF25 2 Tank Unit #4 pF26 2 Tank Unit #5 pF27 2 Tank Unit #6 pF28 2 Tank Unit #7 pF29 2 Tank Unit #8 pF30 2 Tank Unit #9 pF31 2 Tank Unit #10 pF32 2 Tank Unit #11 pF33 2 Tank Unit #12 pF34 2 Tank Unit #13 pF35 2 Tank Unit #14 pF36 2 Compensator pF37 2 BITE Capacitor #2 pF38 2 Load Select Lbs39 2 Load Select Lbs40 2 Load Select Lbs41 2 Undefined -42 2 Fuel Density Lbs/Gal43 3 Tank Unit #1 pF44 3 Tank Unit #2 pF45 3 Tank Unit #3 pF46 3 Tank Unit #4 pF47 3 Tank Unit #5 pF48 3 Tank Unit #6 pF49 3 Tank Unit #7 pF50 3 Tank Unit #8 pF51 3 Tank Unit #9 pF52 3 Compensator pF53 3 BITE Capacitor #3 pF54 3 Undefined -55 3 Undefined -56 3 Undefined -57 3 Undefined -58 3 Undefined -59 3 Load Select Lbs60 3 Load select Lbs61 3 Load Select Lbs62 3 Undefined -63 3 Fuel Density Lbs/Gal ARINC SPECIFICATION 429, PART 1 - Page 105 ATTACHMENT 6 GENERAL WORD FORMATS AND ENCODING EXAMPLE TABLE 6-38-1 Tank Unit Data – Label 241 160 (cont’d) RAW DATA TABLE All Data Entries are 12-bit Center Justified Words Table Organization: Words 1-20 raw data for left tank Word 1 = Tank Unit #1 Word 2 = Tank Unit #2 Word 3 = Tank Unit #3 Word 4 = Tank Unit #4 Word 5 = Tank Unit #5 Word 6 = Tank Unit #6 Word 7 = Tank Unit #7 Word 8 = Tank Unit #8 Word 9 = Tank Unit #9 Word 10 = Tank Unit #10 Word 11 = Tank Unit #11 Word 12 = Tank Unit #12 Word 13 = (Spare) Word 14 = (Spare) Word 15 = BITE Capacitor #1 Word 16 = Compensator Word 17 = Load Select 10,000 Digit Word 18 = Load Select 1,000 Digit Word 19 = Load Select 100 Digit Word 20 = None Word 21-40 raw data for right tank Word 21 = Tank Unit #1 Word 22 = Tank Unit #2 Word 23 = Tank Unit #3 Word 24 = Tank Unit #4 Word 25 = Tank Unit #5 Word 26 = Tank Unit #6 Word 27 = Tank Unit #7 Word 28 = Tank Unit #8 Word 29 = Tank Unit #9 Word 30 = Tank Unit #10 Word 31 = Tank Unit #11 Word 32 = Tank Unit #12 Word 33 = (Spare) Word 34 = (Spare) Word 35 = Compensator Word 36 = BITE Capacitor #2 Word 37 = Load Select 10,000 Digit Word 38 = Load Select 1,000 Digit Word 39 = Load Select 100 Digit Word 40 = None Words 41-60 raw data for Center Tank Word 41 = Tank Unit #1 Word 42 = Tank Unit #2 Word 43 = Tank Unit #3 Word 44 = Tank Unit #4 Word 45 = Tank Unit #5 Word 46 = Tank Unit #6 Word 47 = Tank Unit #7 Word 48 = Tank Unit #8 Word 49 = Tank Unit #9 Word 50 = Compensator Word 51 = BITE Capacitor #3 Word 52 = (Spare) Word 53 = (Spare) Word 54 = (Spare) Word 55 = (Spare) Word 56 = (Spare) Word 57 = Load Select 10,000 Digit Word 58 = Load Select 1,000 Digit Word 59 = Load Select 100 Digit Word 60 = None ARINC SPECIFICATION 429, PART 1 - Page 106 ATTACHMENT 6 GENERAL WORD FORMATS AND ENCODING EXAMPLES TABLE 6-39 Note: Bit examples for 24- bit ICAO address labels 24/216 have been moved to Part 2 of ARINC 429.

c-17 ARINC SPECIFICATION 429, PART 1 - Page 107 ATTACHMENT 6 GENERAL WORD FORMATS AND ENCODING EXAMPLES TABLE 6-40 RADIO SYSTEMS MANAGEMENT WORD FORMATS ADF Function PAR ITY (od d) SIG N/S TA TU S MA TR IX 1000 kHz (1) 100 kHz (0) 10 kHz (5) 1 kHz (7) 0. 5 kH z SPA RE AN T BFO RE SER VE D (SD I) LABEL ADF Frequency (032) 8 7 6 0 1 0 5 6 4 1 1 0 2 1 0 0 Bit No. Example Notes 32 1 31 30 0 0 29 28 27 0 0 1 26 25 24 23 0 0 0 0 22 21 20 19 0 1 0 1 18 17 16 15 0 1 1 1 14 1 [1] 13 0 12 0 [2] 11 0 [2] 10 9 0 0 2 3 0 [1] When bit no. 14 is “zero,” the radio should tune to the whole kilohertz frequency encoded in the word. When bit no. 14 is “one,”the radio should tune 0.5 kHz above this frequency. [2] TABLE 6-41 DME Function PAR ITY (od d) SIG N/S TA TU S MA TR IX 10 MHz 1 MHz 0.1 MHz 0.00 /0.0 5 M Hz IDE NT D ISPL AY ML S FR EQ . ILS FRE Q. DME Mode SDI LABEL DME Frequency (035) 8 7 6 1 0 1 5 4 3 1 1 0 2 1 0 0 Bit No. Example Notes [1] [5] 32 1 31 30 0 0 29 28 27 0 0 1 26 25 24 23 0 1 0 1 22 21 20 19 0 1 1 0 18 1 [2] 17 16 0 1 [7] 15 0 [3] 14 0 13 12 11 0 0 0 [4] 10 9 0 0 5 3 0 [1] Directed Frequency #1, 115.65 MHz, VOR [2] Bit 18 is used only for VOR & ILS frequencies and is limited to .00 or .05 [3] Bits 15 & 14 codes: VOR (0,0), ILS (0,1) or MLS (1,0), (1,1) is spare .

[4] Refer to table in Section 4.1.2 of ARINC Characteristic 709 for mode codes .

[5] Although not encoded in the tuning word all VOR & ILS frequencies have 1 as hundreds digit. Although not encoded in the tuning word all MLS frequencies have 5 as the thousand digit and 0 as the hundred digit.

Add 5031 MHz to the coded value to obtain the MLS frequency. [6] (Original note deleted) [7] Bit 16 when equal to “one” specifies that a displayable BCD output is to be provided for that station, and when bit 17 is a “one,” an ident output is to be generated for that station. c-4 Bit Zero One 11 BFO off BFO on 12 ADF Mode ANT Mode c-4 c-16 c-10 ARINC SPECIFICATION 429, PART 1 - Page 108 ATTACHMENT 6 GENERAL WORD FORMATS AND ENCODING EXAMPLES TABLE 6-42 RADIO SYSTEMS MANAGEMENT WORD FORMATS HF COM Word #1 Function PAR ITY (O dd) SIG N/S TA TU S MA TR IX 10 MHz (2) 1 MHz (3) 0.1 MHz (5) 0.01 MHz (7) 0.001 MHz (9) USB /LSB MO DE SS M/A M M OD E WO RD ID EN T.

LABEL HF COM Frequency (037) 8 7 6 1 1 1 5 4 3 1 1 0 2 1 0 0 Bit No. Example Notes 32 0 31 30 0 0 29 28 1 0 27 26 25 24 0 0 1 1 23 22 21 20 0 1 0 1 19 18 17 16 0 1 1 1 15 14 13 12 1 0 0 1 11 10 9 0 0 0 [1] [2] 7 3 0 [1] Bit no. 11 should be set to “zero” for LSB operation and “one” for USB operation. [2] Bit no. 10 should be set to “zero” for AM operation and “one” for SSB operation. TABLE 6-42-1 HF COM Word #2 Function PAR ITY (od d) SIG N/S TA TU S M AT RIX 0.1 kHz (5) NOT USED RE SER VE D WO RD ID EN T. LABEL HF COM Frequency (037) 8 7 6 1 1 1 5 4 3 1 1 0 2 1 0 0 Bit No. Example 32 0 31 30 0 0 29 28 27 26 0 1 0 1 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 10 9 0 1 [1] 7 3 0 [1] Bit No. 10 is reserved for CW mode select.

The CW mode is selected when bit number 10 is a “one”. When the second word is transmitted, it should immediately follow the first HF word. ALTERNATE FORM TABLE 6-43 HF COM Word #1 Function PAR ITY (od d) SIG N/S TA TU S MA TR IX 10MHz (2) 1 MHz (3) 0.1 MHz (5) 0.01MHz (7) 0.001MHz (9) WO RD ID EN T. SDI LABEL HF COM Frequency (205) 8 7 6 1 0 1 5 4 3 0 0 0 2 1 0 1 Bit No. Example 32 0 31 30 0 0 29 28 1 0 27 26 25 24 0 0 1 1 23 22 21 20 0 1 0 1 19 18 17 16 0 1 1 1 15 14 13 12 1 0 0 1 11 0 10 9 0 1 5 0 2 c-4 ARINC SPECIFICATION 429, PART 1 - Page 109 ATTACHMENT 6 GENERAL WORD FORMATS AND ENCODING EXAMPLES TABLE 6-43-1 HF COM Word #2 Function PAR ITY (od d) SIG N/S TA TU S MA TR IX 0.1 kHz (5) NOT USED WO RD ID EN T. SDI LABEL HF COM Frequency (205) 8 7 6 1 0 1 5 4 3 0 0 0 2 1 0 1 Bit No. Example 32 0 31 30 0 0 29 28 27 26 0 1 0 0 25 24 23 22 21 20 19 18 17 16 15 14 13 12 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 11 1 10 9 0 0 5 0 2 RADIO SYSTEMS MANAGEMENT WORD FORMATS TABLE 6-44 ILS Function PAR ITY (od d) SIG N/S TA TU S MA TR IX 10 MHz (0) 1 MHz (9) 0.1 MHz (3) 0.01 MHz (0) SPA RE ILS CA T.

RES. (SDI) LABEL Frequency (033) 8 7 6 1 1 0 5 4 3 1 1 0 2 1 0 0 Bit No. Example 32 1 31 30 0 0 29 28 27 0 0 0 26 25 24 23 1 0 0 1 22 21 20 19 0 0 1 1 18 17 16 15 0 0 0 0 14 13 0 0 12 11 0 0 10 9 0 0 3 3 0 BIT POSITION 12 11 CATEGORY NOT ILS CAT I ILS CAT II ILS CAT III 0 0 1 1 0 1 0 1 TABLE 6-44-1 VOR/ILS Function PA RIT Y (odd) S IGN /ST AT US M AT RIX 10 MHz (0) 1 MHz (9) 0.1 MHz (3) 0.01 MHz (0) IL S M OD E SPARE RES. (SDI) LABEL VOR/ILS Frequency (034) 8 7 6 0 0 1 5 4 3 1 1 0 2 1 0 0 Bit No. Example 32 1 31 30 0 0 29 28 27 0 0 0 26 25 24 23 1 0 0 1 22 21 20 19 0 0 1 1 18 17 16 15 0 0 0 0 14 0 [1] 13 12 11 0 0 0 10 9 0 0 4 3 0 [1] Bit number 14 should be set to “zero” for VOR frequencies and “one” for ILS frequencies by the tuning information sources. c- 2 c- 5 c- 5 c- 3 ARINC SPECIFICATION 429, PART 1 - Page 110 ATTACHMENT 6 GENERAL WORD FORMATS AND ENCODING EXAMPLES TABLE 6-45 VHF/COM Function PAR ITY (od d) SIG N/S TA TU S MA TR IX 10 MHz (2) 1 MHz (8) 0.1 MHz (5) 0.01 MHz (3) 0.001 MHz (0) RES (SDI) LABEL VHF COM Frequency (030) 8 7 6 0 0 0 5 4 3 1 1 0 2 1 0 0 Bit No. Example 32 1 31 30 0 0 29 28 27 0 1 0 26 25 24 23 1 0 0 0 22 21 20 19 0 1 0 1 18 17 16 15 0 0 1 1 14 13 12 11 0 0 0 0 10 9 0 0 0 0 3 0 TABLE 6-46 RADIO SYSTEMS MANAGEMENT WORD FORMATS ATC TRANSPONDER Function PAR ITY (od d) SIG N/S TA TU S M AT RIX Pilot Selected Mode A Reply Code 0-7 0-7 0-7 0-7 (3) (6) (2) (0) A4 A2 A1 B4 B2 B1 C4 C2 C1 D4 D2 D1 Hij ack Mod e Con trol Fun ctio n AL T. D AT A S OU RC E SEL . Iden t (SP I) CO NT RO L F UN CT ION AL T. R EP. ON /OFF RES. (SDI) LABEL Beacon Transponder Code (031) 8 7 6 1 0 0 5 4 3 1 1 0 2 1 0 0 Bit No. Example Notes 32 1 31 30 0 0 29 28 27 0 1 1 26 25 24 1 1 0 23 22 21 0 1 0 20 19 18 0 0 0 17 0 16 15 0 0 [2] 14 0 [1] 13 0 12 0 [2] 11 0 [1] 10 9 0 0 1 3 0 [1] Bit Zero One 11 13 14 Altitude Report On Ident. (SPI) OFF Use #1 Alt.

Data Source Altitude Reporting Off Ident. ON Use #2 Alt. Data Source LABEL_Beacon Transponder Code (031) New Bit Assignment Bit 17 Meaning 0 Transponder IS NOT operating in the Hijack Mode 1 Transponder IS operating in the Hijack Mode Control Panel Function Function 16 15 12 DABS ON/ ASAS OFF 0 0 1 Reset Aural Warning Signal 0 1 0 c-17 ARINC SPECIFICATION 429, PART 1 - Page 111 ATTACHMENT 6 GENERAL WORD FORMATS AND ENCODING EXAMPLES TABLE 6-47 TACAN Control – Label 146 112 RANGE 126 RESOLUTION 1.0 RATE 5Hz ±10% Bit No. Description 1 2 3 4 5 6 7 8 9-10 11 12 13 14 15 16 17-20 21-24 25 26 27-28 29 30-31 32 0 1 1 1 0 4 0 1 1 6 0 SDI Distance Memory (DIST MEM=1) Bearing Memory (BRG MEM=1) Pad Zero VOR/TAC Select (TAC=1, VOR=0) TACAN Select (TAC 1=1, TAC 2=0) Pad Zero BCD Units Chan Cont (LSB=17) Hex Tens Chan Cont (LSB=24) Pad Zero X/Y Mode (X=1, Y=0) Mode Cont (See Table A) Pad Zero SSM (See Table B) Parity (Odd) RADIO SYSTEMS MANAGEMENT WORD FORMATS Table A – Mode Control Table B - SSM Bits Description 27 28 0 0 0 1 1 0 1 1 REC A/A REC T/R A/A T/R Bits Description 30 31 0 0 0 1 1 0 1 1 Valid Functional Test No Computed Data Not Used ARINC SPECIFICATION 429, PART 1 - Page 112 ATTACHMENT 6 GENERAL WORD FORMATS AND ENCODING EXAMPLES TABLE 6-48 TACAN Control Word – Label 147 115 Bit No. Function 1 0 Note 1 0 2 1 3 1 4 0 5 0 6 1 7 1 8 1 9 10 11 12 13 14 15 -16 17 18 19 20 21 22 23 24 25 26 27-28 29 30-31 32 1 4 Label Number (147) 7 SEL SEL LOBE AUTO/MAN TUNE A/A AGC Disable Pad TACAN/MLS Select (LSB) BCD Channel Code Units (MSB) (LSB) HEX Channel Code Tens (MSB) TST X/Y Mode Control INT SSM Parity (odds) TACAN 1 ANTENNA 2 ANTENNA LOBE AUTOTUNE ENABLE TEST X NORMAL TACAN 2 ANTENNA 1 MANUAL TUNE DISABLE X NO TEST Y INVERSE [1] [2] [3] [1] TACAN/MLS Select [2] Mode Control [3] SSM Bits Description 15 16 0 0 1 0 0 1 1 1 TACAN MLS W Not Used MLS Z Bits Description 27 28 0 0 1 0 0 1 1 1 REC T/R A/A REC A/A T/R Bits Description 30 31 0 0 0 1 1 0 1 1 Valid Data No Computed Data Functional Test Not Used ARINC SPECIFICATION 429, PART 1 - Page 113 ATTACHMENT 6 GENERAL WORD FORMATS AND ENCODING EXAMPLES TABLE 6-49 Horizontal Alarm Limit/Horizontal Integrity Threshold (BNR) – Label 124 – IE2 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 Octal Label 4 2 1 P SSM [Note 1] Horizontal Alarm Limit (HAL) /Horizontal Integrity Threshold [Notes 2, 3] Pad [Note 4] Phase of Flight [Note 5] 0 0 1 0 1 0 1 0 [1] SSM (Status Matrix): BITS 31 30 Meaning 0 0 Failure Warning 0 1 No Computed Data (NCD) 1 0 Functional Test 1 1 Normal Operation [2] Horizontal Alarm Limit (HAL) / Horizontal Integrity Threshold The LDPU’s optional internal GNSS receiver will generate a horizontal position integrity alarm when the EPU (Estimated Position Uncertainty) exceeds the Horizontal Alarm Limit for a period of time equal to the Time To Alarm for the current phase of flight. If the value of the HPL (Horizontal Protection Level, label 130) output from the internal GNSS receiver exceeds the horizontal integrity threshold specified in label 124, then horizontal integrity is deemed to be unavailable.

In the HAL field, the LSB (bit 16) has a weight of 1 meter, while the MSB (bit 28) has a weight of 4096 m. [3] “All Ones” Value for HAL Field If an “all ones” value is encoded into bits 28 to 18, the HAL value should be assumed to be the default value for the phase of flight specified in bits 13 to 11.

If the HAL value is “all ones” (8191 meters) and the phase of flight code is “000” (“unspecified”) then the SSM field should be set to NCD. [4] Pad Bits The pad bits, bits 15 and 14, should be set to 0. [5] Phase of Flight The “phase of flight” field, bits 13 to 11, informs an optional GNSS receiver within the LDPU of the current phase of flight, so that the GNSS receiver may adjust its internal parameters to meet requirements for that phase of flight. BITS Alarm Limit 13 12 11 Phase of Flight Horizontal Vertical Time To Alarm 0 0 0 Not Specified Unchanged Unchanged Unchanged 0 0 1 Oceanic 4 NM (7408 m) N/A 8 s 0 1 0 En Route 2 NM (3704 m) N/A 8 s 0 1 1 Terminal/Departure 1 NM (1852 m) N/A 8 s 1 0 0 Non-Precision Approach 0.3 NM (555.6 m) N/A 8 s 1 0 1 LNAV/VNAV Precision Appr. 1 s 1 1 0 APV-II Precision Approach 1 s 1 1 1 GLS Precision Approach As specified in bits 28 to 18 As specified in Vertical Alarm Limit word, label TBD 1 s ARINC SPECIFICATION 429, PART 1 - Page 114 ATTACHMENT 6 GENERAL WORD FORMATS AND ENCODING EXAMPLES TABLE 6-50 Vertical Alarm Limit / Vertical Integrity Threshold (BNR) – Label 127 – IE2 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 Octal Label 7 2 1 P SSM Note 1 Vertical Alarm Limit (VAL) /Vertical Integrity Threshold [Note 2] Pad [Note 3] 1 1 1 0 1 0 1 0 [1] SSM (Status Matrix): BITS 31 30 Meaning 0 0 Failure Warning 0 1 No Computed Data 1 0 Functional Test 1 1 Normal Operation [2] Vertical Alarm Limit (VAL) / Vertical Integrity Threshold The LDPU’s optional internal GNSS receiver will generate a vertical position integrity alarm when the estimated error in vertical position exceeds the Vertical Alarm Limit for longer than the time-to-alarm for the current phase of flight. (The phase of flight is specified in label 124.) If the value of the VPL (Vertical Protection Level, label 130) output from the internal GNSS receiver exceeds the vertical alarm limit specified in bits 28-21, then vertical position integrity is defined to be “unavailable.” The LSB, bit 21, has a weight of 1 meter, while the MSB, bit 28, has a weight of 128 m. [3] Pad Bits The pad bits, bits 20 to 11, should be set to 0. ARINC SPECIFICATION 429, PART 1 - Page 115 ATTACHMENT 6 GENERAL WORD FORMATS AND ENCODING EXAMPLES TABLE 6-51 CDTI Display Unit - Label 262 - 144 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 P SSM S Display Range Spare SDI Octal Label 0 0 + 20 NM 0 0 2 6 2 0 0 0 0 0 0 0 0 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 010 011 01 Bit Description Notes 1 Label 1st digit 1 2 Label 1st digit ___2 0 3 Label 2nd digit 1 4 Label 2nd digit 1 5 Label 2nd digit ___6 0 6 Label 3rd digit 0 7 Label 3rd digit 1 8 Label 3rd digit ___2 10 9 Reserved for SDI 0 10 Reserved for SDI 0 11 Reserved 0 12 Reserved 0 13 Reserved 0 14 Reserved 0 15 Display Range LSB (1/32 NM) [1] 16 Display Range (1/16 NM) [1] 17 Display Range (1/8 NM) [1] 18 Display Range (1/4 NM) [1] 19 Display Range (1/2 NM) [1] 20 Display Range (1 NM) [1] 21 Display Range (2 NM) [1] 22 Display Range (4 NM) [1] 23 Display Range (8 NM) [1] 24 Display Range (16 NM) [1] 25 Display Range (32 NM) [1] 26 Display Range (64 NM) [1] 27 Display Range (128 NM) [1] 28 Display Range MSB (256 NM) [1] 29 sign (always positive) 0 30 SSM [2] 31 SSM [2] 32 Parity NOTES [1] All zeroes = “Range is less than 1/32 NM,” All ones = “Range is 512 NM.” [2] Sign/Status Matrix (SSM): Bits 31 30 Meaning 0 0 Failure Warning 0 1 No Computed Data 1 0 Functional Test 1 1 Normal Operation ARINC SPECIFICATION 429, PART 1 - Page 116 ATTACHMENT 6 GENERAL WORD FORMATS AND ENCODING EXAMPLES TABLE 6-52 Range Ring Radius – 261 144 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 P SSM Range Ring Radius Spare RR T SDI Octal Label Valid 2 NM 0 0 1 6 2 1 1 1 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 100 011 01 Bit Description Notes 1 Label 1st digit 1 2 Label 1st digit ___2 0 3 Label 2nd digit 1 4 Label 2nd digit 1 5 Label 2nd digit ___6 0 6 Label 3rd digit 0 7 Label 3rd digit 0 8 Label 3rd digit ___1 1 9 Reserved for SDI 0 10 Reserved for SDI 0 11 RRT,Range Ring Type (0 = floating, 1 = locked) 12 Spare 0 13 Spare 0 14 Range ring radius LSB (1/64 NM) 15 Range ring radius (1/32 NM) 16 Range ring radius (1/16 NM) 17 Range ring radius (1/8 NM) 18 Range ring radius (1/4 NM) 19 Range ring radius (1/2 NM) 20 Range ring radius (1 NM) 21 Range ring radius (2 NM) 22 Range ring radius (4 NM) 23 Range ring radius (8 NM) 24 Range ring radius (16 NM) 25 Range ring radius (32 NM) 26 Range ring radius (64 NM) 27 Range ring radius (128 NM) 28 Range ring radius MSB (256 NM) 29 sign (always positive) 0 30 SSM [1] 31 SSM [1] 32 Parity NOTES [1] Sign/Status Matrix (SSM) Bits 31 30 Meaning 0 0 Failure Warning 0 1 No Computed Data 1 0 Functional Test 1 1 Normal Operation 12 34 56 78 910 11N H IN UL L LO BIT NU MB ER BI - P OL AR RZ DA TA 10 11 01 01 00 11 ATTACHMENT 7DATA BIT ENCODING LOGIC ARINC SPECIFICATION 429, PART 1 - Page 117 ARINC SPECIFICATION 429, PART 1 - Page 118 ATTACHMENT 8 OUTPUT SIGNAL TIMING TOLERANCES PARAMETER HIGH SPEED OPERATION LOW SPEED OPERATION Bit Rate Time Y Time X Pulse Rise Time** Pulse Fall Time** 100k bps + 1% 10 µsec + 2.5% 5 µsec + 5% 1.5 + 0.5 µsec 1.5 + 0.5 µsec 12 – 14.5kbps Z* µsec + 2.5% Y/2 + 5% 10 + 5 µsec 10 + 5 µsec * Z = 1 where R = bit rate selected from 12 – 14.5kbps range ** Pulse rise and fall times are measured between the 10% and 90% voltage amplitude points on the leading and trailing edges of the pulse and include permitted time skew between the transmitter output voltages A-to-ground and B-to-ground. These rise and fall times are for open circuit output measurements – Appendix 1 provides waveforms for typical test performance. c-16 HI NULL LO TR AN SM ITT ED VO LT AG E L INE A T O L INE B X Y ARINC SPECIFICATION 429, PART 1 - Page 119 ATTACHMENT 9A GENERAL AVIATION LABELS AND DATA STANDARDS The following labels and data standards provided by GAMA (General Aviation Manufacturers Association) are typically used by general aviation. Labels with a “G” or “P” suffix refer to GAMA standard, or GA industry PRIVATE bit structures, respectively. All others are ARINC standard words. LABEL (OCTAL) EQPT. ID (HEX) PARAMETER NAME DATA TYPE UNITS RANGE SIG BITS / DIGITS POSITIVE SENSE APPROX. RESOL MIN XMIT INT (msec) MAX XMIT INT (msec) MAX UPDATE INT NOTES 0 0 1 0 2 0 9 Distance to go Distance to go BCD BCD N.M. ±3999.9 5 Always Pos Always Pos 0.1 100 200 0 0 1 2 0 2 0 9 Time to go Time to go BCD BCD Min. 0-399.9 4 Always Pos Always Pos 0.1 100 200 0 1 2 0 2 0 9 Ground Speed Ground Speed BCD BCD Knots 0-2000 4 Always Pos Always Pos 1.0 250 500 0 1 7 1 0 Selected Runway Heading BCD Degrees 0-359.9° 4 Always Pos 0.1° 167 333 0 2 4 G 1 1 Selected Course 1 BCD Degrees 0-359° 3 Always Pos 1.0° 167 333 Bit 11 Non Std 0 2 7 1 1 Selected Course 2 BCD Degrees 0-359° 3 Always Pos 1.0° 167 333 0 3 0 G 0 2 1 6 VHF COM Frequency VHF COM Frequency BCD BCD MHz MHz 118-135.975 118-135.975 5 5 0.025 0.025 100 100 200 200 SSM Squelch SSM XMIT 0 3 1 G 0 2 1 8 Beacon Transponder Code Beacon Transponder Code BCD BCD Discrete Discrete 100 100 200 200 SSM Reply 0 3 2 0 2 1 2 ADF Frequency ADF Frequency BCD BCD KHz KHz 190-1750 190-1750 5 5 0.5 0.5 100 100 200 200 0 3 3 0 2 1 0 ILS Frequency ILS Frequency BCD BCD MHz MHz 108-111.95 108-111.95 4 4 0.05 0.05 167 167 333 333 0 3 4 G 0 2 1 0 1 1 VOR/ILS Frequency VOR/ILS Frequency VOR/ILS Frequency BCD BCD BCD MHz MHz MHz 108-117.95 108-117.95 108-117.95 4 4 4 0.05 0.05 0.05 167 167 167 333 333 333 See Att. 9B See Att. 9B See Att. 9B 0 3 5 G 0 2 0 9 DME Frequency DME Frequency BCD BCD MHz MHz 108-135.95 108-134.95 4 4 0.05 0.05 100 100 200 200 See Att. 9B See Att. 9B 0 4 1 0 2 Set Position Latitude BCD Deg:Min 180N-180S 6 North 0.1 250 500 0 4 2 0 2 Set Position Longitude BCD Deg:Min 180E-180W 6 East 0.1 250 500 0 4 3 0 2 Set Magnetic Heading BCD Deg 0-359° 3 1 .0° 250 500 0 6 0 P 0 2 Omega Data Select BNR Discrete 100 200 See Att. 9B 0 6 1 P 0 2 Covariance Data BNR 100 200 See Att. 9B 0 7 4 G 0 2 Data Record Header DSC Discrete See Note 1 See Att. 9B 0 7 5 G 0 2 Active WPT From/To Data DSC Discrete See Note 1 See Att. 9B 1 0 0 G 0 2 Selected Course 1 BNR Deg/180 ±180° 12 0.05° 167 333 Bit 11 Non Std 1 0 0 1 1 Selected Course 1 BNR Deg/180 ±180° 12 0.05° 167 333 1 0 1 G 0 2 2 5 Selected Heading Selected Heading BNR BNR Deg/180 Deg/180 ±180° ±180° 12 12 0.05° 0.05° 31.3 31.3 62.5 62.5 Bit 11 Non Std 1 0 2 G 0 2 Selected Altitude BNR Feet 65536 16 Above S.L. 1 100 200 See Att. 9B 1 0 5 1 0 Selected Runway Heading BNR Deg/180 ±180° 11 0.1° 167 333 1 1 0 1 1 Selected Course 2 BNR Deg/180 ±180° 12 0.05° 167 333 1 1 3 G 0 2 Message Checksum BNR See Note 2 See Att. 9B 1 1 4 0 2 Desired Track (True) BNR Deg/180 ±180° 12 0.05° 31.3 62.5 1 1 5 0 2 Waypoint Bearing (True) BNR Deg/180 ±180° 12 A/C To WPT 0.05° 31.3 62.5 1 1 6 G 0 2 Cross Track Distance BNR Naut Mi 128 18 Fly Left 0.0005 31.3 62.5 1 1 7 G 0 2 Vertical Deviation BNR Feet 16384 14 Fly Down 1.0 31.3 62.5 See Att. 9B 1 2 1 0 2 HORIZ.CMD.(To Autopilot) BNR Deg/180 ±180° 14 Fly Right 0.01° 50 100 1 2 2 G 0 2 VERT.CMD. (To Autopilot) BNR Deg/180 ±180° 12 Fly Up 0.05° 50 100 1 2 3 0 2 Throttle Command BNR Deg/sec 2.56 18 Inc. Power 0.001° 50 100 1 2 5 0 2 Greenwich Mean Time BCD Hr/Min 0-23.59.9 5 0.1 100 200 1 4 7 G 0 2 Magnetic Variation BNR Deg/180 ±180° 12 East 0.05° 500 1000 Bit 11 Non Std 1 5 0 0 2 Greenwich Mean Time BNR Hr:Min:Sec 23:59:59 5:6:6 1.0 sec 50 100 See Att. 6 1 5 7 P 0 6 Normalized AOA BNR 1=Stall ±2 12 Upward 0.0005 125 125 125 1 6 2 G 1 2 ADF Bearing BNR Deg/180 ±180° 12 0.05° 31.3 62.5 Bit 11 Non Std 1 6 3 G 0 2 Wind on Nose BNR Knots 256 9 Head Wind 0.5 50 100 Bit 29 Non Std 1 7 3 1 0 Localizer Deviation BNR DDM 0.4 12 Fly Right 0.0001 33.3 66.6 1 7 4 1 0 Glideslope Deviation BNR DDM 0.8 12 Fly Down 0.0002 33.3 66.6 2 0 2 0 2 0 9 DME Distance DME Distance BNR BNR Naut Mi Naut Mi 512 512 16 16 Always Pos Always Pos 0.005 0.005 83.3 3.3 167 167 2 0 4 0 2 Baro Corrected Alt.#1 BNR Feet 131,072 17 Above S.L. 1.0 31.3 62.5 2 1 0 0 2 True Airspeed BNR Knots 2047.93 15 Always Pos 0.0625 62.5 125 2 1 3 0 2 Static Air Temperature BNR Deg C 512 11 Above Zero 0.25 250 500 2 2 2 P 0 2 VOR Radial BNR Deg/180 ±180° 12 To Station 0.044° 50 100 See Att. 6 2 2 2 0 2 1 0 1 1 VOR Omnibearing VOR Omnibearing VOR Omnibearing BNR BNR BNR Deg/180 Deg/180 Deg/180 ±180° ±180° ±180° 12 12 12 From VOR From VOR From VOR 0.044° 0.044° 0.044° 50 31.3 31.3 100 62.5 62.5 More than one MKR beacon bit set is MKR self test. 2 4 1 P Normalized AOA BNR 1-Stall ±2 12 Upward 0.0005 125 125 125 2 5 1 G 0 2 Distance To Go BNR Naut Mi 4096 15 Always Pos 0.125 100 200 2 5 2 0 2 Time-To-Go BNR Minutes 512 9 Always Pos 1.0 100 200 2 6 0 G 0 2 Date BCD Discrete 6 1 Day 500 1000 See Att. 9B 2 6 1 P 0 2 GPS Discrete Word 1 DSC Discrete 1000 1000 1000 2 7 5 G 0 2 LRN Status Word DSC Discrete 200 400 See Att. 9B 2 7 7 P 0 2 Cabin DSPY Cont DSC DSC Discrete 200 200 3 0 0 G 0 2 STN MAG DEC, Type & Class BNR Discrete See Note 2 See Att. 9B THIS ATTACHMENT WAS REPRODUCED WITH THE PERMISSION OF GAMA. REVISIONS ARE NOT SHOWN, FOR ANY COMMENTS OR QUESTIONS, PLEASE CONTACT GAMA. ARINC SPECIFICATION 429, PART 1 - Page 120 THIS ATTACHMENT WAS REPRODUCED WITH THE PERMISSION OF GAMA. REVISIONS ARE NOT SHOWN, FOR ANY COMMENTS OR QUESTIONS, PLEASE CONTACT GAMA. ATTACHMENT 9A GENERAL AVIATION LABELS AND DATA STANDARDS LABEL (OCTAL) EQPT. ID (HEX) PARAMETER NAME DATA TYPE UNITS RANGE SIG BITS / DIGITS POSITIVE SENSE APPROX. RESOL MIN XMIT INT (msec) MAX XMIT INT (msec) MAX UPDATE INT NOTES 3 0 1 G 0 2 Message Characters 7-9 BNR Discrete See Note 2 3 0 2 G 0 2 Message Characters 10-12 BNR Discrete See Note 2 3 0 3 G 0 2 Message Length / Type / Number BNR Discrete See Note 2 3 0 4 G 0 2 Message Characters 1-3 BNR Discrete See Note 2 3 0 5 G 0 2 Message Characters 4-6 BNR Discrete See Note 2 3 0 6 G 0 2 NAV/WPT/AP Latitude BNR Deg/280 180N-180S 20 North .000172° See Note 2 3 0 7 G 0 2 NAV/WPT/AP Longitude BNR Deg/180 180E-180W 20 East .000172° See Note 2 3 1 0 0 2 Present Position Latitude BNR Deg/180 180N-180S 20 North .000172° 100 200 3 1 1 0 2 Present Position Longitude BNR Deg/180 180E-180W 20 East .000172° 100 200 3 1 2 0 2 Ground Speed BNR Knots 4096 15 Always Pos 0.125 25 50 3 1 3 0 2 Track Angle (True) BNR Deg/180 ±180° 12 0.05 25 50 3 1 4 0 2 True Heading BNR Deg/180 ±180° 15 0.0055° 25 50 3 1 5 0 2 Wind Speed BNR Knots 256 8 Always Pos 1.0 50 100 3 1 6 0 2 Wind Angle (True) BNR Deg/180 ±180° 8 0.7 50 100 3 2 0 0 2 Magnetic Heading BNR Deg/180 ±180° 15 0.0055° 25 50 3 2 1 0 2 Drift Angle BNR Deg/180 ±180° 12 0.05° 25 50 3 2 6 G 0 2 Lateral Scale Factor BNR Naut Mi ±128 15 0.0039 NM 80 1200 3 2 7 G 0 2 Vertical Scale Factor BNR Feet ±2048 15 0.0625 Ft 80 1200 3 5 1 G 0 2 Distance To Destination BNR Naut Mi 32,768 18 Always Pos 0.125 500 1000 3 5 2 G 0 2 Est Time to Destinaiton BNR Minutes 4096 12 Always Pos 1.0 500 1000 Via Flight Plan 3 5 3 P 0 2 Dest Local Time Offset BCD Hour/Min 23:59 5 Always Pos .01 Min 1000 1000 1000 Via Flight Plan 3 7 1 G 0 2 0 9 1 0 1 1 1 2 1 6 1 8 Specific Equipment Ident Specific Equipment Ident Specific Equipment Ident Specific Equipment Ident Specific Equipment Ident Specific Equipment Ident Specific Equipment Ident DSC DSC DSC DSC DSC DSC DSC 500 500 500 500 500 500 500 1000 1000 1000 1000 1000 1000 1000 See Att. 9B NOTE 1: These labels are transmitted once at the beginning of each flight plan/graphics map data transfer. Refer to the GAMA FMS Output Bus Standard for further information.

NOTE 2: These labels are used to make up the individual records that comprise a flight plan/graphics map data transfer. Not all labels are transmitted with each record. Ten records are transmitted in one second. Refer to the “FMS Waypoint/Navaid/Airport Data Transfer Protocol”, addendum 3. ARINC SPECIFICATION 429, PART 1 - Page 121 ATTACHMENT 9B GENERAL AVIATION WORD EXAMPLES 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 P SSM See Chapter 3 See Below SDI VOR/ILS Frequency Label 034G Bit 11 Bit 12 Bit 13 Marker Sensitivity Last Tune Source VOR Digital Filtering “1” denotes high, “0” denotes low “1” denotes control head.

“0” denotes other “1” denotes no filter.

“0” denotes filter (Normally “1” but “0” for Honeywell (Olathe) manufactured equipment) 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 P SSM See Chapter 3 See Below SDI DME Frequency Label 035G Bit 13 12 11 DME Mode 0 0 0 0 1 1 1 1 0 0 1 1 0 0 1 1 0 1 0 1 0 1 0 1 Standby Directed Freq #1 Directed Freq #2 Directed Freq #3 Hold Freq #1 Hold Freq #2 Not used Spare 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 P SSM 0 Relane MSB Binary Address Omega Data Select Label 060P *Specific user word Bit 28 Bit 27 Full Restart Bit Rho Rho Updating “1” denotes restart “1” inhibits update Bit 26 25 Function 0 0 1 1 0 1 0 1 No Action Relane Do Not Release Invalid Use 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 P SSM Term Indent - Exponent (IEEE Flt. Pt.) MSB Mantissa (IEEE Flt. Pt.) Coveriance Data* Label 061P *Specific user word Bit 27 Sign “1” denotes negative Bit 29 28 Functions 0 0 1 1 0 1 0 1 Term 1 Term 2 Term 3 Not Used 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 P SSM Pad (Zeros) Pad (Zeros) MSB Number of Records Data Record Header Lable 074G Bit 21 Prior Record Change “1” denotes changed record 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 P SSM 0 From Waypoint LS Byte To Waypoint LS Byte From Waypoint MS Byte To Waypoint MS Byte See Below Active Waypoint From/To Data Label 075G Bit 9 Bit 10 Bit 11 Bit 12 Auto/Leg/Man/Obs Mag/True Reference Radar Waypoint Displayed Lat/Long/ILS Mode “1” denotes Auto/Leg, “0” denotes Man/Obs “1” denotes True, “0” denotes Magnetic “1” inhibits display “1” denotes ILS, “0” denotes Lat/Long These are User Specific bits 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 P SSM Same as Attachment 2 SDI Selected Altitude Label 102G Bit 11 Bit 12 Altitude Select Knob Altitude Alert “0” denotes “in motion” “1” denotes “on” User-specific bits THIS ATTACHMENT WAS REPRODUCED WITH THE PERMISSION OF GAMA.

REVISIONS ARE NOT SHOWN, FOR ANY COMMENTS OR QUESTIONS, PLEASE CONTACT GAMA. ARINC SPECIFICATION 429, PART 1 - Page 122 ATTACHMENT 9B GENERAL AVIATION WORD EXAMPLES 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 P SSM Check Sum Message Check Sum Label 113G The message checksum is the two’s complement 21 but sum of all the other words transmitted in the group discarding the intermediate carry and replacing bit 32 with odd parity. 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 P SSM + - Data See Below SDI Vertical Deviation Label 117G Bit 14 Bit 13 Bit 12 Bit 11 VNAV Arm Enable/Alert VNAV Bendover VNAV Bendover Direction Altitude with respect to 1000 ft. “1” denotes enable “1” denotes “capture”, “0” denotes “track” “1” denotes “fly up”, “0” denotes flydown” “1” denotes “greater”, “0” denotes less User Specific bits 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 Day Month Year SDI P SSM 10s 1s 10s 1s 10s 1s Date Label 260G 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 P SSM Spare Waypoint Number (Binary) See Below Words in Message Message Length/Type/No. Label 303G Bit 16 Date Record “1” denotes “off route”, “0” denotes “on route” Bit 24 FMS Plan Mode “1” denotes “SELECT”, “0” denotes “not SELECT” Bit 25 WPT at Plan Center “1” denotes “CENTER”, “0” denotes “not CENTER” Bit 26 Flight Plan GAP Follows “1” denotes “GAP”, “0” denotes “no GAP” Bit 15 14 13 WYPT/STATION TYPE 0 0 0 0 1 1 1 1 0 0 1 1 0 0 1 1 0 1 0 1 0 1 0 1 Waypoint Nav Aid Airport NDB Altitude Profile Point No Symbol VOR Intersection THIS ATTACHMENT WAS REPRODUCED WITH THE PERMISSION OF GAMA. REVISIONS ARE NOT SHOWN, FOR ANY COMMENTS OR QUESTIONS, PLEASE CONTACT GAMA. ARINC SPECIFICATION 429, PART 1 - Page 123 THIS ATTACHMENT WAS REPRODUCED WITH THE PERMISSION OF GAMA. REVISIONS ARE NOT SHOWN, FOR ANY COMMENTS OR QUESTIONS, PLEASE CONTACT GAMA. ATTACHMENT 9B GENERAL AVIATION WORD EXAMPLES Bit No. Function Bit Status 1 0 1 2 3 4 5 6 7 8 Label 261G 02 LRN Status x x x x x x x x 9 10 SDI 11 12 Spare Pad Zero 13 14 15 16 17 18 19 Reserved 20 Vert Dev (Final Appr) Angular Linear 21 Lat Dev Scaling in Transition Yes No 22 Lat Dev. (Final Appr) Angular Linear 23 Appr Integrity (Final Appr) Valid Invalid 24 GPS Integrity Fail Valid 25 26 27 GPS Annunciation 27(0) & 26(0) & 25(0) – Enroute 27(0) & 26(0) & 25(1) – Terminal 27(0) & 26(1) & 25(0) – Approach (27(1) & 26(0) & 25(0) – Oceanic 28 29 Spare 30 31 SSM 31(0) & 30(0) – Normal Operations 31(0) & 30(1) – No Computed Data 31(1) & 30(0) – Functional Test 31(1) & 30(1) – Not used 32 Parity (odd) ARINC SPECIFICATION 429, PART 1 - Page 124 ATTACHMENT 9B GENERAL AVIATION WORD EXAMPLES Bit No. Function Bit Status 1 0 1 2 3 4 5 6 7 8 Label 275G 02 LRN Status x x x x x x x x 9 10 SDI 11 Waypoint Alert On Off 12 Dead Reckon DR Not DR 13 Direct To Select Not Select 14 15 Mode 15(0) & 14(0) – Multiple Sensor Based 15(0) & 14(1) – VOR/DME Offset (RNAV) Approach 15(1) & 14(0) – VOR/TACAN (non-Offset) Approach/Enroute 15(1) & 14(1) – ILS Approach 16 Vert & Lat Dev Scaling Approach Enroute 17 FMS Controlled Hdg Sub-mode FMS/FGS FGS Only 18 Remote FGS Army for Nav Capt Arm No Change 19 FMS Plan Mode Select Not Select 20 Display Final Appr Course Display No Change 21 Angular Scaling Active Not Active 22 Integrity Warn Warn Not Warn 23 To To Not To 24 From From Not From 25 Parallel XTK Offset Selected Not Selected 26 Airport Display Selected Select Not Selected 27 Message Alert On Off 28 True/Mag True Magnetic 29 HSI Valid (NAV Warn) Valid Warn 30 31 SSM 32 Parity (odd) THIS ATTACHMENT WAS REPRODUCED WITH THE PERMISSION OF GAMA. REVISIONS ARE NOT SHOWN, ANY COMMENTS OR QUESTIONS, PLEASE CONTACT GAMA. ARINC SPECIFICATION 429, PART 1 - Page 125 ATTACHMENT 9B GENERAL AVIATION WORD EXAMPLES Bit No. Function Bit Status 1 0 1 2 3 4 5 6 7 8 Label 277G 02 LRN Status x x x x x x x x 9 10 SDI (if required) 11 Play Briefing #1 12 Play Briefing #2 13 Play Briefing #3 14 Play Briefing #4 15 Play Briefing #5 16 Play Briefing #6 17 Cancel Briefing #1 18 Cancel Briefing #2 19 Cancel Briefing #3 20 Cancel Briefing #4 21 Cancel Briefing #5 22 Cancel Briefing #6 23 Annunciate Cabin Message (Note) 24 25 26 27 28 Spares Pad Zero 29 Alternate Format ALTERNATE STD 30 31 SSM 31(0) & 30(0) – Normal Operation 31(0) & 30(1) – No Computed Data 31(1) & 30(0) – Functional Test 31(1) & 30(1) – Failure Warning 32 Parity (Odd) NOTE: The ALTERNATE FORMAT bit (#29) causes the briefing play (BITS 11 – 16) and briefing cancel (BITS 17 – 22) controls to be interpreted as the briefing number from 1 to 63 with the briefing #1 bit as the least significant. If BIT 29 is set to 1, this decoding will be used. If the briefing number is non zero, the indicated briefing will be played or canceled. THIS ATTACHMENT WAS REPRODUCED WITH THE PERMISSION OF GAMA. REVISIONS ARE NOT SHOWN, FOR ANY COMMENTS OR QUESTIONS, PLEASE CONTACT GAMA. ARINC SPECIFICATION 429, PART 1 - Page 126 ATTACHMENT 9B GENERAL AVIATION WORD EXAMPLES Bit No. Function Bit Status 1 0 1 2 3 4 5 6 7 8 Label 300 02 Station Declination x x x x x x x x 9 10 11 12 13 14 Spares Pad Zero 15 16 DME Tuned and Received Not Collated Being Received Same Location Not Received 17 18 19 20 21 22 23 24 Station Declination Binary number with sign bit 24 East is positive. West is 2’s complement of the positive value. Range is 127 deg. E/W. Resolution is 1 degree at bit 17. 25 26 27 VOR at location DME at location TACAN at location Yes Yes Yes No No No 28 29 Class Bit 29/28/0 low 0/1 high 1/0 terminal 30 31 SSM 32 Parity THIS ATTACHMENT WAS REPRODUCED WITH THE PERMISSION OF GAMA. REVISIONS ARE NOT SHOWN, FOR ANY COMMENTS OR QUESTIONS, PLEASE CONTACT GAMA. ARINC SPECIFICATION 429, PART 1 - Page 127 ATTACHMENT 9B GENERAL AVIATION WORD EXAMPLES 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 P Company Private Use Company I. D. (Binary) EQ Code MSD (Hex) EQ Code MSD (Hex) SDI GA Equipment Ident LABEL 371 LABEL 371 Company I. D. Field Binary Bit Assignments COMPANY 24 23 22 21 20 19 0 0 0 0 0 1 B&D INSTRUMENTS 0 0 0 0 1 0 BEECH AIRCRAFT 0 0 0 0 1 1 BENDIX AVIONICS 0 0 0 1 0 0 CANADIAN MARCONI 0 0 0 1 0 1 CESSNA AIRCRAFT 0 0 0 1 1 0 COLLINS AVIONICS 0 0 0 1 1 1 DELCO ELECTRONICS 0 0 1 0 0 0 FOSTER RNAV 0 0 1 0 0 1 GABLE CONTROLS 0 0 1 0 1 0 GLOBAL SYSTEMS 0 0 1 0 1 1 GULFSTREAM AEROSPACE 0 0 1 1 0 0 HONEYWELL 0 0 1 1 0 1 KING RADIO 0 0 1 1 1 0 LEARJET 0 0 1 1 1 1 LITTON AERO PRODUCTS 0 1 0 0 0 0 OFFSHORE NAVIGATION 0 1 0 0 0 1 RACAL AVIONICS 0 1 0 0 1 0 SPERRY 0 1 0 0 1 1 UNIVERSAL NAVIGATION SYS 0 1 0 1 0 0 3M AVIATION SAFETY SYSTEMS 0 1 0 1 0 1 ALLIEDSIGNAL GENERAL AVIATION AVIONICS 0 1 0 1 1 0 ALLIEDSIGNAL GLOBAL WULFSBERG 0 1 0 1 1 1 BF GOODRICH AVIONICS 0 1 1 0 0 0 GARMIN 0 1 1 0 0 1 ARNAV 0 1 1 0 1 0 COMPUTER INSTRUMENT CORPORATION 0 1 1 0 1 1 SPARE 1 1 1 1 1 1 SPARE THIS ATTACHMENT WAS REPRODUCED WITH PERMISSION OF GAMA. REVISIONS ARE NOT SHOWN, FOR ANY COMMENTS OR QUESTIONS, PLEASE CONTACT GAMA. ARINC SPECIFICATION 429, PART 1 - Page 128 THIS ATTACHMENT WAS REPRODUCED WITH THE PERMISSION OF GAMA. REVISIONS ARE NOT SHOWN, FOR ANY COMMENTS OR QUESTIONS, PLEASE CONTACT GAMA. ATTACHMENT 9C GENERAL AVIATION EQUIPMENT IDENTIFIERS Equipment HEX ID EQUIPMENT 01 Flight Control Computer 02 Flight Management Computer 04 Inertial Reference System 05 Attitude and Heading Ref. System 06 Air Data System 09 Airborne DME 0B Global Positioning System 10 Airborne ILS Receiver 11 Airborne VOR Receiver 12 Airborne ADF System 16 Airborne VHF Comm Receiver 18 ATC Transponder 25 Electronic Flight Instruments 27 Microwave Landing System 36 Radio Management System 5A Loran 5B Omega A9 Airborne DME Controller B0 Airborne ILS Controller B2 Airborne ADF Controller B6 VHF Comm Controller B8 ATC Transponder Controller C7 Microwave Landing System Controller FA Loran Controller FB Omega Controller ARINC SPECIFICATION 429, PART 1 - Page 129 ATTACHMENT 10 MANUFACTURER SPECIFIC STATUS WORD c-17 32 31 30 29 28 27 26 25 24 23 22 21 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 P Company Private Use [A] Company I.D. (Binary) SDI [B] Label (171) BIT 16 15 14 13 12 11 Company 0 0 0 0 0 1 0 0 0 0 1 0 0 0 0 0 1 1 0 0 0 1 0 0 0 0 0 1 0 1 0 0 0 1 1 0 0 0 0 1 1 1 0 0 1 0 0 0 0 0 1 0 0 1 0 0 1 0 1 0 0 0 1 0 1 1 0 0 1 1 0 0 0 0 1 1 0 1 0 0 1 1 1 0 0 0 1 1 1 1 0 1 0 0 0 0 0 1 0 0 0 1 0 1 0 0 1 0 0 1 0 0 1 0 0 1 1 0 1 0 1 0 0 0 1 0 1 0 1 0 1 0 1 1 0 0 1 0 1 1 1 0 1 1 0 0 0 0 1 1 0 0 1 0 1 1 0 1 0 0 1 1 0 1 1 1 1 1 1 1 1 B&D INSTRUMENTS BEECH AIRCRAFT BENDIX AVIONICS CANADIAN MARCONI CESSNA AIRCRAFT COLLINS AVIONICS DELCO ELECTRONICS FOSTER RNAV GABLES CONTROLS GLOBAL SYSTEMS GULFSTREAM AEROSPACE HONEYWELL KING RADIO LEAR JET LITTON AERO PRODUCTS OFFSHORE NAVIGATION RACAL AVIONICS SPERRY UNIVERSAL NAVIGATION SYSTEMS 3M AVIATION SAFETY SYSTEMS ALLIED SIGNAL GENERAL AVIATION AVIONICS ALLIED SIGNAL GLOBAL WULFSBAG BF GOODRICH AVIONICS GARMIN ARNAV COMPUTER INSTRUMENT CORPORATION RYAN SPARE SPARE [A] This word is used for manufacturer-specific information exchange (e.g., sub-LRU-Level BITE status). The Company I.D. fields should be used to differentiate each manufacturer’s unique use of the Company Private Use field. [B] Per Section 2.1.4 ARINC SPECIFICATION 429, PART 1 - Page 130 ATTACHMENT 11 SYSTEM ADDRESS LABELS c-14 c-15 c-17 c-17 SYSTEMS SYSTEM ADDRESS LABEL (OCTAL) 777 CABIN INTERPHONE SYSTEM 152 CVR #2 156 CVR 157 747 DFHR AND A330/340 SSFDR 163 DFDAU (MANDATORY LOAD FUNCTION) 170 SDU #2 173 RFU 174 HGA/IGA HPA 175 LGA HPA 177 GPS/GNSS SENSOR 201 FCMC Com A340-500/600 210 FCMC Mon A340-500/600 211 FCMC Int A340-500/600 212 MCDU 1 220 MCDU 2 221 MCDU 3 222 PRINTER 1 223 PRINTER 2 224 HUD 225 HIGH SPEED DL (ARINC 615) 226 MCDU 4 230 EIVMU 1 234 EIVMU 2 235 EIVMU 3 236 EIVMU 4 237 APM-MMR 241 MMR 242 ILS 244 MLS 245 AHRS 246 HIGH-SPEED DATA (HSDU #1) 247 HIGH-SPEED DATA (HSDU #2) 250 VDR #1 251 VDR #2 252 VDR #3 253 NETWORK SERVER SYSTEM 254 ELECTRONIC FLIGHT BAG LEFT 255 ELECTRONIC FLIGHT BAG RIGHT 256 CABIN VIDEO SYSTEM (AIRSHOW) 266 LOW SPEED DL (ARINC 603) 300 FMC 1 300 FMC 2 301 DFDAU (AIDS) 302 CFDIU 303 ACARS MU/CMU (724B, 748) 304 WBS 305 TCAS 306 SDU #1 307 c-16 c-14 c-16 c-16 c-15 c-17 c-17 c-17 ARINC SPECIFICATION 429, PART 1 - Page 131 ATTACHMENT 11 SYSTEM ADDRESS LABELS SYSTEMS SYSTEM ADDRESS LABEL (OCTAL) GPWS 310 GNLU 1 311 GNLU 2 312 GNLU 3 313 GNU 1 314 GNU 2 315 GNU 3 316 AUTOTHROTTLE COMPUTER 321 FCC 1 322 FCC 2 323 FCC 3 324 APU 325 APU CONTROLLER 326 MODE CONTROL PANEL (MCP) 327 FMC 3 330 ATC TRANSPONDER 331 DADC 332 CABIN TELECOMMUNICATIONS UNIT (CTU) 334 HF DATA RADIO/DATA UNIT #1 340 HF DATA RADIO/DATA UNIT #2 344 REMOTE DATA CONCENTRATOR 345 ACESS 360 EFIS 361 PASSENGER SERVICES SYSTEM (PSS) 767300,400 362 CABIN SERVICE SYSTEM (CSS) 747-400 363 AUDIO ENTERTAINMENT SYSTEM (AES)BOEING 364 ENGINE INDICATION UNIT 365 MULTICAST 366 BRIDGE 367 CABIN TERMINAL 3 372 CABIN TERMINAL 4 373 CABIN TERMINAL 1 374 CABIN TERMINAL 2 375 OMEGA NAV. SYSTEMS 376 c-14 c-16 c-14 c-16 c-14 c-15 c-16 c-17 ARINC SPECIFICATION 429, PART 1 - Page 132 APPENDIX A LABORATORY VERIFICATION OF ARINC 429 DITS ELECTRICAL CHARACTERISTICS A1-1.0 Introduction Selection of the electrical characteristics of the Mark 33 DITS followed verification of the suitability of proposed values in laboratory tests performed by the Boeing Commercial Airplane Co. Boeing presented two reports to AEEC’s Systems Architecture and Interfaces Subcommittee on these activities, one at the meeting held in Arlington, Virginia, in March 1977 and the other at the meeting held in Los Angeles, California, in May 1977. The material in this Appendix is excerpted from these reports. A1-2.0 Electromagnetic Emission and Susceptibility Tests Electromagnetic emission and susceptibility tests were conducted to determine if the proposed 100 kbps waveform was suitable for use in a commercial airplane EMI environment. The EMI conditions used for the tests were derived from RTCA Document DO-160, “Environmental Conditions and Test Procedures for Airborne Electronic/Electrical Equipment and Instruments” dated February 28th, 1975. A1-2.1 Cable and Test Configuration The cable used for the tests was standard aircraft type twisted shielded wire of 22 AWG. The wire configuration consisted of approximately 60 ft. of cable which was subjected to the EMI environment within a screened room. This cable was connected in series with 300 ft. of cable not subjected to the EMI environment. The test was configured to simulate the maximum length wire run with DO-160 conditions applied. The 60 Ft. length of cable was connected to the transmitter for the emission tests and to the receiver for the susceptibility tests. A1-2.2 Transmitter Characteristics The block schematic of the bipolar line driving transmitter built for the tests is shown in Figure a-(i). The waveform was shaped at the pulse generator such that it exhibited the following characteristics: Differential Output Voltage: HI +10V NULL 0V LO -10V Risetime = Falltime = l.0 μ sec Bit Rate= 100 kilobits/second HI time= NULL time= LO time A1-2.3 Receiver Input Circuit Description To perform the susceptibility tests, receivers were constructed utilizing various methods of common mode rejection and various processing schemes. Differential Amplifier Input. Figure a-(ii) shows schematics of the differential input stages used for the receivers. The differential amplifier input stage required resistors to local ground at the input to provide a path for the input current for the voltage followers. Voltage protection was used to prevent damage to the voltage followers in the event of high voltage, common mode spikes. The voltage follower stages provided a controlled impedance for the differential amplifier stage.

Opto-Isolator Input The opto-isolator input stage utilized two H-P 5082-4371 isolators connected in opposite polarity to detect the bipolar data. The HP 5082-4371 input has a forward conduction “knee” at approximately 1.4 volts. A second simple LED (HP 5082-4650) was connected in series with each opto-isolator to provide a combined knee voltage of approximately 3 volts. A series resistor RL of 1000 ohms was placed in series with the LED/opto-isolator network to limit the receiver current to 7mA at 10 volts (differential) applied at the input. At 4.5V differential on the line, one opto-isolator conducts 1.5 mA. One circuit configuration which enables the opto-isolator to operate at 100 kilobits per second at these low input currents is shown in figure a-(iii). A potential of +15 volts is applied to pin 8 to provide maximum gain in the first transistor. During conduction, a charge on the second transistor is discharged via pin 7 and R2 to a potential of +0.5 volts set by R1 and R3. Discharging to a +0.5 volt potential reduces the possibility of a loss of the first bit following a long null period. This problem has been observed when discharging pin 7 to ground potential. ARINC SPECIFICATION 429, PART 1 - Page 133 APPENDIX A LABORATORY VERIFICATION OF ARINC 429 DITS ELECTRICAL CHARACTERISTICS FIGURE a-(i) BIPOLAR TRANSMITTER BLOCK SCHEMATIC DETAIL OF LINE DRIVER AND TERMINATION LM0002 LM0002 2R o L 1 L 1 PULSEGENERATOR + _ PSEUDORANDOMBIT SEQUENCEGENERATOR SWITCHINGLOGIC SHAPEDBIPOLAR RZ LINEDRIVER TERMINATION 2R o ARINC SPECIFICATION 429, PART 1 - Page 134 APPENDIX A LABORATORY VERIFICATION OF ARINC 429 DITS ELECTRICAL CHARACTERISTICS FIGURE a-(ii) RZ BIPOLAR RECEIVER INPUT TYPES TESTED R > 12 K Ohms (Provides Path for V. F. Input Current) Figure (a) Differential amplifier input schematic. RL = CURRENT LIMITING = 1000 OHMS LED = LED IN SERIES WITH OPTO ISOLATOR TO PROVIDE ON NULL LEVEL OPTO-ISOL = HP 5082-4371 Figure (b) OPTO-ISOLATED INPUT SCHEMATIC L1 OPTO ISOLATORS L2 RL LEDLED OVER VOLTAGE PROTECTION DIFFERENTIALAMPLIFIER VOLTAGEFOLLOWERS R R ZERO’SONE’S ARINC SPECIFICATION 429, PART 1 - Page 135 APPENDIX A LABORATORY VERIFICATION OF ARINC 429 DITS ELECTRICAL CHARACTERISTICS A1-2.4 Receiver Data Detection Technique Two data detection schemes were used, (i) data sampling (sample and decision) and (ii) integrate and dump (Figure a-(iv). The data sampling system detects positive-going or negative-going edges which exceed ±3 volts differential voltage. The edges cause a timing circuit to time for approximately 2 μsec. When the timing circuit has timed out, a sample of the input is taken. If the sample is HI, a ONE is declared. If the sample is LO, a ZERO is declared. If the sample is NULL, and error diagnostic can be output, since a NULL state is known to be invalid at the data sampling time. An error diagnostic will be output if, for example, during a period of NULL on the line, a short-duration noise spike causes the input to exceed the ±3V threshold, so initiating the edge detector timing circuit, but dissipates rapidly so that a NULL is estimated at the data sampling time. The integrate-and-dump processor circuit detects positive or negative-going edges which exceed the ±3V differential threshold. The edge detection causes an integration circuit to integrate the input voltage for a period of 5 μsec. The output of the integrator is sampled (timing is derived from the edge detector) at the end of the integration period. If it is above zero voltage, a ONE is declared; if it is below zero voltage, a ZERO is declared. A threshold level could be introduced about zero voltage to provide an indication of the total energy contained in the pulse. If the integrator output fell within the threshold, an error diagnostic could be presented indicating the at the detection of the bit was marginal. A1-2.5 Test Data Message The test waveform was a continuous pseudo-random bit pattern.

This continuous pattern did not test the initial synchronization or “false-alarm” aspects in a word-by-word transmission environment with NULL on the transmission line between words. A1-2.6 Emission of RF Energy Test Results The following tests were performed under conditions of light (one receiver) and heavy (20 receivers) line loading. A. Conducted RF Interference (RTCA DO-160 Paragraph 21.2) The interference measured was within the limits specified in DO 160 Figure 21-2. B. Radiated RF Interference (RTCA DO-160 Paragraph 21.3) The interference measured was within the limits specified in DO-160 Figure 21-5. It should be noted that the 20dB limit exceedance permitted in DO 160 was not taken. The transmitter output spectrum can be further improved by the addition of filtering to attenuate output frequencies above those of interest in the digital data. A1-2.7 Susceptibility Test Results The tests were performed to determine the susceptibility of the Mark 33 DITS to RF, AF and spike interference levels specified in DO-160 under conditions of light (one receiver) and heavy (20 receivers) line loading. The following receiver configurations were tested: (i) Differential Amplifier input, time sample processing (ii) Differential Amplifier input, integrate-and-dump processing (iii) Opto-isolator input, time sample processing (iv) Opto-isolator input, integrate-and-dump processing The data transmitted consisted of a continuous pseudo-random bit sequence. Error checking was made on a bit-by-bit basis. A. Conducted RF Susceptibility (DO-160 Paragraph 20.20B Category Z) No bit errors were detected with RF applied to any of the line loading and receiver configurations. B. Magnetic Fields Induced Into Interconnecting Cables (DO-160 Paragraph 19.3) Test performed at a level above those specified in DO-160 Figure 19-1. No bit errors were detected with the field applied to the cable for any cable loading or receiver configuration. ARINC SPECIFICATION 429, PART 1 - Page 136 APPENDIX A LABORATORY VERIFICATION OF ARINC 429 DITS ELECTRICAL CHARACTERISTICS FIGURE a-(iii) OPTO-ISOLATOR FRONT-END CIRCUIT SCHEMATIC 5 V 15 V R 4 5.6k 8 6 5 O/ P HP - 5082 - 4371 5 V R1 10k R2 500 R3 1k 7 2 3 ARINC SPECIFICATION 429, PART 1 - Page 137 APPENDIX A LABORATORY VERIFICATION OF ARINC 429 DITS ELECTRICAL CHARACTERISTICS FIGURE a-(iv) DATA DETECTION (a) SAMPLE - AND - DECISION (b) INTEGRATE - AND - DUMP LEGEND: E = EDGE DETECT (BIT TIMING) D = DELAY S = SAMPLE I = INTEGRATION INTERVAL DMP = DUMP INTEGRATOR CHARGE HI NULL LO BIT N BIT N + 1 T +T - S D E ZERO D E S HI NULL LO S I E DMP S I E DMP T+ T- ARINC SPECIFICATION 429, PART 1 - Page 138 APPENDIX A LABORATORY VERIFICATION OF ARINC 429 DITS ELECTRICAL CHARACTERISTICS C. Electric Fields Induced Into Interconnecting Cables (DO-160 Paragraph 19.4) The tests were perform with voltage levels above those specified in DO 160 Figure 19-1 Category Z. No bit errors were detected with the field applied for any cable loading or receiver configuration.

D. Spikes Induced Into Interconnecting Cables (DO-160 Paragraph 19.5, Category Z) The spikes were generated and applied to the cable as shown in DO-160, Figure 19-4. Bit errors were counted during the application of 50 transients and also following the transient test. The following results were observed: Receiver Configuration Line Loading Light Heavy Diff. Amp., Sample Det 0 0 Diff.

Amp., Int. & Dump Det 0 0 Opto-Isolator, Sample Det 8 15 Opto-Isolator, Int & Dump Det 0 1 All configurations performed with zero bit errors for approximately 107 bits following the transient test. A1-3.0 Pulse Distortion Tests For Typical Aircraft wire Installations Laboratory testing and computer simulation studies were conducted to investigate the pulse distortion introduced on typical aircraft wire installations. A1-3.1 Laboratory Tests Receivers and a transmitter were constructed to operate using the DITS high speed (100 KBPS) waveform.

Lengths of twisted shielded cable were connected to form a representative wiring configuration for digital data. The wire length and stub configuration were selected to represent postulated installations on a B747 airplane.

The cable used for lab tests was 20 and 22 AWG twisted shielded cable with wrapped KAPTON insulation, no.

BMS B-51, Class 2 type III. The pulse distortion at the receiver nodes of the wiring systems were recorded. The characteristics of the 20 AWG cable were measured and used to develop the cable model used in the computer simulation. A1-3.2 Computer Simulation A computer program was developed to evaluate pulse distortion on lines with stubs. The DITS transmitter impedance and voltage waveform was modeled. The cable model was developed from the measured cable characteristics. The DITS receiver input impedance was modeled. The computer simulation was run and results were plotted for various line length and stub configurations representing postulated installations on a B747 airplane. A1-3.3 Results The results of the laboratory tests and computer simulation for the same cable configuration showed good agreement, with a maximum difference of 0.4 volts on rising and falling edges. The computer simulation showed slightly higher cable loss effect than the lab test. The lab test results were recorded using an oscilloscope camera; the computer results were plotted. Only the plotted results are presented here. Figure a-(v) shows the schematic for the first simulation. This configuration represents a transmitter, a receiver and a single length of twisted shielded cable 200 feet long. The cable is modeled as Blocks 1 to 4, for later stub connection. At the transmitter and receive ends of the cable, the shields are grounded via a 0.05 μH inductor (which models the inductance of the ground lead). At other nodes, the shields and cable inners are carded through, representing a continuous length of cable. Figure a-(vi) Transmitter open circuit differential output voltage. This waveform was used for all the simulation runs. Figure a-(vii) The transmitter output voltage and receiver input voltage for the configuration in Figure a-(v). Figure a-(viii) shows the schematic for the second simulation. This configuration represents a transmitter at an engine location, with receivers at the equipment bay and the flight deck. Four receiver loading configurations are shown with maximum loading of twenty receivers. The waveforms for this simulation run are shown in Figures a-(ix) through a-(xvi). ARINC SPECIFICATION 429, PART 1 - Page 139 APPENDIX A LABORATORY VERIFICATION OF ARINC 429 DITS ELECTRICAL CHARACTERISTICS Figures a-(ix) and a-(x) Transmitter and receiver waveform for loading configuration 1. Figures a-(xi) to a-(xvi) Waveforms for loading configurations 2, 3 and 4. Figure a-(xvii) shows the schematic for the third simulation. This configuration represents a transmitter at the flight deck with receivers at the equipment bay, the inner engine and the outer engine. Figures a-(xviii) to a-(xxi) Waveforms for the third simulation. Figure a-(xxii) shows the schematic for the fourth simulation. This configuration represents a transmitter at the equipment bay with receivers at the equipment bay, the flight engineer’s panel, the first officer’s panel and the captain’s panel. Figures a-(xxiii) to a-(xxvi) Waveforms for the fourth simulation. Figure a-(xxvii) shows the schematic for the fifth simulation. This is a long line simulation and is included to show the operation of the system with lines longer than would realistically be used in a “B747-sized” airplane. This configuration represents a transmitter with one receiver close (10 feet) and one receiver remote (500 feet). Figures a-(xxviii) and a-(xxix) Waveforms for the “long line” configuration. A1-3.4 Conclusions From laboratory tests and simulations, it is concluded that no intolerable bit distortion is introduced into the “high speed DITS” waveform due to cable lengths and stub configurations likely to be encountered on a “B747-size” transport aircraft. If installations are anticipated involving longer line lengths or cables with radically different electrical characteristics, then further investigation may be required. ARINC SPECIFICATION 429, PART 1 - Page 140 APPENDIX A LABORATORY VERIFICATION OF ARINC 429 DITS ELECTRICAL CHARACTERISTICS FIGURE a-(v) TRANS (58m) BUSLIN 1 (1m)BUSLIN 2 SHIELD 1 SHIELD2 (1m) BUSLIN 3 (1m) BUSLIN 4 SHIELD 3 SHIELD 4 REC 1 100k TERM * SHIELD TIED TO INDUCTOR ON TERM A B 1 2 3 4 5 6 .01 .01 40 40 .1 .1 1 1 1 1 11 2 2 2 2 2 2 22 2 1 11 2 3 33 3 4 44 4 5 5 5 5 66 6 6 TRANSMITTER BMS 13-51 20 AWG TSP 200 FEET 100 k * * TRANS ALL L’s .05μh ARINC SPECIFICATION 429, PART 1 - Page 141 APPENDIX A LABORATORY VERIFICATION OF ARINC 429 DITS ELECTRICAL CHARACTERISTICS FIGURE a-(vi) TRANSMITTER LEAD A TO LEAD B VOLTAGE Am pli tud e V olts Time (microseconds) ARINC SPECIFICATION 429, PART 1 - Page 142 APPENDIX A LABORATORY VERIFICATION OF ARINC 429 DITS ELECTRICAL CHARACTERISTICS FIGURE a-(vii) TRANSMITTER OUTPUT VOLTAGE OPEN CIRCUIT VOLTAGE AT RECEIVER ONE Am pli tud e V olts Time (microseconds) Am pli tud e V olts Time (microseconds) ARINC SPECIFICATION 429, PART 1 - Page 143 APPENDIX A LABORATORY VERIFICATION OF ARINC 429 DITS ELECTRICAL CHARACTERISTICS FIGURE a-(viii) TRANS Configuration # Load Rec 1 # Load Rec 2 1 1 1 2 1 10 3 10 1 4 10 10 ALL L’s .05 REC 1 RECEIVERTWO TRANSMITTER 85 FEET200 FEET 10 FEET RECEIVER One REC 2 (3.05m) BUSLIN 5 SHIELD 5 1 1 1 1 2 2 2 3 4 5 6 TRANS (61m) BUSLIN 1 (10m) BUSLIN 2 SHIELD 1 SHIELD 2 (10m) BUSLIN 3 (6m) BUSLIN 4 SHIELD 3 SHIELD 4 REC 1 TERM * SHIELD TIED TO INDUCTOR ON TERM BLOCK 1 2 3 4 5 6 .01 .01 40 40 .1 .1 1 1 1 1 11 2 2 2 2 2 22 2 1 11 1 2 3 33 3 4 44 4 5 5 5 5 66 6 6 1 2 3 4 5 7 6 8 9 50pf6k 40pf 16.5k 45pf 15k 1 2 * * * * * * Node 1 h μ ARINC SPECIFICATION 429, PART 1 - Page 144 APPENDIX A LABORATORY VERIFICATION OF ARINC 429 DITS ELECTRICAL CHARACTERISTICS FIGURE a-(ix) TRANSMITTER OUTPUT VOLTAGE VOLTAGE AT FIRST NODE CO NF IGU RA TIO N 1 CO NF IGU RA TIO N 1 Am pli tud e V olts Time (microseconds) Am pli tud e V olts Time (microseconds) ARINC SPECIFICATION 429, PART 1 - Page 145 APPENDIX A LABORATORY VERIFICATION OF ARINC 429 DITS ELECTRICAL CHARACTERISTICS FIGURE a-(x) VOLTAGE AT RECEIVER ONE VOLTAGE AT RECEIVER TWO CO NF IGU RA TIO N 1 CO NF IGU RA TIO N 1 Am pli tud e V olts A mp litu de Vol ts Time (microseconds) Time (microseconds) ARINC SPECIFICATION 429, PART 1 - Page 146 APPENDIX A LABORATORY VERIFICATION OF ARINC 429 DITS ELECTRICAL CHARACTERISTICS FIGURE a-(xi) TRANSMITTER OUTPUT VOLTAGE VOLTAGE AT FIRST NODE CO NF IGU RA TIO N 2 CO NF IGU RA TIO N 2 Am pli tud e V olts Time (microseconds) Am pli tud e V olts Time (microseconds) ARINC SPECIFICATION 429, PART 1 - Page 147 APPENDIX A LABORATORY VERIFICATION OF ARINC 429 DITS ELECTRICAL CHARACTERISTICS FIGURE a-(xii) VOLTAGE AT RECEIVER ONE VOLTAGE AT RECEIVER TWO Am pli tud e V olts Time (microseconds) Am pli tud e V olts Time (microseconds) CO NF IGU RA TIO N 2 CO NF IGU RA TIO N 2 ARINC SPECIFICATION 429, PART 1 - Page 148 APPENDIX A LABORATORY VERIFICATION OF ARINC 429 DITS ELECTRICAL CHARACTERISTICS FIGURE a-(xiii) TRANSMITTER OUTPUT VOLTAGE VOLTAGE AT FIRST NODE CO NF IGU RA TIO N 3 CO NF IGU RA TIO N 3 Am pli tud e V olts A mp litu de Vol ts Time (microseconds) Time (microseconds) ARINC SPECIFICATION 429, PART 1 - Page 149 APPENDIX A LABORATORY VERIFICATION OF ARINC 429 DITS ELECTRICAL CHARACTERISTICS FIGURE a-(xiv) VOLTAGE AT RECEIVER ONE VOLTAGE AT RECEIVER TWO CO NF IGU RA TIO N 3 CO NF IGU RA TIO N 3 Time (microseconds) Am pli tud e V olts A mp litu de Vol ts Time (microseconds) ARINC SPECIFICATION 429, PART 1 - Page 150 APPENDIX A LABORATORY VERIFICATION OF ARINC 429 DITS ELECTRICAL CHARACTERISTICS FIGURE a-(xv) TRANSMITTER OUTPUT VOLTAGE VOLTAGE AT FIRST NODE CO NF IGU RA TIO N 4 CO NF IGU RA TIO N 4 Am pli tud e V olts Time (microseconds) Am pli tud e V olts Time (microseconds) ARINC SPECIFICATION 429, PART 1 - Page 151 APPENDIX A LABORATORY VERIFICATION OF ARINC 429 DITS ELECTRICAL CHARACTERISTICS FIGURE a-(xvi) VOLTAGE AT RECEIVER ONE VOLTAGE AT RECEIVER TWO CO NF IGU RA TIO N 4 CO NF IGU RA TIO N 4 Am pli tud e V olts Time (microseconds) Am pli tud e V olts Time (microseconds) ARINC SPECIFICATION 429, PART 1 - Page 152 APPENDIX A LABORATORY VERIFICATION OF ARINC 429 DITS ELECTRICAL CHARACTERISTICS FIGURE a-(xvii) ALL L’S .05 TR AN SM ITT ER 85 FEET 150 FEET 10 FEET RECTWO 50 FEET 50 FEET RECTHREE 50 FEET TRANS (26m) BUSLIN 1 SHIELD1 (15m) BUSLIN 3 (3.05m) BUSLIN 4 SHIELD3 SHIELD4 REC 1 TERM * SHIELD TIED TO INDUCTORON TERM BLOCK 1 2 3 4 5 6 .01 .01 40 40 .1 .1 1 1 1 11 2 2 22 22 2 1 11 2 3 33 44 4 55 6 6 6 h 1 2 3 4 5 76 8 9 50pf6k 40pf 16.5k 45pf 15k 1 2 1LOAD NODE1 NODE2 NODE3 (46m) BUSLIN 2 SHIELD2 1 2 2 1 3 6 1 2 4 5 (15m) BU SL IN 6 SH IEL D 6 1 2 2 136 1 2 4 5 RE C 3 1 LOAD (3.0 5m) BU SLIN 5 SH IEL D 5 1 2 2 136 1 2 4 5 RE C 2 10 LOADS TRANS REC 1 ** ** μ * * * * * * ** 1 10 FEET ARINC SPECIFICATION 429, PART 1 - Page 153 APPENDIX A LABORATORY VERIFICATION OF ARINC 429 DITS ELECTRICAL CHARACTERISTICS FIGURE a-(xviii) TRANSMITTER OUTPUT VOLTAGE VOLTAGE AT FIRST NODE Time (microseconds) Am pli tud e V olts Time (microseconds) Time (microseconds) Am pli tud e V olts ARINC SPECIFICATION 429, PART 1 - Page 154 APPENDIX A LABORATORY VERIFICATION OF ARINC 429 DITS ELECTRICAL CHARACTERISTICS FIGURE a-(xix) VOLTAGE AT RECEIVER ONE VOLTAGE AT RECEIVER TWO Time (microseconds) Am pli tud e vo lts Time (microseconds) Am pli tud e V olts ARINC SPECIFICATION 429, PART 1 - Page 155 APPENDIX A LABORATORY VERIFICATION OF ARINC 429 DITS ELECTRICAL CHARACTERISTICS FIGURE a-(xx) VOLTAGE AT SECOND NODE VOLTAGE AT RECEIVER THREE Time (microseconds) Am pli tud e V olts A mp litu de volt s Time (microseconds) ARINC SPECIFICATION 429, PART 1 - Page 156 APPENDIX A LABORATORY VERIFICATION OF ARINC 429 DITS ELECTRICAL CHARACTERISTICS FIGURE a-(xxi) VOLTAGE AT THREE NODE Am pli tud e V olts Time (microseconds) ARINC SPECIFICATION 429, PART 1 - Page 157 APPENDIX A LABORATORY VERIFICATION OF ARINC 429 DITS ELECTRICAL CHARACTERISTICS FIGURE a-(xxii) AL L L’S .0 5 TR AN S(1 .5m) BU SLIN 1 SH IEL D1 (6.1 m) BU SLIN 3 (6.1 m) BU SLIN 4 SH IEL D3 SHIE LD 4 RE C 1 TE RM * S HIE LD TIE D T O I ND UC TO RO N T ER M B LO CK 1 2 3 4 5 6 .01 .01 4040 .1.1 11 11 2 22 22 2 11 12 33 3 44 55 5 66 6 h 12 34 57 68 9 50p f6k 40p f16 .5k 45p f15 k 1 2 1L OA DN OD E1 NO DE 2N OD E3 (26m) BU SLIN 2 SHIE LD 2 1 2 2 136 1 2 4 5 (1.5m)BUSLIN 5 SHIELD5 1 2 2 1 36 1 2 4 5 REC 21 LOAD TR AN SR EC 1 (6.1m)BUSLIN 6 SHIELD6 1 2 2 1 36 1 2 4 5 REC 31 LOAD (6.1m)BUSLIN 7 SHIELD7 1 2 2 1 36 1 2 4 5 REC 41 LOAD TR AN SM ITT ER 5 F EE T85 FE ET 5 F EE T RE CT WO 20 F EE T 20 F EE T RE CT HR EE 20 F EE T 20F EE T RE CF OU R μ ** ** ** ** * * * * * * ARINC SPECIFICATION 429, PART 1 - Page 158 APPENDIX A LABORATORY VERIFICATION OF ARINC 429 DITS ELECTRICAL CHARACTERISTICS FIGURE a-(xxiii) TRANSMITTER OUTPUT VOLTAGE VOLTAGE AT FIRST NODE Am pli tud e V olts Time (microseconds) Time (microseconds) Am pli tud e V olts ARINC SPECIFICATION 429, PART 1 - Page 159 APPENDIX A LABORATORY VERIFICATION OF ARINC 429 DITS ELECTRICAL CHARACTERISTICS FIGURE a-(xxiv) VOLTAGE AT RECEIVER ONE VOLTAGE AT RECEIVER TWO Time (microseconds) Am pli tud e V olts Time (microseconds) Am pli tud e vo lts ARINC SPECIFICATION 429, PART 1 - Page 160 APPENDIX A LABORATORY VERIFICATION OF ARINC 429 DITS ELECTRICAL CHARACTERISTICS FIGURE a-(xxv) VOLTAGE AT SECOND NODE VOLTAGE AT RECEIVER THREE Am pli tud e V olts Time (microseconds) Am pli tud e vo lts Time (microseconds) ARINC SPECIFICATION 429, PART 1 - Page 161 APPENDIX A LABORATORY VERIFICATION OF ARINC 429 DITS ELECTRICAL CHARACTERISTICS FIGURE a(xxvi) VOLTAGE AT NODE THREE VOLTAGE AT RECEIVER FOUR Time (microseconds) Am pli tud e V olts Time (microseconds) Am pli tud e V olts ARINC SPECIFICATION 429, PART 1 - Page 162 APPENDIX A LABORATORY VERIFICATION OF ARINC 429 DITS ELECTRICAL CHARACTERISTICS FIGURE a-(xxvii) ALL L’s .05 REC 2(1.5m) BUSLIN5 SHIELD5 1 1 1 2 2 2 3 4 56 TRANS (1.5m) BUSLIN 1 (100m) BUSLIN 2 SHIELD2 (50m) BUSLIN 3 (2m) BUSLIN 4 SHIELD3 SHIELD 4 REC 1 TERM * SHIELD TIED TO INDUCTOR ON TERM BLOCK 1 1 1 1 11 1 2 2 2 2 2 22 2 2 1 1 1 2 3 3 3 3 4 44 4 5 5 5 5 66 6 6 h 1 2 3 4 5 76 8 9 50pf6k 40pf 16.5k 45pf 15k 1 2 1 LOAD,@ 100 1 LOAD SHIELD1 2 1 μ Node 1 Node2 Node3 * * * * * * * * * * RECTWO TRANSMITTER 328 FEET5 FEET 5 FEET REC ONE 164 FEET8 FEET OR 100 1 2 3 4 5 6 .01 .01 40 40 .1 .1 Trans ARINC SPECIFICATION 429, PART 1 - Page 163 APPENDIX A LABORATORY VERIFICATION OF ARINC 429 DITS ELECTRICAL CHARACTERISTICS FIGURE a-(xxviii) TRANSMITTER OUTPUT VOLTAGE VOLTAGE AT FIRST NODE Time (microseconds) Am pli tud e V olts A mp litu de Vol ts Time (microseconds) ARINC SPECIFICATION 429, PART 1 - Page 164 APPENDIX A LABORATORY VERIFICATION OF ARINC 429 DITS ELECTRICAL CHARACTERISTICS FIGURE a-(xxix) VOLTAGE AT RECEIVER ONE VOLTAGE AT RECEIVER TWO Time (microseconds) Am pli tud e vo lts Am pli tud e V olts Time (microseconds) ARINC SPECIFICATION 429, PART 1 - Page 165 APPENDIX B AN APPROACH TO A HYBRID BROADCAST-COMMAND/RESPONSE DATA BUS ARCHITECTURE A2-1.0 Introduction During the time that the broadcast approach to digital information transfer became established in the air transport industry, the military aviation community adopted a command/response time division multiplex technique as its standard. In this approach, all aircraft systems needing to exchange digital data are connected to a common bus and a dedicated “bus controller” determines which of them may output data on to the bus at any given time.

MIL STD 1553 was written to describe this system. The airlines considered adopting MIL STD 1553, or something like it, for use on post-1980 new civil aircraft types but found the multiplex technique to be inappropriate for such applications. In civil avionics systems, data typically flows from a given source to a single sink, or group of sinks which may be connected in a parallel, and these sinks are typically not themselves data sources. Thus there is no need for the data transfer system to provide the capability for every unit of every avionics system to both talk and listen to every other unit. The broadcast technique is adequate, and thus the airlines elected to stay with it for their new DITS.

Another development in this same time frame has been the increased use by the military, particularly in transport aircraft, of avionics equipment designed originally for the airlines. This trend may be expected to continue and so give rise to the need to interface equipment providing Mark 33 DITS I/0 capability with a MIL STD 1553A data bus system.

The material in this Appendix prepared by the Information Engineering Division of the USAF Directorate of Avionics Engineering describes one way of doing this, using a data exchange buffer to compensate for the electrical, logic and timing differences between the two systems. A2-2.0 Suggested Mark 33 DITS/MIL STD 1553A Interface The following is a proposed method for interfacing an avionic system employing sensors designed for any combination of ARINC Mark 33 DITS and MIL-STD-1553A. This method minimizes message related differences and compensates for electrical, logic and timing differences in a Data Exchange Buffer (DEB). In a hybrid system such as shown in Figure b-(i), a signal may originate in either a DITS type subsystem or a 1553A subsystem and may be destined for either type of terminal. DITS data received by a DEB is momentarily stored and then retransmitted, complete with label, to the 1553A bus controller. The bus controller determines the intended destinations from the label and look-up table. For DITS destinations, the word is retransmitted, as received, to the appropriate DEB. For 1553A destinations, the data may be retransmitted as received or reformatted, as required by the destination subsystem. Reformatting could involve removal of label and reversing of bit order (MSB vs LSB first).

Figure b-(ii) shows the handling of a word originating in the destined for DITS terminals. Upon arrival at the appropriate destination DEB, the data is momentarily stored and then retransmitted in DITS format, complete with label, to the destination subsystem. If all labels in the system are unique, all receivers in all subsystems associated with a DEB may be connected in parallel. Only the data with the proper label will be recognized by each receiver. If labels are not unique, the DEB must have separate transmitters to transmit the data with identical labels. The desired transmitter could be specified in the 1553A subaddress field.

The retransmission of the data by the DEB allows inherently for different electrical and logical characteristics. The storage of the data allows for simultaneous reception from multiple receivers (DITS and 1553A) and retransmission when the desired bus is available. The much higher speed of 1553A would make retransmission delays small. Figure b-(iii) illustrates the organization of a minimum system. It consists of multiple DITS receivers dumping received data into a first-in first-out (FIFO) stack, available as single LSI chips. The received data is temporarily stored and then retransmitted by the 1553A terminal.

Data received via 1553A is dumped into another FIFO for retransmission by a DITS transmitter. The hardware consists only of DITS receivers, the 1553A terminal, the DITS transmitter, and as many FIFO’s as are required. Hand-shaking signals available on the FIFO’s eliminate almost all supporting SSI chips. This entire system would probably fit on one full ATR card or less. Figure b-(iv) illustrates possible organization for a more sophisticated DEB. It consists of an many DITS transmitters and receivers as necessary, a single (internally redundant) 1553A remote terminal, a buffer memory, a controller (microprocessor), and a program for the controller contained in ROM. Whenever a complete, valid word is available at a receiver, the controller is notified. When the parallel data bus becomes available, the word is transferred to memory. When the desired transmitter (DITS or 1553A) becomes available, the data word is routed from memory to the transmitter. The low rate of DITS terminals (minimum 320 microsec/word) would result in a very low loading of the parallel bus and controller. The speed of the 1553A terminal might necessitate a direct memory access arrangement. The controller, the program memory, the buffer memory and a dual 1553A remote terminal would probably fit on one one-sided 3/4 ATR card. The required ARINC transmitters and receivers would probably fit on another card. This method represents one way of constructing a hybrid system. The retransmission of the label with the data greatly reduces the intelligence required by the DEB but increases bus loading. A more intelligent DEB, perhaps located in the bus controller, could achieve much higher efficiencies. ARINC SPECIFICATION 429, PART 1 - Page 166 APPENDIX B AN APPROACH TO A HYBRID BROADCAST-COMMAND/RESPONSE DATA BUS ARCHITECTURE NE WS UB SY ST EM RT BU SC ON TR OL LE R DU AL 155 3A B US D AT AE XC HA NG EB UFF ER RT TR R OL DS UB SY ST EM OL DS UB SY ST EM TR RT RR OL DS UB SY ST EM TR DIT SB US ES NE WS UB SY ST EM RT RT TR FIGURE b-(i) HYBRID BUS ARCHITECTURE ARINC SPECIFICATION 429, PART 1 - Page 167 APPENDIX B AN APPROACH TO A HYBRID BROADCAST-COMMAND/RESPONSE DATA BUS ARCHITECTURE FIGURE b-(ii) MESSAGE WORD FORMATTING LA BE L LA BE L SS LA BE L LA BE L LA BE L Rec eive d D ITS wor d (32b its) Dat a st ored in b uff er (2x16 bit s) Dat a st ored in b uff er (2x16 bit s) Tra nsm itte d v ia 1 553A Ret ran smit ted via DIT S (32 b its) ARINC SPECIFICATION 429, PART 1 - Page 168 APPENDIX B AN APPROACH TO A HYBRID BROADCAST-COMMAND/RESPONSE DATA BUS ARCHITECTURE FIGURE b-(iii) MINIMUM DATA EXCHANGE BUFFER DIT S B US 1 DIT S B US 2 DIT S B US 3D ITS XM TR DIT SR EC EIV ER DIT SR EC EIV ER FIF O15 53A TE RM INA L 1553 AB US ARINC SPECIFICATION 429, PART 1 - Page 169 APPENDIX B AN APPROACH TO A HYBRID BROADCAST-COMMAND/RESPONSE DATA BUS ARCHITECTURE FIGURE b-(iv) PROGRAMMABLE DATA EXCHANGE BUFFER DIT SX MT RB UF FE RM EM OR Y In tern al P arra llel Dat a B us DIT SR EC EIV ER DIT SR EC EIV ER 1553 AT ER MIN AL Ad dre ssC ON TR OL LE R PR OG RA M Roc kwel l In tern atio nal 4 M ay 1 979 A Con trol Sys tem Vie w o f AR INC 429 Bus Spe cifi cati ons By T . G. S harp e an d G . E. F orqu er I. I ntro duct ion and Sum mar y The dis cuss ion belo w s umm ariz es c once pts that hav e gr own out of a n in -hou se effo rt to de term ine wha t p aram eter ch arac teri stic s Col lins fee ls shou ld be incl uded in the dat a s tand ards tabl es o f A RIN C Bus Spe cifi cati on 4 29 (DIT S). T he D ITS spe cifi cati on s eem s to be evol ving as mor e th an m erel y a digi tal bus desc ript ion sinc e in man y w ays it i s ta king on the char acte rist ics of a sys tem in terf ace spec ific atio n. Thi s ra ises phi loso phic al q uest ions con cern ing thos e ch arac teri stic s, w hich sho uld appe ar i n th e in divi dual equ ipm ent spec ific atio ns vers us t hose whi ch s houl d ap pear in “429 ”. The aut hors can not reso lve such pa rtit ioni ng q uest ions . H opef ully we can cont ribu te, as o utli ned belo w, to a n un ders tand ing of w hat info rmat ion is r equi red by c ontr ol s yste ms desi gner s to ac hiev e an acc epta ble syst em p erfo rman ce. The det aile d di scus sion in this pap er evol ves a se t of ter ms (out line d be low) w hich are usa ble in a spe cifi cati on. W hich of thes e te rms appe ar in the indi vidu al e quip men t spe cifi cati ons and whi ch a ppea r in “42 9” r emai ns to be dete rmin ed. At the pres ent tim e, i t is sug gest ed t hat cont rol syst em d esig ners int erfa cing wit h di gita lly buse d da ta shou ld be conc erne d w ith thre e pr ime area s: stab ilit y co nsid erat ions , si gnal deg rada tion , an d sp ectr al c hara cter isti cs.

Wit hout the se elem ents of info rmat ion, tho roug h an alys is o f sy stem per form ance will not be poss ible . The fo llow ing eigh t pa ram eter cha ract eris tics sho uld prov e ad equa te f or t he min imal con trol of inte rfac ing cons ider atio ns. S tabi lity • Con trol Ban d • Mag nitu de L imit s • Pha se L imit s Si gnal Deg rada tion • Mod ific atio n S igna l to Noi se R atio (M SN) • Sta tic Acc urac y Spe ctra l Cha ract eris tics • Upd ate Inte rval • Tra nsm it I nter val • P re-s ampl ing Ban dwid th L imit T he foll owin g di scus sion of th ese char acte rist ics shou ld aid the read er in unde rsta ndin g th eir purp ose and asse ssin g th eir adeq uacy .

I t is rec ogni zed that so me chan ges may nec essa rily tak e pl ace as t he i ndus try com plet es i ts d igit al inte rfac ing stan dard izat ion task . II . S tabi lity Con side rati on The re i s no thin g un ique ly d igit al i n th is a rea. H ere our conc ern is w ith thos e ch arac teri stic s th at a re m ost o ften use d in line ar s yste m s tabi lity ana lysi s – nam ely gain and pha se c hara cter isti cs. We reco gniz e at the out set that all sen sor syst ems are not 100% lin ear but this doe s no t pr even t us fro m d efin ing a li near mod el o f su ffic ient qua lity to supp ort stab ilit y an alys es. It is usef ul t o co nsid er h ere that ge nera lly the sens or w ill be w ideb and rela tive to the band of freq uenc ies of inte rest to the cont rol syst em. Thi s is nec essa ry f rom a s tabi lity poi nt o f vi ew sinc e th e co nver se (that is, sig nals nar row band rel ativ e to the cont rol b and) wou ld intr oduc e ex cess ive phas e la g in the con trol ban d. Thu s fa r w e ha ve i mpl icit ly cons ider ed b oth band pass and low pass cen tere d at zer o fr eque ncy. For sim plic ity, ho wev er, t he d iscu ssio n be low wil l as sum e lo w p ass sens or c hara cter isti cs b ut t he idea s ap ply gene rall y. F igur e 1 illu stra tes an a ssum ed s enso r ch arac teri stic . Gai n an d P hase Con stra ints N ote that pri me conc erns are tha t th e ga in r emai n es sent iall y co nsta nt t hrou gh t he cont rol band and tha t th e ph ase be b ound ed b y a line ar c hara cter isti c th roug h th e co ntro l ba nd. Fro m a con trol law sta bili ty p oint of view , w e ar e no t co ncer ned wit h w hat happ ens at f requ enci es a bove the con trol ban d be caus e th ese are beyo nd t he r ange whe re t he d ata is b eing use d by the con trol sys tem .

I f w e co nsid er o pen loop Bod e pl ots brok en a t th e se nsor out put, the cont rol band as used abo ve s houl d be wid e en ough to incl ude the phas e cr osso ver as w ell as t he gain cro ssov er. The pha se a nd g ain char acte rist ics prov ide info rmat ion abou t ph ase and gain mar gin degr adat ion. F or m ost sens ors the gain cro ssov er i n ty pica l co ntro l la ws is k now n ap prox imat ely. P hase cro ssov er i s no t as eas ily dete rmin ed. A r eso nabl e fi rst cut wou ld b e to def ine the cont rol band as appr oxim atel y te n ti mes the ope n lo op c ross over fre quen cy w ith the expe ctat ion th at b eyon d th is r ange con trol law gai n is low eno ugh to p reve nt g ain mar gin ARINC SPECIFICATION 429, PART 1 – Page 170 APPENDIX C DIGITAL SYSTEMS GUIDANCE (PART 1) Col lins Avi onic s D ivis ions 40 0 C ollin s R oad, NE C edar Rap ids, Iow a, 5 2406 (3 19) 395- 1000 C able CO LIN RA D C edar Rap ids prob lem s. How ever , so me sens ors may hav e tr oubl e ho ldin g a tigh t ga in (and phas e) s pec over this wid e a band wid th. Pos sibl y in thes e ca ses a lo osen ing of th e sp ec b etw een open loo p cr osso ver and ten tim es o pen loop cro ssov er m ay b e re quir ed.

Wit h th is k ind of s peci fica tion a s impl e tr ansp ort dela y in com bina tion w ith a ga in c hang e ca n be use d fo r st abil ity anal ysis or, for sli ghtl y m ore com plex ca ses, sim ple tran sfer fun ctio ns c an b e us ed t o ap prox imat ely fit the spec . T he impo rtan t po int here is not to c onst rain the sen sor desi gner to a fi rst orde r or se cond ord er o r an y sp ecif ic i mpl emen tati on, but to r athe r bo und in a sim ple yet usab le s ense the sta bili ty d egra dati on t he s enso r ca n in trod uce. T he i mpo rtan t st abil ity char acte rist ics are defi ned conc isel y be low . • Con trol Ban d – Tha t ba nd o f fr eque ncie s ov er w hich mag nitu de a nd p hase ch arac teri stic s of the sens or a re im port ant t o th e co ntro l sys tem sta bili ty. • M agni tude Con stra int – T he b ound s (e nvel ope) on the perm issi ble gain va riat ion in a lin ear freq uenc y re spon se s ense tha t ar e pe rmis sibl e ov er t he cont rol b and. • Pha se C onst rain t – The bou nds (env elop e) o n th e pe rmis sibl e ph ase vari atio n in a l inea r fr eque ncy resp onse sen se t hat are perm issi ble over the con trol ba nd.

ARINC SPECIFICATION 429, PART 1 – Page 171 APPENDIX C DIGITAL SYSTEMS GUIDANCE (PART 1) f( ) SE NS OR Sig nal D epen den tN oise Inte rnal lyG ener ated Noi se Inst alla tion Noi se Sig nal Pro cess Noi seS enso rIn put Sen sor Oup ut Mea sure men tE rror - ++ + ++ + ++ + Pot enti al M easu rem ent T echn ique The se q uant itie s co uld be m easu red by p rovi ding a s inus oida l in put stim uli at sele cted fre quen cies in the cont rol band usi ng a mid -ran ge a mpl itud e. At each fr eque ncy the outp ut c ompo nent of inte rest (as sum ing som e di stor tion) w ill b e th e ou tput com pone nt w hose fre quen cy c orre spon ds t o th e in put freq uenc y. The ph ase and ampl itud e of thi s co mpo nent of this com pone nt r elat ive to t he f orci ng func tion wil l pr ovid e th e m agni tude and pha se in form atio n. I n th e te rmin olog y of no nlin ear syst em anal ysis , th is proc edur e yi elds an d em piri call y de rive d de scri bing fun ctio n fo r th e se nsor ove r th e co ntro l ba nd. If a mpl itud e de pend ent nonl inea riti es a re s ever e, m ore than one am plit ude of f orci ng f unct ion may hav e to be used wit h th e pr oced ure repe ated at e ach ampl itud e.

III. Sig nal D egra dati on In t his area we are conc erne d w ith wha t th e se nsor may hav e do ne t o de grad e th e si gnal . T he t hrus t he re i s no t st abil ity but perf orm ance . F igur e 2 pres ents a v iew of sen sor and sign al c hara cter isti cs th at is use ful i n th is c onte xt. In F igur e 2 som e im port ant sour ces of s igna l de grad atio n ar e il lust rate d.

The term “no ise” is u sed som ewha t lo osel y in Fig ure 2 to den ote degr adat ion sour ces. P roce ss n oise and in stal lati on n oise are inh eren t in the sig nal impi ngin g on the sen sor – th e fo rmer be ing thin gs s uch as g ust n oise and bea m n oise and the latt er b eing eff ects suc h as E MI, mou ntin g er rors , et c. Wit hin the sens or i tsel f th ere is i nter nall y ge nera ted nois e su ch a s sh ot n oise fro m r esis tors , E MI from dig ital buse s, e tc. that is inde pend ent of t he i nput sig nal. In a ra dio rece iver this is th e ki nd o f no ise that is mea sure d at the out put whe n th e in put is s hort ed. Not e th at t his “noi se” can also in clud e bi as a nd d rift eff ects . I f th ere is a dig ital sam plin g pr oces s in the sen sor, so me alia sing of the inpu t si gnal spe ctru m will occu r. Thi s al iase d en ergy may al so b e re gard ed a s no ise. T he o ther inh eren t se nsor deg rada tion is mor e di ffic ult to d eal wit h, h owev er, f or it i s si gnal dep ende nt. A f amil iar anal og e xam ple is i nput am plit ude depe nden t ch arac teri stic s su ch as satu rati on effe cts that on ly beco me sign ific ant abov e ce rtai n in put ampl itud es.

A noth er is nonl inea riti es that pr oduc e ha rmon ic dist orti on u nder sin e w ave exci tati on a s sh own in th e ex ampl e be low . Fig ure 2. Sen sor and Sig nal Ch arac teri stic an d M easu rem ent Noi se ARINC SPECIFICATION 429, PART 1 – Page 172 APPENDIX C DIGITAL SYSTEMS GUIDANCE (PART 1) 22 kkm S o P o S o P o Har mon ic D isto rtio n Con side r sq uare law dis tort ion in a n ot herw ise line ar s enso r. L et th e se nsor ou tput be y(t) = x(t) + kx(t)^{2} Whe re x (t) is th e se nsor inpu t and let x (t) = s inw t. T hen y(t) = sin wt + ksi n^{2}w t y(t) = s inw t ± cos 2wt Not e th at d .c. a nd s econ d ha rmon ic c ompo nent s as wel l as the for cing fre quen cy app ear a t th e out put. In digi tal s yste ms a si mil ar e ffec t occ urs whe n m ulti ple rate s ar e in trod uced , su ch a s si gnal s be ing rece ived at one rate fro m a dig ital bus and be ing used at a di ffer ent rate by a so ftw are prog ram . I f th e an alog sig nals or igin ally sam pled and put on the bus wer e si nuso idal at one freq uenc y th en, in gene ral, freq uenc y co mpo nent s le ss th an a n d g reat er th an the inp ut f requ ency (as w ell as t he i nput fre quen cy) appe ar a fter the sec ond sam pler . T he a mpl itud e an d nu mbe r of thes e sp urio us o utpu ts is a f unct ion of t he tw o sa mpl ing rate s as wel l as the inpu t fr eque ncy. The ne t ef fect of al l su ch inte rnal se nsor ef fect s is ob serv able by subt ract ing sens or i nput fro m s enso r ou tput to yiel d m easu rem ent erro r as sho wn in F igur e 2. Mea sure men t Err or The inv olve d na ture of wha t ca n ha ppen to the sign al w ithi n th e se nsor as show n in Fig ure 2 is the sou rce of a mbi guit y in con vent iona l “a ccur acy” spe cs.

Sin ce mea sure men t no ise can be d epen dent on inpu t am plit ude as w ell as s pect ral char acte rist ics, it is n ot p ossi ble to s peci fy i t w ith a si ngle and sim ple met ric. It sh ould als o be app aren t th at m easu rem ent erro r m ust be a ddre ssed sta tist ical ly sinc e a sign ific ant port ion of t he i nput , pr oces s no ise, is only des crib able as a ra ndom pro cess .1 T echn ical ly t he i nput sig nal is a lso in g ener al a ran dom pr oces ses infl uenc ed b y su ch t hing s as the gus t st riki ng t he a ircr aft. Gus ts a lso can only be desc ribe d as ran dom pro cess es. 1 Rec ogni zing that a c ompl ete desc ript ion of a ran dom pro cess incl udes not onl y pr obab ilit y di stri buti ons but a lso spec tral cha ract eris tics . To eval uate the spe ctra l ch arac teri stic s of mea sure men t er ror wil l re quir e te sts whi ch f orce the sys tem wit h no ise type inp uts. E xpon enti ally cor rela ted nois e of sp ecif ied vari ance and cor rela tion tim e (o r ba ndw idth) sh ould be suff icie nt i n m ost case s. If a sen sor is k now n to be susc epti ble to a spe cifi c ty pe o f no ise, ho wev er, that noi se s houl d be inc lude d in the tes t. O ften it wil l be use ful to sepa rate out the low fre quen cy o r d- c co mpo nent s of mea sure men t er ror sinc e th ese may be mor e to lera ble in s ome appl icat ions tha n dy nam ic e rror s. A s et o f te sts that wil l mea sure thes e ch arac teri stic s is des crib ed b elow . M odif ied Sig nal t o N oise Rat io (MS N) F orce the sen sor wit h ra ndom noi se o f sp ecif ied rms valu e (σ) an d co rrel atio n ti me (τ). D eter min e th e po wer spe ctra l de nsit y (P SD) of the inp ut s igna l to the se nsor . D eter min e th e P SD of the mea sure men t er ror. P lot the two PS D’s on a co mm on p lot as s how n in Fig ure 3. Def ine a m odif ied sign al t o no ise rati o (w hich wil l be a f unct ion of f requ ency) as the squ are root of nois e ra tio at e ach freq uenc y of sig nal PS D a mpl itud e to mea sure men t er ror PS D. Not e in the ex ampl e sh own in F igur e 3 ther e is a b ulge in the measurem en t er ror arou nd z ero freq uenc y. Thi s ef fect wou ld i ndic ate d-c bias and pos sibl y lo w f requ ency bia s dr ift from the sen sor. T his effe ct m ay o r m ay n ot b e im port ant depe ndin g on w heth er t he a ppli cati on p erm its was hing out low fre quen cy c ompo nent s, e .g. in a co mpl emen tary fil ter. In the ran ge o f fr eque ncie s w here acc urat e se nsor res pons e is req uire d, i t is sug gest ed t hat appr opri ate valu es f or t he m odif ied sign al t o no ise (MS N) wil l be 100 to 1000 . R ough ly, thes e nu mbe rs c orre spon d to noi se p ower be ing 1% t o .1 % o f si gnal pow er a t ea ch f requ ency or nois e be ing 40 t o 60 db dow n fr om s igna l. T he r elat ions hip betw een MS D a nd o rdin ary sign al t o no ise can be u nder stoo d by ass umin g bo th s igna l an d no ise PS D’s are fla t ov er a ban d of fre quen cies Δw as show n in Fig ure 3. Let the val ue o f th e si gnal PS D i n th is band be So, the n rm s si gnal pow er i n th e ba nd Δ w i s gi ven by S o*w . S imil arly , rm s er ror pow er i s gi ven by P o*w . T here fore con vent iona l si gnal to nois e ov er the band w i s gi ven by . R equi ring tha t th is s igna l to noi se b e 10 0 is eq uiva lent to requ irin g th at n oise pow er b e 1% of sign al p ower ove r t his band . C arry ing this bac k to the MS N i mpl ies that MS N (w) = = 100 ove r th e ba nd Δw. The abo ve a lso repr esen ts t he m otiv atio n fo r co nsid erin g sq uare roo t of the ra tio than the rati o di rect ly. Am plit ude Dep ende nt N onli near itie s The app roac h de scri bed abov e te sts for inpu t fr eque ncy depe nden t de grad atio ns b y pr ovid ing a re alis tic inpu t sp ectr um. It shou ld b e re aliz ed t hat if t here are am plit ude depe nden t de grad atio ns, the MS N a naly sis wil l yi eld diff eren t an swer s de pend ing on t he r ms valu e of the inp ut n oise . I t is sug gest ed t hat the MS N mea sure men t be don e w ith wor st c ase inpu t no ise, i.e ., la rges t rm s an d ba ndw idth ARINC SPECIFICATION 429, PART 1 – Page 173 APPENDIX C DIGITAL SYSTEMS GUIDANCE (PART 1) Sign al P ower Spe ctra lD ensi ty(SPSD (w)) Mea sure men tE rror Pow erSp ectr al D ensi ty(M EP SD(w)) freq uenc y wΔ w | /|\| \(Δ= wrm sp 0 () wrm ss Δ= 0 MSN (w) = MSN M odif ied Sign al to Noi se R atio Δ Fig ure 3. M odif ied Sign al to Noi se R atio SP SD (w)M EP SD (w) A M P L I T U D ES o P o that wil l be enc ount ered . I n so me case s al tern ate MS N s pecs for dif fere nt f ligh t re gim es m ay b e ap prop riat e. In m any case s a mor e ex plic it p rese ntat ion of t he a mpl itud e de pend ent non- line arit ies may be desi rabl e. A g ood exam ple here is loca lize r re ceiv er l inea rity , sp ecif ied as b eing lin ear wit hin a gi ven perc enta ge u p to .15 5 D DM , a larg er perc enta ge f rom .15 5 to .31 0 D DM and not dec reas ing betw een .310 and .40 0 D DM . S uch a sp ecif icat ion is i mpo rtan t in defin inin g lo cali zer capt ure law s, w here on e ca n be gin “usi ng” the sign al c rude ly b efor e it is li near or prec isel y ac cura te. I t sh ould be note d th at t his is a sli ghtl y di ffer ent use of s enso r da ta t han for prec ise stat e co ntro l, i.e . th e co ntro l is car ryin g th e sy stem to a pr escr ibed sta te r athe r th an m aint aini ng i t at a p resc ribe d st ate in t he p rese nce of n oise . N orm ally the la tter ope rati on w ill requ ire mor e ac cura te i nfor mat ion from the sen sor. T he ampl itud e de pend ent degr adat ions sho uld be m easu red stat ical ly - - th at i s, o ne shou ld p rovi de a tes t in put at s peci fied am plit ude, all ow t rans ient s to set tle, and m easu re th e ou tput val ue. The im port ant sign al d egra dati on t erm s ar e de fine d co ncis ely belo w. Onl y th e la st tw o ar e pr opos ed a s a pa ram eter cha ract eris tics --th e fi rst t hree bei ng d efin itio ns to c lari fy th e la st tw o. • Mea sure men t E rror – T he d iffe renc e be twee n th e si gnal im ping ing on t he s enso r a nd th e ou tput rep rese ntat ion of t hat sign al b y th e se nsor exp ress ed in con sist ent u nits .

• S igna l P SD (S PS D) – T he p ower spe ctra l de nsit y of the sig nal impi ngin g on the sens or. • Mea sure men t E rror PS D (ME PS D) – T he p ower spe ctra l de nsit y of m easu rem ent e rror intr oduc ed b y th e se nsor . • M odif ied Sig nal to Noi se Rat io – A m easu re prim aril y of th e sp ectr al c hara cter isti cs o f se nsor err ors defi ned as t he s quar e ro ot o f th e ra tio of S PS D a nd M EP SD at each fre quen cy i n th e co ntro l ba nd. i.e., MS N(w) = • Sta tic Accu rac y – A mea sure of th e am plit ude depe nden t ch arac teri stic s of sen sor erro rs d efin ed a s th e di ffer ence bet wee n in put a nd o utpu t sig nals aft er a ll tr ansi ents hav e se ttle d. Pot enti al M easu rem ent T echn ique Mod ifie d S igna l to Noi se (MS N) dete rmin atio n re quir es a ssum ing a ra ndom pr oces s m odel for the sig nal impi ngin g on the sen sor.

N orm ally an expo nent iall y co rrel ated si gnal w ith spec ifie d va rian ce wil l be su ffic ient . Em piri call y de term ined po wer sp ectr al dens itie s (u sing di scre te Fou rier T rans form te chni ques) w ill need to be m easu red for inpu t si gnal as wel l as mea sure men t er ror. Sta tic accu racy mea sure men t was des crib ed a bove . IV . S pect ral C hara cter isti cs In t his area the dig ital nat ure of t he s yste m i nter face mus t be fac ed s quar ely. T he cont rol syst em desi gner ca nnot al ter the sign al degr adat ion intr oduc ed by ARINC SPECIFICATION 429, PART 1 - Page 174 SP SD (w)M EP SD (w) APPENDIX C DIGITAL SYSTEMS GUIDANCE (PART 1))2f2 ,2f1 (the sens or w heth er i t be due to nonl inea riti es, alia sing , no ise, etc . H e ha s gr eat pote ntia l, ho wev er, f or m akin g m atte rs w orse if h e is not ale rt to pot enti al a lias ing prob lem s th at h e m ay i ntro duce . T o an alyz e al iasi ng p reci sely he wou ld n eed a pr ecis e de fini tion of the spec trum of each sig nal bein g re ceiv ed o n th e di gita l bu s in clud ing the upda te i nter val for each sig nal. A m ore prac tica l ap proa ch i s to pl ace an uppe r bo und on the rece ived si gnal sp ectr um and then en sure do wns trea m p erfo rman ce i s ad equa te u sing thi s bo und as t he s igna l sp ectr um.

The se id eas are mad e m ore prec ise belo w. M ulti rate Sam plin g A sim ple mod el f or s igna ls r ecei ved from a b us a nd u sed in a dig ital pro cess or i s sh own in F igur e 4. We note that the spec trum of the sign al o n th e bu s, F 1 (s), is an infi nite ly r epli cate d ve rsio n of the ana log inpu t sp ectr um w ith repl icas spa ced by the inpu t sa mpl ing freq uenc y F 1. We cann ot, ther efor e, s peak of the band wid th of F 1 (s) st rict ly. Wha t w e m ean here is that a b ound is requ ired on each cop y in F 1 (s). Der ivin g th e sp ectr um o f th e si gnal F2 (s) is b eyon d th e sc ope of t his disc ussi on b ut a tech niqu e ha s be en d evel oped that wil l yie ld th is s pect rum , F2 (s), gi ven the quan titi es F 1, F 2, a nd t he s hape of the repe ated spe ctru m o f F (s) in F1 (s).

The re is cons ider able sp read ing of sign al en ergy in this pr oces s w ith cons ider able “al iasi ng” pote ntia l ev en i f th e qu anti ty f c in Fig ure 4 is muc h le ss than th e N yqui st freq uenc y fo r bo th F 1 a nd F2. The “al iasi ng” in the spec trum F2 (s) occu rs b ecau se t he s econ d sa mpl er i s no t op erat ing on a pr oper ly b and lim ited fun ctio n (s ee F igur e 4) due to the “inf init e re plic a” n atur e of the spec trum F2 (s). Det erm inis tic Ver sus Ran dom Sig nals T he d iscu ssio n ab ove did not spec ify whe ther the ori gina l an alog qua ntit y w as a de term inis tic sign al o r a rand om p roce ss.

For det erm inis tic case s w e de al w ith the Fou rier tra nsfo rms of t he s igna ls i nvol ved. H owev er, as p oint ed o ut i n S ecti on I II t he s igna ls o f in tere st a re r eall y de scri babl e on ly i n te rms of r ando m proc esse s. F or th is c ase the deve lopm ent m ust p roce ed in term s of pow er s pect ral dens ity of t he s igna ls i nvol ved. F igur e 5 then ill ustr ates the bou nd o n bu sed sign al P SD tha t is env isio ned. R ecal l th at w hite noi se t hrou gh a low pass filt er yiel ds a PS D th at r olls off at 4 0 db /dec ade as s how n be low . Whi te N oise Inp ut P SD : U (S) = A - ∞ < w < + ∞ F ilte r T rans fer Fun ctio n: T (jw) = 1 J τw+ 1 O utpu t PS D: Y (S) = T(S)T*(S)U (S) Y (w) = A τ2 w2 + 1 Ade quat e ro ll o ff c hrac teri stic of the digi tall y bu sed data red uces the ali asin g pr oble m o f th e se cond sam pler if the seco nd s ampl ing is p rope rly perf orm ed. How ever , not onl y th is s pect rum but als o th e fr eque ncy F1 ente rs i nto the alia sing in F2 (s), the refo re, it i s de sira ble also to care full y sp ecif y F 1. T his wil l be ac com plis hed thro ugh the upda te i nter val. Ass umin g F2 is som ewha t fi xed by com pute r sp eed and load ing cons ider atio ns, a lias ing can be m inim ized for a g iven in put s pect rum by mak ing F1 as hig h re lati ve to F2 as pos sibl e. The impo rtan t spe ctra l cha ract eris tic term s ar e de fine d co ncis ely belo w. • U pdat e In terv al – The cyc lic tim e in terv al, as m easu red at t he D ITS bus in terf ace, bet wee n tr ansm issi ons of n ew f resh ly s ense d an d co nver ted/ deri ved valu es o f th e pa ram eter . Dig ital Reg iste r Sam pler Sam pler f 1f 2 F(S)F An alog Qu anti ty Bu sed Sig nal Sof twar eF etch F(S)A nal ogIn put Spe ctru m S -2f1 -f1 -fc 2f1 Sfc Fig ure 4 A naly sis of M

ulti rate Sam plin g 2(S)F 1(S) f1 ARINC SPECIFICATION 429, PART 1 - Page 175 APPENDIX C DIGITAL SYSTEMS GUIDANCE (PART 1) • T rans mit Int erva l – The cyc lic tim e in terv al, as m easu red at t he D ITS bus in terf ace, be twee n tr ansm issi ons of the para met er. T rans mit In terv al ≤ U pdat e In terv al. • P re-s ampl ing Ban dwid th L imit – T hat b andw idth for a f irst ord er la g th at w ill uppe r bo und the spec tral cha ract eris tics of the sign al o f th e si gnal on the bus. Fig ure 5 P SD Bou nd on Bu sed Sig nal Not e: P erio dic Fu nct ion - O nly Pos itiv e H alf of Zer o C ente red Com pon ent Sh own (se e F igu re 4) Fre qu ency w 40 d b/d ecad e Pow er S pec tral Den sity Pre -Sam pli ng Ban dw idth Lim it ARINC SPECIFICATION 429, PART 1 - Page 176 APPENDIX C DIGITAL SYSTEMS GUIDANCE (PART 1) BO EIN G C OM ME RC IAL AIR PL AN E C OM PA NY P.O . Box 370 7 Sea ttle, Was hing ton 9812 4 M/S 47- 09 A Div isio n of The Boe ing Com pany May 11, 197 9 SYST -B87 13-7 9-20 9 M r. B . R. C lim ie, C hair man A irli nes Ele ctro nic Eng inee ring Com mit tee Aer onau tica l Rad io, I nc.

2551 Riv a R oad Ann apol is, M aryl and 2140 1 D ear Ric k: The enc lose d pa per is a rev ised ver sion of “Des ign Par amet ers for Dig ital A vion ic S yste ms, ” w hich was ori gina lly circ ulat ed w ith AE EC let ter 79- 022/ SA I-99 .

T he r evis ion addr esse s th e to pic of a lias ing whi ch c ould oc cur whe n re duci ng t he s ampl ing rate of a di gita lly enco ded sign al. Thi s to pic was dis cuss ed a t th e D ITS wor king gro up m eeti ng h eld on A pril 18 and 19. S ince rely AIR TR AF FIC CO NT RO L A ND EL EC TR ON IC S YS TE MS A. F . Nor woo d, C hief A FN : E nclo sure Att achm ent t o S YS T-B -876 4-20 -075 DE SIG N P AR AM ET ER S F OR DIG ITA L A VIO NIC SY ST EM S Pre pare d by B oein g C omm erci al A irpl ane Com pany R EV ISIO N A S umm ary Thi s pa per expl ains th e ne cess ity for defi ning pr esam plin g fi lter ch arac teri stic s, t rans port del ays and min imum upd ate rate s fo r di gita l an d no ise char acte rist ics are disc usse d. A d esig n pr oced ure for sele ctin g th e re quir ed f ilte r ch arac teri stic and upd ate rate is p rese nted . In trod ucti on The new gen erat ion of c omm erci al a ircr aft wil l us e di gita l te chno logy to impl emen t m any func tion s, whi ch wer e tr aditi ona lly perf orm ed wit h an alog har dwar e.

The se f unct ions inc lude inn er a nd o uter ser vo l oops for ai rcra ft cont rol and guid ance , pr oces sing an d fi lter ing sign als from na viga tion and oth er s enso rs, and filt erin g of dat a pr ior to i ts d ispl ay o n co ckpi t in stru men ts. Dig ital tec hnol ogy wil l al so r epla ce t he m ajor ity of the form erly an alog co mm unic atio n pa ths betw een syst ems, se nsor s, inst rum ents and act uato rs.

A b asic pro pert y of the se a nd o ther dig ital sys tem s is tha t th ey o nly proc ess or t rans fer valu es o f da ta f rom dis cret e po ints in tim e. The co ntra st b etw een the disc rete tim e na ture of a di gita l sy stem and the co ntin uous tim e na ture of an a nalo g sy stem is show n in Fig ure 1. Ana log syst ems are said to oper ate in t he c onti nuou s ti me dom ain whi le d igit al syst ems are said to o pera te in the disc rete tim e do mai n. In o rder for dis cret e ti me digi tal syst ems to b e us ed t o pr oces s or tra nsfe r th e in here ntly con tinu ous tim e da ta f rom rea l w orld phy sica l sy stem s, sam ples of the cont inuo us d ata mus t be tak en a t pe riod ic i nter vals . T hese sa mpl es f rom dis cret e po ints in tim e ca n th en b e us ed a s th e in put to t he disc rete tim e di gita l sy stem . I t is int uiti vely obv ious tha t th e in terv al betw een sam ples aff ects the accu racy wit h w hich the con tinu ous tim e da ta is r epre sent ed b y th e di scre te s ampl es. It is a lso obvi ous that rap idly va ryin g si gnal s sh ould be sam pled mor e of ten than slo wly var ying sig nals in ord er t o m aint ain an a dequ ate repr esen tati on o f th e co ntin uous ana log data . S elec tion of a pr oper sam plin g ra te f or e ach sign al i s a desi gn t ask uniq ue t o di gita l sy stem s. An unde rsta ndin g of the Sam plin g T heor em i s ne cess ary in o rder to mak e th e pr oper tra de o ffs betw een sam plin g ra te, sign al-t o-no ise rati o, s igna l del ay, a nd s yste m c ompl exit y. APPENDIX D DIGITAL SYSTEMS GUIDANCE (PART 2) ARINC SPECIFICATION 429, PART 1 - Page 177 BB BOO O EE EII I NN N GG G The Sam plin g T heor em The Sam plin g T heor em s tate s th at a sig nal whi ch c onta ins no f requ ency co mpo nent s hi gher than fo H ertz can be exac tly reco vere d fr om a set of its sam ples if th e sa mpl es a re s pace d no fur ther apa rt th an ½ fo sec onds . T his is e quiv alen t to req uiri ng t hat the sam plin g fr eque ncy be g reat er t han twic e th e hi ghes t fre quen cy c ompo nent of the sign al. The rea son for this req uire men t ca n be sho wn by e xam ing the freq uenc y sp ectr um o f th e sa mpl er o utpu t. M odel ing the sam plin g op erat ion as t he mul tipl icat ion of t he i nput sig nal b y an im puls e tr ain as s hown in Fig ure 2 al low s th e sa mpl er outp ut spec trum to be co mpu ted from a Fou rier T rans form id enti ty. T he requ ired id enti ty stat es that ti me dom ain mul tipl icat ion is e quiv alen t to fre quen cy d omai n co nvol utio n. The refo re, the outp ut s pect rum is foun d by con volv ing the inpu t sp ectr um w ith the spec trum of the impu lse trai n. Thi s re lati onsh ip i s sh own in F igur e 3. T he c onvo luti on o pera tion has the eff ect of r epro duci ng t he s pect rum of the inpu t sig nal a bout zer o fr eque ncy and at a ll h arm onic s of the sam plin g fr eque ncy. If the sam plin g fr eque ncy, 1/T s, is gre ater tha n tw ice f o t he spec tral co mpo nent s ce nter ed abou t th e sa mpl ing freq uenc y an d it s ha rmon ics wil l no t ov erla p th e sp ectr al c ompo nent cen tere d ab out zero fr eque ncy. T here fore , the spe ctra l co mpo nent cen tere d ab out zero , w hich is ide ntic al t o th e in put spec trum , can be obta ined by pass ing the sam pled ou tput thro ugh a lo w p ass filt er w ith a ba ndw idth of f o H z. App lica tion of the Sam plin g T heor em to Dig ital Avi onic s S yste ms The dis cuss ion of t he S ampl ing The orem in the prec edin g se ctio n ha s sh own that a s igna l w hich con tain s no fre quen cy c ompo nent s hi gher tha n f o Hz. can be exac tly repr esen ted by a ser ies of s ampl es s pace d no fur ther ap art than ½ f o se cond s. How ever , si gnal s, w hich rep rese nt p hysi cal quan titi es, such as thos e pr oces sed by a vion ic s yste ms neve r sa tisf y th e st rict ban dwid th l imit atio n re quir emen t st ated abo ve. The refo re e xact re prod ucti on o f th e or igin al s igna l fr om i ts s ampl es i s no t po ssib le. The ef fect of the non- band lim ited nat ure of s igna ls i s to dis tort the rep lica re cons truc ted from the sam ples . T he s hade d ar ea s how n in Fig ure 4 re pres ents typ ical hig h fr eque ncy sign al e nerg y w hich dis tort s th e lo w freq uenc y po rtio n of the sig nal spec trum . T he h igh freq uenc y po rtio n of th e si gnal tak es o n th e id enti ty o f th e lo wer fre quen cies , he nce the nam e “a lias ing” for this phe nom enon . A lias ing beco mes a g reat er p robl em w hen the sign al is cor rupt ed b y no ise, w hich has a w ider ban dwid th t han the sign al. Whe n th is o ccur s bo th sign al e nerg y an d no ise ener gy w hich is beyo nd o ne h alf of t he s ampl ing freq uenc y is ali ased int o th e lo w f requ ency por tion of the reco vere d si gnal . T his effe ct i s sh own in F igur e 5. T he s igna l-to -noi se r atio is degr aded by both noi se a nd s igna l co mpo nent s w hich are ali ased int o th e lo w f requ ency por tion of the sign al s pect rum .

T he e ffec t of ali asin g ca n be dec reas ed b y sa mpl ing the inco min g si gnal at a hig her rate and /or usin g a pres ampl ing filt er to redu ce the band wid th of the sign al prio r to sa mpl ing. N eith er o f th ese appr oach es c an e ver com plet ely elim inat e th e effe ct o f al iasi ng a nd t hey each res ult in s ome nega tive im pact on the over all s yste m.

An incr ease in the sam plin g ra te r equi res mor e co mpu tati ons to b e do ne in a give n pe riod of tim e. Thi s re quir es m ore com puta tion al r esou rces , w hich inc reas es t he w eigh t, co mpl exit y, a nd p ower req uire men ts o f th e co mpu ter subs yste ms.

The us e of a pres ampl ing filt er to lim it the band wid th p rior to s ampl ing dist orts the sig nal. It a lso incr ease s th e de lay expe rien ced by sign als as they pr opag ate thro ugh the syst em. T he incr ease in dela y re duce s ph ase mar gin if t he s igna l is use d in a c lose d lo op c ontr ol s yste m. The refo re, mor e st ring ent dela y re quir emen ts m ust be p lace d on oth er c ompo nent s in the loo p if the sys tem pha se m argi n is to rem ain cons tant . D esig n T rade offs for Dig ital Avi onic s S yste ms The fin al c hoic es o f sa mpl e ra te a nd p resa mpl ing filt er d epen d up on t he inpu t si gnal and noi se s pect ra, max imum all owab le s igna l-to -noi se r atio de grad atio n du e to ali asin g, m axim um a llow able tran spor t del ay, a vail able co mpu tati onal res ourc es, and the band wid th o f th e sy stem whi ch u ses the data . A pra ctic al w ay t o m ake thes e ch oice s is to anal yze the syst em f or vari ous sam ple rate s an d fi lter s. Thi s ca n be st b e do ne w ith the aid of a co mpu ter prog ram whi ch c ompu ters the eff ect of e ach com bina tion of sam ple rate and fil ter char acte rist ic o n th e ou tput sig nal- to-n oise rat io f or the defi ned inpu t sig nal a nd n oise spe ctra . T he in itia l com puta tion is to det erm ine the effe ct o f th e pr efil ter on th e in -ba nd s igna l-to -noi se r atio wit hout reg ard to a lias ing effe cts. A typ ical pl ot o f si gnal -to- nois e ra tio vers us p resa mpl ing filt er b andw idth is show n in the top cur ve o f F igur e 6. T his curv e fo rms a ba seli ne a gain st w hich sign al -to- nois e ra tio degr adat ion caus ed b y al iasi ng c an b e co mpa red. T he s igna l-to -noi se r atio is dete rmin ed b y co mpu ting the inp ut s igna l po wer and inp ut n oise pow er, whi ch i s pa ssed by the sele cted pre filt er. Thi s pa ram eter wil l gen eral ly e xhib it a pea k va lue at a spe cifi c ba ndw idth . T he s igna l-to -noi se r atio wil l de crea se w ith incr easi ng b andw idth as mor e no ise is a dmit ted and decr ease wit h de crea sing ban dwid th a s si gnal ene rgy is e lim inat ed. The fil ter orde r is an impo rtan t de sign par amet er b ecau se h ighe r or der filt ers roll off mor e ra pidl y ne ar t he c utof f fr eque ncy. T here fore hig her orde r fi lter s ad mit les s no ise and sign al f rom bey ond the cuto ff f requ ency th an l ow o rder fil ters . B ecau se o f th is c hara cter isti c, h igh orde r fi lter s al ias no m ore nois e in to t he s igna l th an s ligh tly narr ower ban dwid th l ow orde r fi lter s. How ever , hi gh o rder fil ters del ay t he s igna l m ore than low or der filt ers. T he u ltim ate obje ctiv e of the des ign task dis cuss ed i n th is p aper is to achi eve acce ptab le syst em perf orm ance w ith the min imum po ssib le ARINC SPECIFICATION 429, PART 1 - Page 178 APPENDIX D DIGITAL SYSTEMS GUIDANCE (PART 2) sam plin g ra te. S yste m perf orm ance is ad vers ely affe cted by la rge prop agat ion dela ys a nd h igh in-b and nois e le vels . If the m axim um a llow able pr opag atio n de lay is give n, the min imum us able fil ter band wid th c an b e fo und stan dard plo ts o f gr oup dela y ve rsus fr eque ncy for the type and ord er o f fi lter con side red. (See for exa mpl e R efer ence 1, page 112 .) Thi s m inim um b andw idth is plot ted on F igur e 6 as a ve rtic al line .

The m axim um achi evab le sign al-t o-no ise rati o is co nstr aine d by the req uire men t fo r a pres ampl ing filt er w ide enou gh t o li mit de lay to the give n va lue. The in ters ecti on of the min imum ba ndw idth li ne wit h th e to p cu rve of Fig ure 6 gi ves the max imum ac hiev able sig nal- to-n oise rat io i .e., the sign al-t o-no ise rati o w hich wou ld be a chie ved by a n un sam pled sys tem . S ampl ing rate is ch osen by co mpa ring th e m axim um acce ptab le degr adat ion in s igna l-to -noi se r atio to the actu al a lias ing degr adat ion due to s ampl ing at t he c andi date rat es. For the exa mpl e sh own in F igur e 6, a sam plin g ra te o f 50 Hz wou ld b e ch osen . A sys tem int erfa ce w hich mee ts p resc ribe d li mit s on sig nal dela y an d m axim um n oise due to alia sing can be desi gned usi ng t he p roce dure s ou tlin ed a bove . S ome syst ems whi ch u se s ampl ed d ata, suc h as clo sed loop con trol sys tem s, h ave a ba ndw idth whi ch i s m uch smal ler than tha t of the sam plin g fi lter . F or t his reas on i t is im port ant to v erif y th at t he sign al a nd n oise pow er w hich is a lias ed in to th e fr eque ncy band of inte rest is wel l bel ow th e in here nt n oise in th at b and. T his can be a ccom plis hed by c onst ruct ing a si gnal and noi se p ower sp ectr al d ensi ty p lot for the filt er a nd s ampl ing rate cho sen. T he p ower sp ectr al d ensi ty p lot is m ost easi ly o btai ned wit h th e ai d of a c ompu ter prog ram . A typ ical plo t of thi s ty pe i s sh own in F igur e 7. T he e xam ple pow er s pect ral dens itie s in Fig ure 7 sh ow t hat the alia sed sign al a nd n oise is muc h lo wer tha n th e in here nt n oise lev el i n th e fr eque ncy rang e of in tere st. If this con stra int is n ot m et a dif fere nt c ombi nati on o f fi lter and sa mpl ing freq uenc y m ust b e ch osen .

In som e si tuat ions it may be desi red to r educ e th e sa mpl ing rate of a di gita lly enco ded sign al. Thi s m ay b e do ne w here wid eban d di gita l da ta is u sed to d rive an inst rum ent or s ubsy stem whi ch r espo nds only to narr ower ban dwid th d ata. Sim ple dele tion of unw ante d sa mpl es to red uce the sam plin g ra te c an c ause ali asin g pr oble ms sim ilar to th ose enco unte red whe n sa mpl ing an a nalo g si gnal at an i nsuf fici ent rate . T he a lias ing can be e lim inat ion of t he u nwan ted sam ples . D esig n of the dig ital fil ter is subj ect to t he s ame set of d elay ver sus alia sing noi se t rade offs as the desi gn o f an ana log pres ampl ing filt er. Con clus ion The pr oced ures ou tlin ed in this pa per can be used to ch oose th e pr esam plin g fi lter and sam plin g ra te r equi red for inte rfac es t o a digi tal sign al p roce ssin g or con trol sys tem . T he v alue s ar e ch osen to mee t th e co nstr aint s of max imum all owab le d elay and max imum all owab le n oise due to a lias ing. S igna l an d no ise spec tra of t he s igna l to be sam pled mus t be sup plie d as an inpu t to the desi gn p roce dure . R efer ence : H erm an J . B linc hiko ff a nd A nato l I. Zve rev, Fil teri ng i n th e T ime and Fre quen cy D omai ns, John Wil ey a nd S ons, New Y ork. An alog Sys tem An alog Inp ut An alog Ou tpu t An alog Inp ut An alog Ou tpu t tim eti me Fig ure 1(a) Typ ical Inp ut a nd O utpu t of Ana log Syst em Dig ital Sys tem Dig ital In pu t(d iscr ete valu es) Dig ital Ou tpu t(d iscr ete valu es) tim eti me Fig ure 1(b) Typ ical Inp ut a nd O utpu t of Dig ital Sys tem Dig ital Inp ut ARINC SPECIFICATION 429, PART 1 - Page 179 APPENDIX D DIGITAL SYSTEMS GUIDANCE (PART 2) Fig ure 4 Sam ple r O utp ut Sp ectr um Wh en I np ut Sig nal Ban dw idth is not Lim ited to On e-H alf of t he Sam pli ng Fre qu ency F igu re 5 (a) In pu t S ign al a nd Noi se S pec tra Fig ure 5(b) O utp ut Sig nal an d N oise S pec tra S how ing Sig nal -to- Noi se Rat io D egra dat ion Du e to Ali asin g of Sig nal an d N oise ∑∞ −∞= − n nTs t) (δ 0 0 0 fT s 2− Ts 1− Ts 21− Ts 21 Ts 1T s 2 Ts 21 Ts 21− Ts 21− ARINC SPECIFICATION 429, PART 1 - Page 180 Ts 21 ∑∞ −∞= − n nTs t) (δ X Low Pas s B w = o Hz r s (t) Fig ure 2 M ath mat ical Mod el o f S amp lin g P roce ssr (t)r (t) 0 R (f) -f o f o Fig ure 3(b) S pec tru m o f f(t) B and lim ited to f o H z })({∑∞ −∞= −ℑ n nTs tδ - - -- - - 0 - 1 Ts 1 Ts f2 T s- 2 Ts Fig ure 3(b) S pec tru m o f In pu t T rain , 0- - - R s(f) sign al r ecov ery + - -f o - - - f f o f o f o 1 Ts - 1 T s 1 T s - 1 Ts Fig ure 3(c) S pec tru m o f S amp ling O utp ut Inp ut Noi se S pec tru m Inp ut Sig nal Sp ectr um APPENDIX D DIGITAL SYSTEMS GUIDANCE (PART 2) ARINC SPECIFICATION 429, PART 1 - Page 181 APPENDIX D DIGITAL SYSTEMS GUIDANCE (PART 2) ARINC SPECIFICATION 429, PART 1 - Page 182 APPENDIX E GUIDELINES FOR LABEL ASSIGNMENTS The ARINC 429 data bus was developed to provide a standardized means of digital information transfer between the “ARINC 700” series of avionics units. ARINC 429 has proven to be a very flexible standard and its usage has extended to provide data transfer between Line Replaceable Units (LRU) which are not otherwise covered by ARINC Characteristics. It is important that each new usage of ARINC 429 be coordinated and indexed by ARINC such that the information on usage (label allocation, data format, etc.) is available industry-wide. The use of the same label for two different functions on a particular LRU type built by different manufacturers can create serious problems. To facilitate the coordination of ARINC 429 label usage between the industry and the ARINC staff, a set of guidelines is provided. 1. New labels should be selected from the five character field as defined in Section 2.3 (three octal and three hexadecimal). 2. The following labels have special significance and should not be used: label 000 (not used) and label 377 (equipment identification). The preferred SSM encoding for method for the Equipment Identification Word (label 377) is according to the Discrete word guidelines. When this label was originally assigned, it was recognized as a non-BNR word. The SSM encoding was according to the BCD and DISC guidelines that were identical at that time.

During development of Supplement 4, the SSM for DISC was revised to it current form to provide enhanced failure warning. When the SSM encoding was changed, some systems retained the BCD encoding for the Equipment Identification word and others changed to DISC encoding. 3. The following labels are presently “spare” and should only be used for new parameters which may have very widespread usage throughout the airplane architecture. 005 040 050 054 107 163 227 371 006 046 051 055 113 167 240 007 047 052 057 124 226 243 4. Where possible, similar word usage should be “grouped”; for example, if Engine N 1 is to be provided from a new unit (PMUX) it should utilize label 246 which is presently N 1 (engine direct). 5. Where possible, grouped usage should have identical data specification (units, range, significant digits/bits, positive sense, resolution, min--max transmit interval). To facilitate this commonality it is permissible for a particular LRU to output a lower resolution signal (fewer significant digits/bits) if the least significant remainder of the data field is set to zeros.

6. Where word grouping is not possible, the labels should be selected from the following subgroups: Binary coded decimal (BCD) sub-group 001 to 067, 125, 165, 170, 200, 201,230 to 237. Binary (BNR) subgroup 070 to 124, 126 to 144, 150 to 154, 162 to 164, 166, 167, 171 to 177, 202 to 227, 240 to 257, 262 to 265, 267, 310 to 347, 360 to 376. Mixed BCD and BNR subgroup 260, 261 Discretes subgroup 145 to 147, 270 to 276 Maintenance and discrete data subgroup 155, 156 Maintenance data subgroup 157 to 161, 350 to 354 Test word subgroup 266, 277 Application dependent subgroups 300 to 307 Acknowledgement subgroup 355 Maintenance ISO #5 subgroup 356 ISO #5 message subgroup 357 A schematic of these subgroups is attached. c-16 c-17 ARINC SPECIFICATION 429, PART 1 - Page 183 APPENDIX E GUIDELINES FOR LABEL ASSIGNMENTS 7. Allocation of bits within words, as defined in the appropriate sections. BCD BNR Discretes Maintenance data Test Application dependent Acknowledgement Maintenance ISO #5 ISO #5 message 8. The data should be fully defined by Equipment ID and the label and the Source Destination Indicator (SDI). It should not be necessary to decode additional bits in the word to correctly interpret the data field.

9. The equipment ID should be allocated as the two least significant digits of the 7XX ARINC equipment specification, if one exists. For equipment not otherwise covered by an ARINC Specification, an equipment ID should be allocated with a non-numeric value of the hexadecimal character set as the least significant digit. 10. Equipment ID of 000 (HEX) should not be used. 11. The SDI code should indicate the aircraft installation number of the source equipment, in a multi-system installation, as described in 2.1.4. Least Significant Digit Two Most Sig. Digits / / / / 0 1 2 3 4 5 6 7 00 X 01 02 03 04 05 06 BCD 07 10 11 BNR 12 BCD 13 14 DISCRETE 15 MAINT DISC M DATA 16 MAINT DATA 17 BCD 20 21 22 23 BCD 24 BNR 25 26 MIX TEST 27 DISCRETE TEST 30 APPLICATION DEPENDENT 31 32 33 34 BNR 35 MAINT DATA ACK M ISO ISO5 36 BNR 37 EQ ID ARINC SPECIFICATION 429, PART 1 - Page 184 APPENDIX X CHRONOLOGY & BIBLIOGRAPHY X-l.0 Chronology AEEC established the Systems Architecture and Interfaces (SAI) Subcommittee in 1975 to develop the air transport industry’s approach to digital avionics systems architecture, to define digital system interface standards. With respect to this last-named, the Subcommittee soon determined that the industry’s previous approaches to digital information transfer, described in ARINC Specification 419, “Digital Data System Compendium”, needed rationalization and modernization to be applicable in the future digital systems world. However, this work was not started immediately because of the need to concentrate on the more basic tasks related to digital systems architecture. About a year later, AEEC deemed it timely to start the spec-writing for a digital automatic flight control system based on the system architecture concepts developed by the SAI Subcommittee. The Subcommittee AEEC established to do this began its work in January 1977. Part of this activity was the definition of black box interface standards, and this brought into sharp focus the need for the new digital information transfer system to be properly specified. The SAI Subcommittee immediately began to devote time to the discussion of the issues involved to give direction to the Digital Information Transfer System (DITS) working group it set up to develop a spec draft. This group met early in April 1977, and produced a draft which the full Subcommittee reviewed at its meeting in May. A second working group meeting during the period of that Subcommittee meeting, followed by a third in mid-June, produced the second draft of the spec.

This draft was submitted to AEEC for adoption, which was achieved at the Summer 1977 General Session in July. The spec adopted by AEEC contained details of numeric data (BNR and BCD) transfer only. The SAI Subcommittee notified AEEC of its intent to broaden the scope of the document to cover alpha/numeric (ISO Alphabet No. 5) and graphic data handling also. These subjects would be addressed in a Supplement to the spec which AEEC would be asked to approve at a later date. X-2.0 Bibliography The following is a list of AEEC letters associated with the preparation of ARINC Specification 429.

A list of AEEC letters related the SAI Subcommittee's overall activities may be found in ARINC Report 299, “AEEC Letter Index”. AEEC Letter No. Date Subject 76-130/SAI-20 Dec. 9, 1976 Report of the Systems Architecture and Interfaces Subcommittee Meeting held November 16th, 17th and 18th, 1976 in Seattle, Washington 77-009/SAI-22 Jan. 27, 1977 Whither On-Board Digital Data Transmission Standards? 77-020/SAI-25 Feb. 11, 1977 More On Digital Data Transmission Standards N77-035/SAI-26 Mar. 21, 1977 Boeing Report On Alternative Digital Information System Signalling Standards 77-037/SAI-28 Mar. 25, 1977 Report of the Systems Architecture and Interfaces Subcommittee Meeting Held March 7th, 8th and 9th, 1977 in Arlington, Virginia 77-047/SAI-33 Apr. 13, 1977 Circulation of Draft No. I of Project Paper 429, “Mark 33 Digital Information Transfer System (DITS)” 77-056/SAI-37 Apr. 18, 1977 Report of the SAI Subcommittee BITS Working Group Meeting Held April 5-6, 1977, in Annapolis, Maryland 77-066/SAI-41 Jun. 8, 1977 Report of the Systems Architecture and Interfaces Subcommittee Meeting Held May 9th, 10th and 11th, 1977 in Los Angeles, California 77-079/SAI-46 Jun. 23, 1977 Circulation of Draft No. 2 of Project paper 429, “Mark 33 Digital Information Transfer System (DITS)” X-3.0 Meeting Attendees The following people comprised the SAI Subcommittee’s Digital Information Transfer System Working Group. Tom Ellison UNITED AIRLINES San Francisco, California Wolfgang Bull DEUTSCHE LUFTHANSA Hamburg, Germany Siegmar Gomille DEUTSCHE LUFTHANSA Hamburg, Germany ARINC SPECIFICATION 429, PART 1 - Page 185 APPENDIX X CHRONOLOGY & BIBLIOGRAPHY Jim Wahlen BENDIX AVIONICS Ft. Lauderdale, Florida Tony Martin BOEING Seattle, Washington Frank Rasmussen BOEING Seattle, Washington Ed Schroeder BOEING Seattle, Washington Arvind Dandekar COLLINS RADIO, ROCKWELL INT. Cedar Rapids, Iowa Bill Harts COLLINS RADIO, ROCKWELL INT. Cedar Rapids, Iowa David Lewis DELCO ELECTRONICS Milwaukee, Wisconsin Ralph Bazil KING RADIO CORPORATION Olathe, Kansas Hal Pierson MITRE CORPORATION McLean, Virginia Bob Clark SPERRY FLIGHT SYSTEMS Phoenix, Arizona Capt. Russ Glastetter USAF Dayton, Ohio David Featherstone AERONAUTICAL RADIO, INC. Annapolis, Maryland The following people attended one or more of the SAI Subcommittee meetings held November 16th-18th, 1976, March 7th-9th, 1977 and May 9th-11th, 1977, during which the 429 DITS spec drafts and other proposals produced by the DITS working group were reviewed, refined and finalized. Airlines and ARINC Staff T. A. Ellison, Chairman UNITED AIRLINES San Francisco, California J. S. Davidson AIR CANADA Montreal, Canada Gerard Collin AIR FRANCE Orly Aerogare, France Jean Baptiste Rigaudias AIR FRANCE Orly Aerogare, France Jean Le Luc AIR INTER Orly, France Clarence L. Richmond AMERICAN AIRLINES Tulsa, Oklahoma Robert M. Cook DELTA AIRLINES Atlanta, Georgia Jose M. Recacha IBERIA SPANISH AIRLINES Barajas-Madrid, Spain P.

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Schaffer SPERRY FLIGHT SYSTEMS Phoenix, Arizona Harry O. Smith SPERRY FLIGHT SYSTEMS Phoenix, Arizona Al J. Venancio SPERRY FLIGHT SYSTEMS Phoenix, Arizona Lou Borbely SUNSTRAND DATA CONTROL Redmond, Washington Glenn H. Jones SUNSTRAND DATA CONTROL Redmond, Washington Robert Schaeperkoetter SUNSTRAND DATA CONTROL Redmond, Washington C. A. Bennet TELEDYNE CONTROLS El Segundo, California H. E. Sutherland TELEDYNE CONTROLS El Segundo, California D. A. Giroux THOMSON-CSF Les-Moulineaux, France Charles Legrand THOMSON-CSF Les-Moulineaux, France J. Ribiere THOMSON-CSF Malakoff, France J. Lane Ware THOMSON-CSF New York, New York William Donnell TRACOR APPLIED TECHNOLOGY Austin, Texas R. R. Fay TRACOR APPLIED TECHNOLOGY Austin, Texas Jean-Pierre Tomasi TRT Le Plessis-Robinson, France Blaine C. Ferch USAF Wright Patterson AFB, Ohio Erwin C. Gangi USAF Dayton, Ohio Capt. R. A. Glastetter USAF Wright Patterson AFB, Ohio AERONAUTICAL RADIO, INC. 2551 Riva Road Annapolis, Maryland 21401- 7645 USA SUPPLEMENT 1 TO ARINC SPECIFICATION 429 MARK 33 DIGITAL INFORMATION TRANSFER SYSTEM (DITS) Published: June 1, 1978 Prepared by the Airlines Electronic Engineering Committee Adopted by the Airlines Electronic Engineering Committee: April 11, 1978 SUPPLEMENT 1 TO ARINC SPECIFICATION 429 - Page 2 A. PURPOSE OF THIS SUPPLEMENT This Supplement adds to Specification 429 material related to the transfer of graphic and ISO alphabet No. 5 encoded alpha/numeric data by the Mark 33 DITS. Also, it clarifies the purpose of the SDI function, adds BCD and BNR numeric data encoding examples to Attachment 6 and introduces two Appendices into the Specification. B.

ORGANIZATION OF THIS SUPPLEMENT The first part of this document, printed on goldenrod paper, contains descriptions of the changes introduced into the Specification by this Supplement, and, where appropriate, extracts from the original text for comparison purposes. The second part consists of replacement white pages for the Specification, modified to reflect these changes. The modified and added material on each replacement page is identified with “c-1” symbols in the margins. Existing copies of Specification 429 may be updated by simply inserting the replacement white pages where necessary and destroying the pages they replace. The goldenrod pages should be inserted inside the rear cover of the Specification.

Copies of the Specification bearing the number 429-1 already contain this Supplement and thus do not require revisions by the reader. C. CHANGES TO SPECIFICATION 429 INTRODUCED BY THIS SUPPLEMENT This section presents a complete tabulation of the changes and additions to the Specification introduced by this Supplement. Each change or addition is identified by the section number and title currently employed in the Specification, or by the section number and title that will be employed when the Supplement is eventually incorporated. In each case there is included a brief description of the addition or change and, for other than very minor revisions, any text originally contained in the Specification is reproduced for reference. 1.3.2 ISO Alphabet No. 5 Data Transfer Existing text supplemented – no other changes. 1.3.3 Graphic Data Transfer New section added by this Supplement. 2.1.2 Information Element COMMENTARY revised to improved clarity of opening sentence, and to modify the statement concerning the BCD-encoding of latitude and longitude as a consequence of the clarification of the use priorities for bit nos. 9 and 10 introduced into Section 2.1.4 by this Supplement. ORIGINAL TEXT FOLLOWS To permit the use of common hardware elements for the transmission of BNR and BCD numeric data, the format for the Mark 33 DITS BCD word differs from that used formerly for this type of data. Bit no. 32 is assigned to parity, bit nos. 31 and 30 to the sign/status matrix, bit no. 29 is the most significant bit of the data field, and the maximum decimal value of the most significant character is 7. Previously, the BCD word contained no parity bit, the sign/status matrix occupied bit nos. 32 and 31, bit no. 30 was the most significant data bit and the maximum decimal value of the most significant character was 3. This format made the word 8-bit byte oriented with respect to the data.

This characteristic is not retained in the Mark 33 system.

Also, the Mark 33 BCD word will not accommodate latitude and longitude to the formerly specified resolution of 0.1 minute of arc. If BCD transmission of these quantities in required, either the resolution must be decreased or the word must be restructured. Restructuring involves limiting the maximum decimal value of the most significant character to 1, moving the remaining BCD characters towards the MSB by two bit positions and using bit nos. 9 and 10 for data instead of reserving them for source/destination identification encoding per Section 2.1.4 of this document. It is probable, however, that future latitude and longitude displays will not be the simple, dedicated read-out type for which BCD data is intended.

More likely is the use of some form of multiple-message display, such as a CRT, which will be backed by its own data processor and prefer inputs of BNR data. If this proves to be the case, there will be no problem! 2.1.3 Information Identifier Text expanded to explain differing roles of label codes in numeric (BCD/BNR) and alpha/numeric (ISO Alphabet No. 5) data transfer. “Special Note” added. ORIGINAL TEXT FOLLOWS The first eight bits of each word are assigned to a label function so that the data contained in the word may be identified. Label code assignments are set forth in the table of Attachment 1 to this document. 2.1.4 Source/Destination Identifier Section modified to indicate that bit nos.

9 & 10 are not available for the SDI function in DITS words employed for graphic and ISO Alphabet No. 5 data transfer, or in BNR/BCD words in which bit nos. 9 and 10 are needed for valid data in order to achieve the desired resolution. Code table revised and function application more fully described. Consequential revisions to Commentary. SUPPLEMENT 1 TO ARINC SPECIFICATION 429 - Page 3 ORIGINAL TEXT FOLLOWS Bit nos. 9 & 10 of the word should be reserved for a data source/destination identification function. This function may find application when specific words need to be directed to a specific system of a multi-system installation or when the source system of a multi-system installation needs to be recognizable from the word content. When the source/destination identifier function is used, bit nos. 9 & 10 should be encoded as follows. When it is not used, binary zeros or valid data should be transmitted in these positions Bit No. 10 9 System 0 0 1 0 1 2 1 0 3 1 1 4 . COMMENTARY In many applications of the Mark 33 DITS, data source/destination identification will not be needed. In these cases, bits 9 & 10 will be used as pad bits for valid data. In certain other applications of the system, for example, BCD latitude and longitude encoding (if needed – see Commentary following Section 2.1.2 of this document), the need to use bit nos. 9 and 10 to obtain adequate data resolution will preclude source/destination identification in this way. Note that this document does not address the practical question of how these bits will be set in those multi-system installations in which the source/destination identification function is desired. One way would be to use program pins on individual system black boxes which would be wired to set up the appropriate code.

The ARINC Characteristics devoted to the individual systems will define the method actually to be used. 2.1.5 Sign/Status Matrix Section divided into two sub-sections, one to describe the BCD numeric and ISO Alphabet #5 alpha/numeric data sign status matrix, and the other to describe the BNR numeric data sign/status matrix. ORIGINAL TEXT FOLLOWS The “sign” (plus, minus, north, south, etc.) of the transmitted data and the status of the transmitter hardware should be encoded in bit nos.

30 and 31 as shown in the table below. Designation Bit No. 31 30 BNR/BCD Data ISO # 5 Data 0 0 Plus, North, East Right, To 0 1 No Computed Data TBD 1 0 Functional Test 1 1 Minus, South, West, Left, From Notes: 1. A source system should indicate failure by ceasing to supply data to a bus. 2. Both bits should be “zero” in BNR and BCD words when no sign is needed. 3. The “no computed data” code should be generated when computed data is not available for reasons other than equipment failure. 4. When is appears in a word identified by its label as a system output, the “functional test” code should be interpreted as advice that the data in the word results from the execution of a functional test. When it appears in a word identified by its label as an instruction, e.g., a radio channel change command, this code should be interpreted as a command to perform a functional test. 2.1.6 Data Standards Typographical errors corrected in second paragraph of Commentary. 2.2.1 Transmission System Interconnect Existing material supplemented with information concerning shield grounding. 2.2.3.2 Receiver Voltage Levels DC levels between terminal A and ground and terminal B and ground at which receivers should not be damaged raised from +20VDC to +28VDC (min) and for –20VDC to –28VDC (min) respectively to align numerical values with aircraft DC power supply value. 2.3.1.3 ISO Alphabet No. 5 Data New section added by this Supplement.

2.4.1 Bit Rate Existing commentary supplemented with warning against selection of 13.6 KBPS and 100 KBPS because of possible interference with operation of OMEGA and LORAN C system on the aircraft. Attachment 2: Data Standards Tables 1 and 2 Column heading “MIN TRANSMIT INTERVAL msec” changed to “MAX TRANSMIT INTERVAL msec” in each case. Attachment 2: Data Standards Table 3 Table 3 (Alpha/Numeric (ISO Alphabet No. 5) Data Standards) deleted. Table 4 (Discrete Data) renumbered Table 3. Note: Table 3 was reserved for alpha/numeric (ISO Alphabet No. 5) data standards prior to the preparation of this Supplement. The need for it disappeared as a result of the particular approach selected for handling this data introduced into Specification 429 by this Supplement. SUPPLEMENT 1 TO ARINC SPECIFICATION 429 - Page 4 Attachment 6: General Word Formats and Encoding Examples BNR word format example amended as consequence of change to sign/status matrix (see Section 2.1.5) General Word Formats for ISO Alphabet No. 5 data added. Encoding examples added. Appendix 1: Laboratory Verification of ARINC 429 DITS Electrical Characteristics New material added by this Supplement. Appendix 2: An Approach to a Hybrid Broadcast Command/Response Data Bus Architecture. New material added by this Supplement. NOTE: Due to the large number of changes Created by this Supplement, it is NOT available separately to update 429-1.

AERONAUTICAL RADIO, INC. 2551 Riva Road Annapolis, Maryland 21401- 7645 USA SUPPLEMENT 2 TO ARINC SPECIFICATION 429 MARK 33 DIGITAL INFORMATION TRANSFER SYSTEM (DITS) Published: March 1, 1979 Prepared by the Airlines Electronic Engineering Committee Adopted by the Airlines Electronic Engineering Committee: December 6, 1978 SUPPLEMENT 2 TO ARINC SPECIFICATION 429 - Page 2 A. PURPOSE OF THIS SUPPLEMENT This Supplement amends the material added to Specification 429 on ISO Alphabet No. 5 data transfer, and expands the multiple-word DITS message concept first used in this application to cover Discrete, Acknowledgement and Maintenance (ISO Alphabet No. 5 and discrete data formats) information transfer as well. The Application Notes of Chapter 3 of the Specification are amended to bring them into line with adopted practice in the control of DME’s and ATC transponders, and supplemented with material related to the multiple-word message applications of the system just mentioned. Also, additions and modifications have been made to the label codes and data standards in Attachments 1 and 2 of the Specification to bring them into line with adopted practice. B. ORGANIZATION OF THIS SUPPLEMENT The first part of this document, printed on goldenrod paper, contains descriptions of the changes introduced into the Specification by this Supplement, and, where appropriate, extracts from the original test for comparison purposes. The second part consists of replacement white pages for the Specification, modified to reflect these changes. The modified and added material on each replacement page is identified with “c-2” symbols in the margins. Existing copies of Specification 429 may be updated by simply inserting the replacement white pages where necessary and destroying the pages they replace. The goldenrod pages should be inserted inside the rear cover of the Specification. Copies of the Specification bearing the number 429-2 already contain this Supplement and thus do not require revisions by the reader.

C. CHANGES TO SPECIFICATION 429 INTRODUCED BY THIS SUPPLEMENT This section presents a complete tabulation of the changes and additions to the Specification introduced by this Supplement.

Each change or addition is entitled by the section number and title currently employed in the Specification, or by the section number and title that will be employed when the Supplement is eventually incorporated.

In each case there is included a brief description of the addition or change and, for other than very minor revisions, any text originally contained in the Specification is reproduced for reference. 2.1.2 INFORMATION ELEMENT Text revised to describe word application groups. ORIGINAL TEXT FOLLOWS: 2.1.2 Information Element The basic information element is a digital word containing 32 bits. Word formats for the different types of data handled by the Mark 33 DITS (see Section 2.3.1 of this document) are depicted in Attachment 6. When less than the full data field is needed to accommodate the information conveyed in a word in the desired manner, the unused bit positions should be filled with binary zeros or valid data pad bits. If valid data bits are used, the resolution possible for the information will exceed that called for in this specification. The Commentary following Section 2.1.6 of this document refers. 2.1.3 INFORMATION IDENTIFIER Text revised to describe label use for AIM/Discrete/Maintenance data word type identification. ORIGINAL TEXT FOLLOWS: 2.1.3 Information Identifier The first eight bits of each word are assigned to a label function. Labels will a) identify the information contained within numeric (BCD/BNR) data words (e.g., DME distance, static air temperature), and b) act as receiving device addresses for alpha/numeric (ISO Alphabet No. 5) data words (e.g., navigation system CDU or map display). Label code assignments are set forth in Attachment 1 to this document. 2.1.5.1 BCD NUMERIC AND AIM DATA WORDS Title and text revised to include other AIM applications in material originally prepared to describe sign/status matrix use in ISO Alphabet No. 5 words, and to provide definition of Self-Test. ORIGINAL TEXT FOLLOWS: 2.1.5.1 BCD Numeric and ISO Alphabet No. 5 Data Words The sign (plus, minus, north, south, etc.) of BCD numeric data, the word type of alpha/numeric (ISO alphabet No. 5) data and the status of the transmitter hardware should be encoded in bit nos. 30 and 31 of the word as shown in the table below.

Bit No. Designation 31 30 BNR/BCD Data ISO #5 Data 0 0 Plus, North, East Right, to Initial Word 0 1 No Computed Data No Computed Data 1 0 Functional Test Intermediate Word 1 1 Minus, South, West Left, From Final Word Notes: 1. A source system should annunciate any detected failure that causes one or more of the words normally output by that system to be unreliable by ceasing to supply the affected word or words to the data bus. 2. Both bits should be “zero” when no sign is needed. 3.

The “no computed data” code should be generated when computed data is not available for reasons other than equipment failure. SUPPLEMENT 2 TO ARINC SPCIFICATION 429 - Page 3 4. When it appears in a word identified by its label as a system output, the “functional test” code should be interpreted as advice that the data in the word results from the execution of a functional test. When it appears in a word identified by its label as an instruction, e.g., a radio channel change command, this code should be interpreted as a command to perform a functional test. 5. See Section 2.3.1.3 of this document for definitions of the terms “Initial Word”, “Intermediate Word” and “Final Word”. 2.1.5.2 BNR NUMERIC DATA WORDS Text revised to provide definition of Self-Test. ORIGINAL TEXT FOLLOWS: 2.1.5.2 BNR Numeric Data Words The sign (plus, minus, north, south, etc.) of BNR numeric data words and the status of the transmitter hardware should be encoded in bit nos. 29, 30 and 31 of the word as shown in the table below. Bit No. 31 30 29 Designation BNR Data 0 0 0 Failure Warning/Plus, North, East Right, To 0 0 1 Failure Warning/Minus, South, West, Left, From 0 1 0 No Computed Data 1 0 0 Functional Test/Plus, North, East, Right, To 1 0 1 Functional Test/Minus, South, West Left, From 1 1 0 Normal Operation/Plus, North, East, Right, To 1 1 1 Normal Operation/Minus, South West, Left, From 0 1 1 Not Used (Growth) Notes: 1. A source system should annunciate any detected failure that causes one or more of the words normally output by that system to be unreliable by setting bit nos. 30 and 31 in the affected word(s) to the “failure warning” code defined above. Words containing this code should continue to be supplied to the data bus during the failure condition. 2. Bit no. 29 should be “zero” when no sign is needed. 3. The “no computed data” code should be generated when computed data is not available for reasons other than equipment failure. 4. When it appears in a word identified by its label as a system output, the “functional test” code should be interpreted as advice that the data in the word results from the execution of a functional test. A self-test should produce indications of 1/8 of positive full-scale values unless indicated otherwise in an ARINC Equipment Characteristic. 5. If, during the execution of a functional test, a source system detects a failure which causes one or more of the words normally output by that system to be unreliable, it should immediately change the states of bit nos. 30 and 31 in the annunciation is replaced with the “failure warning” annunciation 2.2.3.1 TRANSMITTER VOLTAGE LEVELS Tolerances on “HI” and “LO” voltage states changed from ± 0.5 volt to ± 1.0 volt to correct previously undetected error.

2.3.1.2 DISCRETES Minor changes to existing wording to improve clarity. New paragraphs added to describe two types of dedicated –to-discrete words and their applications. ORIGINAL TEXT FOLLOWS: 2.3.1.2 Discretes In addition to handling numeric data as specified above, the Mark 33 DITS should also be capable of accommodating discrete items of information, either in the “spare” bits of data words or, when necessary, in dedicated words. Any discrete information contained in a word assigned a label in Attachment 1 is specified in the definition for that word in Attachment 2. The rule to be followed in the assignment of bits to discrete functions is to start with the least significant bit available in the word and to continue towards the most significant bit. Attachment 6 shows this against the background of the generalized word structure. 2.3.1.3 Maintenance Data (General Purpose) This section inserted to describe use and application of general purpose Maintenance words. ORIGINAL TEXT FOLLOWS: 2.3.1.3 Alpha/Numeric (ISO Alphabet No. 5) Data ISO Alphabet No. 5 alpha/numeric data will consist of seven-bit characters encoded per the table of Attachment 5 to this document. Three such characters should occupy bit nos. 9 through 29 of a DITS 32-bit word, as shown in the general word format diagram in Attachment 6. As for numeric (BCD) data words, bit nos. 1 through 8 should be the word label (receiving device address-see Section 2.1.3), bit nos. 30 and 31 the sign/status matrix and bit no. 32 the word parity bit. The typical alpha/numeric message contains more than three ISO Alphabet No. 5 characters, necessitating the transmission of multi-DITS-word messages. The following procedure should be used to permit receivers to determine that such messages are received in their entirety, with no words having been “lost along the way”. Only when this determination has been made, and the parity check for each word shows the data to be error-free, should the message be displayed to the aircrew or otherwise utilized. SUPPLEMENT 2 TO ARINC SPECIFICATION 429 - Page 4 2.3.1.3 Alpha/Numeric (ISO Alphabet No. 5) Data (cont’d) The first DITS word of the message should contain the label in bit nos. 1 through 8, two numeric characters encoded per ISO Alphabet No. 5 in bit nos. 9 through 15 and 16 through 22 and the ISO Alphabet No. 5 control character “STX”in bit nos. 23 through 29.

The two numeric characters should indicate the decimal number of DITS words in the message (maximum number is 99), with the most significant character occupying bit nos.

16 through 22. This count, which should include this initial word, will be one plus the next whole number greater than one third of the number of ISO Alphabet No. 5 characters to be transmitted. The sign/status matrix should contain the “initial word” code defined in Section 2.1.5 of this document. The subsequent DITS words of the message should each contain the label in bit nos. 1 through 8 and three ISO Alphabet No. 5 characters.

The sign/status matrix of all these words except the last word should contain the “intermediate word” code defined in Section 2.1.5.1 of this document.

The last word of the message should contain the “final word” code in its sign/status matrix. Any unused bit positions in the final word resulting from the number of ISO characters in the message being one or two less than a number wholly divisible by three should be filled with binary “zeros”. 2.3.1.4 AIM Data Section number, text and title revised to include other AIM word applications in material originally prepared to describe ISO Alphabet No. 5 data handling (originally in Section 2.3.1.3). Detailed amendments in this area also. 3.1.4.2 DME The “Override” switching function has been replaced by the “DME Mode Select” function. 3.1.4.7 ATC TRANSPONDER “Mode A/B Select” and “Standby” deleted from list of switching functions. Control word format re-structured to release bits unneeded in numeric data part of word for assignment to discrete switching functions. Fig. 3-1 Radio Systems Management Word Formats Bit nos.

11 and 12 in the DME data word have been assigned to “DME Mode Select”. The description of bit 14 in the VOR/ILS data word has been revised to improve clarity. ORIGINAL TEXT FOLLOWS: [1] When bit no. 4 is “zero”, the ILS mode should be “off. When bit no 14 is “one”, the ILS mode should be “one”. SUPPLEMENT 2 TO ARINC SPCIFICATION 429 - Page 5 ORIGINAL ATC TRANSPONDER WORD FORMAT ILLUSTRATION FOLLOWS: PAR ITY (od d) SIG N/S TA TU S M AT RIX 0.7 (3) 0.7 (6) 0.7 (2) 0.7 (0) A/B Mod e Se lect IDE NT STA ND BY AL T. R EP. OFF RE SER VE D (SD I) LABEL Beacon Transponder Code ATC TRANSPONDER Bit No. Example 32 0 31 30 0 0 29 28 27 0 1 1 26 25 24 23 0 1 1 0 22 21 20 19 0 0 1 1 18 17 16 15 0 0 0 0 14 0 13 0 12 0 11 0 10 9 0 0 8 7 6 5 4 3 2 1 1 1 0 1 1 0 0 0 [1] [1] Bit Zero One 11 12 13 14 Alt.

Rep. ON Standby OFF Ident OFF Select Mode A Alt. Rep. OFF Standby ON Ident ON Select Mode B The revised format of the ATC transponder word is as shown on page 10.

3.2 AIM Information Transfer New section added by this Supplement. Attachment 1: Label codes Some parameter names have been changed and others have been added to the list.

Instead of showing the entire list, only the original assignment of those that have been changed are shown below. SUPPLEMENT 2 TO ARINC SPECIFICATION 429 - Page 6 Label (Octal) Original Assignment Proposed Assignment 007 Align Status/Inertial Discretes No assignment 014 None assigned Magnetic Heading 015 None assigned Wind Speed 016 None assigned Wind Direction-True 017 None assigned Selected Runway Heading 024 Selected Course Selected Course #1 027 None assigned Selected Course #2 041 None assigned Set Latitude 042 None assigned Set Longitude 043 None assigned Set Magnetic Heading 044 None assigned True heading 045 None assigned Minimum Airspeed 100 Selected Course Selected Course #1 107 AFS Discretes No assignment 110 None assigned Selected Course #2 112 None assigned Selected EPR or N1 124 FMC Discretes Caution & Warning DFDR Discretes #1 130 None assigned Tt2 131 None assigned Pt2 132 None assigned Pt7 133 None assigned Thrust Lever Angle 145 None assigned AFS DFDR Discretes #1 146 None assigned AFS DFDR Discretes #2 147 None assigned AFS DFDR Discretes #3 166 None assigned RALT Check Point Dev. 203 Altitude (29.92) Altitude (1013.25mb) 204 Altitude (Baro) Baro Corrected Altitude #1 214 Air Data Computer Discretes No assignment 216 Baroset No assignment 220 None assigned Baro Corrected Altitude #2 221 None assigned Indicated Angle of Attack 223 Altitude (29.92) No assignment 224 Altitude Baro Caution/Warning DFDR Discretes #2 225 Mach No assignment 226 Computed Airspeed No assignment 227 Max Allowable Airspeed No assignment 234 Baroset (millibars) Baro Correction (mb #1) 235 Baroset (ins. of Hg) Baro Correction (mb #1) 236 None assigned Baro Correction (mb #2) 237 None assigned Baro Corrected (in of Hg #2) 241 None assigned Corrected Angle of Attack 242 None assigned Total Pressure 245 None assigned Minimum Airspeed 247 None assigned Total Fuel 270 None assigned Discrete Data #1 271 None assigned Discrete Data #2 272 None assigned Discrete Data #3 273 None assigned Discrete Data #4 274 None assigned Discrete Data #5 334 Free Heading Platform Heading 340 N1 or EPR Actual EPR Actual 346 None assigned N1 Actual 350 Engine Discretes Maintenance Data #1 351 Control Panel Discretes Maintenance Data #2 352 Control Panel Discretes Maintenance Data #3 353 Control Panel Discretes Maintenance Data #4 354 Instrument Discretes Maintenance Data #5 355 None assigned Acknowledgement 356 None assigned Maintenance ISO #5 Message 357 None assigned ISO #5 Message 360 None assigned Potential Vertical Speed 372 None assigned Wind Direction-Magnetic 373 None assigned N-S Velocity-Magnetic 374 None assigned E-W Velocity-Magnetic 375 None assigned Along Heading Acceleration 376 None assigned Cross Heading Acceleration SUPPLEMENT 2 TO ARINC SPCIFICATION 429 - Page 7 Attachment 2: Data Standards A number of additions and changes have been made to the tables. The octal labels and parameter names are shown for each data item that has been changed. The original data is shown only for the data that has been changed by this supplement. Also a second “Note” has been added to Table 2. Table 1 BCD DATA Label (Octal) Parameter Name Max Transmit Interval Range (Scale) Sig. Fig. Pad Fig. Units Resol 170 Decision Hgt Sel.(EFI) 200 0 - 500 3 2 Feet 1.0 201 DME Distance 200* -1 - 399.99* 5 0 N.M. 0.01 230 True Airspeed 500* 130 - 599* 3 2 Knots 1.0 231 Total Air Temp. 500 +500 — 99* 2 3 oc 1.0 233 Static Air Temp. 500 -99 - +60* 2 3 oc 1.0 234 Baroset (mb)* 200* 0 - 3999* 4* 1* mb 1.0* 235 Baroset (ins. of Hg*) 200* 0 - 39.99* 4* 1* ins.Hg 0.01* *This data has been changed. Note: Labels 017, 027, 041, 042, 043, 044, 045, 236 and 237 previously had no values assigned.

Values for labels 223, 224, 225, 226 and 227 have been changed. Table 2 BNR DATA Label (Octal) Parameter Name Max Transmit Interval Sig. Bits (Not Inc.

Sign) Units Range Approx. Resol. 100 Selected Course 62.5* 9 Deg/180 ± 180 o 0.35o 103 Selected Airspeed 62.5* 11* Deg/180 ± 180 o 0.25* 121 Horiz. Strg. Signal 100 9* Deg/180 +45o * 0.1 o * 122 Vert.Strg.Signal 100 9 Deg/180 +22.50 o * 0.05 o * 140 Flight Director-Roll 62.5* 9 Deg/180 ±45 o 0.1 o 141 Flight Director-Pitch 62.5* 9 Deg/180 ± 22.5 0.05 o 164 Radio Height 50 18* Feet 32768* 0.125 202 DME Distance 200* 16 N.M. 512 0.0008 203 Altitude (29.92) 62.5 17* Feet 131,071 1.0* 206 Computed Airspeed 125 12* Knots 1024 0.25* 207 Max.Allowable Airspeed 500* 12 Knots 1024 0.25 210 True Airspeed 500* 11 Knots 2048 1.0 215 Impact Pressure 125 12* ins/Hg* 32* 0.008* 313 Track Angle True 50* 12 Deg/180 ± 180 o 0.05 o 314 True Heading 50* 12 Deg/180 ± 180 o 0.05 o 317 Track Angle-Magnetic 50* 12 Deg/180 ± 180 o 0.05 o 320 Magnetic Heading 50* 12 Deg/180 ± 180 o 0.05 o 321 Drift Angle 50* 11 Deg/180 +90 o 0.05 o 322 Flight Path Angle 50* 10 Deg/180 ± 45 o 0.05 o 323 Flight Path Acceleration 20 12* g 4* 0.001* 324 Pitch Angle 50* 13 Deg/180 +90 o 0.01 o 325 Roll Angle 50* 14 Deg/180 ± 180 o 0.01 o 331 Body Long-accel. 6.25* 12 g 4 0.001 334 Free Heading 20* 12* Deg/180 ± 180 o 0.05 o 335 Track Angle Rate * * * * * 336 Inertial Pitch Rate 20 12* Deg/sec 128 0.03 o * 337 Inertial Roll Rate 20 12* Deg/sec 128 0.03 o * 340 N1 Actual * 200 12

RPM 4096 1 341 N1 Command 200 12* RPM* 4096* 1* 342 N1 Limit 200 12* RPM* 4096* 1* 343 N1 Derate 200 12* RPM* 4096* 1* 344 N2 100 14 RPM* 16384* 1* SUPPLEMENT 2 TO ARINC SPECIFICATION 429 - Page 8 Table 2 BNR Data (cont'd) Label (Octal) Parameter Name Max Transmit Interval Sig. Bits (Not Inc. Sign) Units Range Approx. Resol. 345 Exhaust Gas Temp. 200 11* OC * 2048 1* 346 N1 Actual 200 12* RPM* 4096* 1* 347 Fuel Flow 200 11* Lbs/hr 32768 16* 362 Along Track Horiz. Accel.

50* 12 g 4 0.001 365 Integrated Vertical Accel. 50* 15* Knots 4096* 0.125* 366 N-S Velocity 200* 15 Knots 4096 0.125 367 E-W Velocity 200* 15 Knots 4096 0.125 Note: Labels 110, 112, 130, 131, 132, 133, 241, 245, 247, 346, 360, 372, 373, 374 and 376 previously had no values assigned. Values for label 216 have been deleted. *This data has been changed. Attachment 6: General Word Formats and Encoding Examples AIM word format examples have been added. Detailed descriptions of these words have been included in the text of Section 2.3.1.3. AERONAUTICAL RADIO, INC. 2551 Riva Road Annapolis, Maryland 21401- 7645 USA SUPPLEMENT 3 TO ARINC SPECIFICATION 429 MARK 33 DIGITAL INFORMATION TRANSFER SYSTEM (DITS) Published: November 1, 1979 Prepared by the Airlines Electronic Engineering Committee Adopted by the Airlines Electronic Engineering Committee: August 31, 1979 SUPPLEMENT 3 TO ARINC SPECIFICATION 429 - Page 2 A. PURPOSE OF THIS SUPPLEMENT This Supplement introduces material on the transfer of file data and the related protocol. The file transfer capability is being added primarily for the Flight management Computer (FMC) program/data load and update and FMC intersystem crosstalk. A number of labels and corresponding data standards have been added. B. ORGANIZATION OF THIS SUPPLEMENT The first part of this document, printed on goldenrod paper, contains descriptions of the changes introduced into the Specification by this Supplement; and, where appropriate, extracts from the original text for comparison purposes. The second part consists of replacement white pages for the Specification, modified to reflect these changes. The modified and added material on each replacement page is identified with "c-3" symbols in the margins. Existing copies of Specification 429 may be updated by simply inserting the replacement white pages where necessary and destroying the pages they replace. The goldenrod pages should be inserted inside the rear cover of the Specification. Copies of the Specification bearing the number 429-3 already contain this Supplement and thus do not require revisions by the reader. C. CHANGES TO SPECIFICATION 429 INTRODUCED BY THIS SUPPLEMENT This section presents a complete tabulation of the changes and additions to the Specification introduced by this Supplement. Each change or addition is entitled by the section number and title currently employed in the Specification or by the section number and title that will be employed when the Supplement is eventually incorporated. In each case there is included a brief description of the addition or change and, for other than very minor revisions, any text originally contained in the Specification is reproduced for reference.

2.1.5.1 BCD NUMERIC, DISCRETE AND AIM DATA WORDS Table amended to provide consistency between AIM and file transfer data words. ORIGINAL TEXT FOLLOWS: Bit No. Designation 31 30 BCD Numeric Data AIM Data 0 0 Plus, North East Right, To Final Word 0 1 No Computed Data Intermed. Word 1 0 Functional Test Control Word 1 1 Minus, South West, Left, From Initial Word 2.1.6 DATA STANDARDS Text added to clarify data encoding. ORIGINAL TEXT FOLLOWS: 2.1.6 Data Standards The units, ranges, resolutions, refresh rates, number of significant bits, pad bits etc. for the items of information to be transferred by the Mark 33 DITS are tabulated in Attachment 2 to this document. COMMENTARY Note that Section 2.3.1.1 of this document calls for numeric data to be encoded in BCD and binary, the latter using two's complement fractional notation. In this notation, the most significant bit of the data filed represents one half of the maximum value chosen for the parameter being defined. Successive bits represents the increments of a binary fraction series. Negative number are encoded as the complements of positive values and the negative sign is annunciated in the sign/status matrix. In establishing a given parameter's binary data standards for inclusion in Attachment 2, the units, maximum value and resolution of the parameter are first determined in that order. The least significant bit of the word is then given a value equal to the resolution increment, and the number of significant bits is chosen such that the maximum value of the fractional binary series just exceeds the maximum value of the parameter, i.e., equals the next whole binary number greater than the maximum parameter value less one least significant bit value. For example, if the Mark 33 DITS is required to transfer altitude in units of feet over a range of zero to 100,000 feet with a resolution of one foot, the number of significant bits is 17 and the maximum value of the fractional binary series is 131,071 (i.e., 131,071 – 1). Note that because accuracy is a quality of the measurement process and not the data transfer process, it plays no part in the selection of word characteristics. Obviously, the resolution provided in the DITS word should equal or exceed the accuracy in order not to degrade it. For the binary representation of angular data, the Mark 33 DITS employs "degrees divided by 180o" as the unit of data transfer and ± 1 (semicircle) as the range for two's complement fractional notation encoding ignoring, for the moment, the subtraction of the least significant bit value.

Thus the angular range 0 through 359.XXX degrees is encoded as 0 through ± 179.XXX degrees, the value of the most significant bit is none half semicircle and there are no discontinuities in the code.

For convenience, all binary word ranges in Attachment 2 are shown as whole binary numbers rather than such numbers less one least significant bit value. Also the resolutions shown are approximate only. Accurate resolutions can be determined, if required, by reference to the range values and numbers of significant bits for the words of interest.

SUPPLEMENT 3 TO ARINC SPECIFICATION 429 - Page 3 2.1.6 Data Standards (cont'd) COMMENTARY (cont'd) It should be noted that in all applications of the two's complement fractional notation, the maximum value of the word, once chosen, cannot be changed by the use of more bits in the data field.

The number of bits in the word affects only the resolution of the data, not its range. Binary coded decimal (BCD) data is encoded per the numeric subset of the ISO Alphabet No. 5 code (see Attachment 5 to this document) using bit nos. 1 through 4 of the seven-bit-per-character code. Alpha/numeric data is encoded using all seven bits per character of the ISO Alphabet #5 code and is transmitted using the special word format described in Section 2.3.1.3 of this document. 2.3.1.5 FILE DATA TRANSFER Section added to provide description of file data transfer protocol. 3.1.4.3 HF COMMUNICATIONS Text amended to describe switching functions and finer frequency selection increments. ORIGINAL TEXT FOLLOWS: 3.1.4.3 HF Communications Frequency Range: 2.8MHz to 24MHz Frequency Selection 1kHz Increments Characters encoded 10MHz, 1MHz, 0.1MHz, in DITS word: 0.01MHz, 0.001MHz Switching Functions: USB/AM mode selection Fig. 3-1 RADIO SYSTEMS MANAGEMENT WORD FORMATS Error corrected in bits 24 and 25 of ILS word. HF COMM frequency word format changed and second word added to enable the use of 100 Hz channel spacing. ORIGINAL TEXT FOLLOWS: HF COM Function P AR ITY (O dd) SIG N/S TA TU S MA TR IX 10M Hz (2) 1MH z (3) 0.1M Hz (5) 0.01 MH z (7) 0. 001M Hz (9) US B/A M M OD E RE SE RV ED (S DI) LABEL HF COM Frequency Bit No. Example Notes 32 0 31 30 0 0 29 28 27 0 1 0 26 25 24 23 0 0 1 1 22 21 20 19 0 1 0 1 18 17 16 15 0 1 1 1 14 13 12 11 1 0 0 1 10 0 [1] 9 0 [2] 8 7 6 5 4 3 2 1 1 1 1 1 1 1 0 0 0 [1] When bit no. 10 is "zero" the equipment should operate in the AM mode.

When bit no. 10 is "one" the equipment should operate in the SSB (USB) mode. [2] Only bit no. 9 is available for the SDI function in this word. ATTACHMENT 1: LABEL CODES The following labels have been given new assignments: 053, 056, 060, 061, 062, 063, 065, 066, 067, 070, 071, 075, 076, 077, 120, 126, 134, 137, 143, 175, 176, 177, 200, 217, 226, 251, 252-256, 257, 260, 261, 277, 300-307, 361. ATTACHMENT 2: DATA STANDARDS Tables 1 and 2 have both additions and modifications made to the data standards. Notes 2 thru 5 deleted. The original information provided in ARINC 429-2 is included in these tables. An asterisk beside a value designated that a change has been recommended. The formats of table 1 and 2 have also been changed to provide the addition of data standard descriptors. Table 3.7 added for GPWS discretes. SUPPLEMENT 3 TO ARINC SPECIFICATION 429 - Page 4 ATTACHMENT 2: DATA STANDARDS (cont'd) TABLE 1 BCD DATA LABEL (OCTAL) PARAMETER NAME MAX. TRANSMIT INTERVAL msec RANGE (SCALE SIG. FIG. PAD FIG. UNITS RESOL 0 1 0 Present Position-Lat. 200* 90S-90N 5 0 Deg/Min* 0.1 0 1 1 Present Position-Long. 200* 180E-180W 6 0 Deg/Min* 0.1 0 1 2 Ground Speed 200* 0-2000 4 1 Knots 1.0 0 1 3 Track Angle (true) 200* 0-359.9 4 1 Deg 0.1 0 1 4 Magnetic Heading 200* 0-359 3 2 Deg 1.0 0 1 5 Wind Speed 200* 0-299 3 2 Knots 1.0 0 1 6 Wind Direction (true) 200* 0-359 3 2 Deg 1.0 0 4 1 Set Latitude 200* 90S-90N 5 0 Deg/Min 0.1 0 4 2 Set Longitude 200* 180E-180W 6 0 Deg/Min 0.1 0 4 3 Set Magnetic Heading 200* 0-359.9* 4* 1* Deg 0.1* 1 2 5 Greenwich Mean Time 200 0-23.59.9 5 0 Hr/Min* 0.1 2 3 0 True Airspeed 62.5* 100-599 3 0 Knots 1.0 TABLE 2 BNR DATA LABEL (OCTAL) PARAMETER NAME MAX. TRANSMIT INTERVAL msec SIG.

BITS (NOT INC. SIGN) UNITS RANGE See Note 1 APPROX RESOL 1 0 0 Selected Course #1 50 9* Deg/180 ±180o 0.35* 1 0 1 Selected Heading 62.5 9* Deg/180 ±180o 0.35* 1 0 5 Selected Runway Heading 62.5 9* Deg/180 ±180o 0.35* 1 1 0 Selected Course #2 50 9* Deg/180 ±180o 0.35* 1 1 6 Cross Track Distance 62.5 8* N.M. 128 0.5* 1 2 1 Horiz. Steering Signal 100 10* Deg/180 ±60 o 0.06* 1 2 2 Vertical Steering Signal 100 9* Deg/180 ±30 o 0.06* 1 2 3 Throttle Command * * * * * 1 3 0 Tt2* 200 11 oC 128 0.06 1 3 1 Pt2* 200 13 PSIA 32 0.004 1 3 2 Pt7* 200 13 PSIA 32 0.004 1 4 0 Flight Director-Roll 100 9* Deg/180 ±45 o * 0.1* 1 4 1 Flight Director-Pitch 100 9* Deg/180 ±22.5 o 0.05 1 4 2 Fast/Slow 62.5 8* Knots 32 0.125* 1 4 3 Flight Director-Yaw* 100* 12* Deg/180* ±180 o 0.05* 1 6 4 Radio Height 50 17* Feet 16384* 0.125 2 0 3 Altitude (1013.25mb) 62.5 18* Feet 131,072 0.05* 2 1 0 True Airspeed 62.5* 11* Knots 2048 1.0* 2 1 1 Total Air Temp. 500 10* oC 512 0.5* 2 1 3 Static Air Temp. 500 10* oC 512 0.5* 2 2 1 Indicated Angle of Attack 62.5 11* Deg/90* ±90 o * 0.05 2 4 1 Corrected Angle of Attack 62.5 11* Deg/90* ±90 o * 0.05 2 4 7 Total Fuel 200* 15* Lb. 655,360 20* 3 1 0 Present Position-Lat. 200 18* Deg/180 0-90N-0-90S 0.00035* 3 1 1 Present Position-Long. 200 18* Deg/180 0-180E-0-180W 0.00070* 3 1 2 Ground speed 100* 15 Knots 4096 0.125 3 1 3 Track Angle True 40* 12 Deg/180 ±180 o 0.05 3 1 4 True Heading 40* 12 Deg/180 ±180 o 0.05 3 1 7 Track Angle-Mag 40* 12 Deg/180 ±180 o 0.05 3 2 0 Magnetic Heading 40* 12 Deg/180 ±180 o 0.05 3 2 1 Drift Angle 40* 11* Deg/180 ±90 o * 0.05 3 2 2 Flight Path Angle 40* 10* Deg/180 ±45 o * 0.05 3 2 4 Pitch Angle 20* 13* Deg/180 ±90 o * 0.01 3 2 5 Roll Angle 20* 14 Deg/180 ±180 o 0.01 3 6 0 Potential Vertical Speed 50 10* Ft/min* 16384* 16* # The change to MTI was erroneously omitted from Draft 1 of Supplement 3, but was included prior to publication of Supplement 3. # SUPPLEMENT 3 TO ARINC SPECIFICATION 429 - Page 5 ATTACHMENT 2: DATA STANDARDS (cont'd) NOTES 1. The number entered in the Range Column for each parameter that is not angular in nature is the nearest whole binary number greater than the parameter range required.

As explained in the Commentary following Section 2.1.6 of this document, the weight of the most significant bit of the two's complement fractional notation binary word will be one half this value, and the actual maximum value of the parameter capable of being encoded will be the number in the range column less one least significant bit value. The numbers entered in the RANGE column for angular parameters are the actual degree ranges required. The way in which these parameters are encoded is also explained in the Commentary following Section 2.1.6. 2. Bit nos. 9 and 10 of the word may be used to achieve a 20 bit capability for high resolution of the Lat./Long. Position (codes 310 and 311). The resulting resolution is .000086o for latitude and .00017 o for longitude. 3. A change in ARINC 707 not shown in Supplement 2 is a planned change for Supplement 3. A self-test inhibit bit will be added and the range of the data word will be halved to a value of 8192 ft. 4. A change in ARINC 710 not shown in Supplement 2 is a planned change for Supplement 3. The resolution of Selected Runway Heading (BCD and BNR) will be changed to .1 o. 5. A change being considered for Supplement 3 is to change the range to –6g - +4g to facilitate direct recording by the flight recorder. ATTACHMENT 6: GENERAL WORD FORMATS & ENCODING EXAMPLES SSM codes in AIM words changed to reflect table amendment of section 2.1.5.1. Radio Height code example changed to reflect shift in field. Note 4 of Table 6.2 deleted to revert data coding to the original two's complement notation. Word formats added for date/flight leg and flight number information. Word format added for VOR Omnibearing. Codes 203, 204, 206 and 207 deleted in Table 6.1a. ORIGINAL TEXT FOLLOWS: ATTACHMENT 6 GENERAL WORD FORMATS AND ENCODING EXAMPLES 1. GENERAL WORD FORMATS SUPPLEMENT 3 TO ARINC SPECIFICATION 429 - Page 6 ATTACHMENT 6: GENERAL WORD FORMATS & ENCODING EXAMPLES (cont'd) SUPPLEMENT 3 TO ARINC SPECIFICATION 429 - Page 7 ATTACHMENT 6: GENERAL WORD FORMATS & ENCODING EXAMPLES (cont'd) DME DISTANCE WORD Attachment 6 (cont'd) GENERAL WORD FORMATS AND ENCODING EXAMPLES NOTES [1] Source/Destination Identifier (SDI) Field The purpose of the SDI field is explained in Section 2.1.4 of this document, as are also the limitations on its use. When the SDI function is not required, this field may be occupied by binary zero or valid data pad bits. [2] Discretes As discussed in Section 2.3.1.2 of this document, unused bits in a word may be assigned to discrete functions, one bit per variable.

Bit #11 of the word should be the first to be so assigned; followed by bit #12 and so on in ascending numerical order until the data field is reached. In the absence of discretes, unused bit positions should be occupied by binary zero or valid data pad bits. [3] Pad All bit positions not used for data or discretes should be filled with binary zero or valid pad bits. Section 2.1.2 of this document refers. [4] Sign/Status Matrix (SSM) Section 2.1.5 of this document describes the functions of the sign/status matrix and the ways in which the bits constituting it are encoded. [5] Parity Bit This bit is encoded to render word parity odd. Section 2.3.4 of this document refers. SUPPLEMENT 3 TO ARINC SPECIFICATION 429 - Page 8 TABLE 6-1a BCD DATA ENCODING EXAMPLES NOTES: [1] "P" denotes pad "zero" or valid data. Section 2.1.2 if this document refers. Note possible use of pad bits for discrete functions per Section 2.3.1.2. [2] Because the actual maximum value of the most significant character of each of these quantities exceeds 7, it cannot be encoded in the most significant character position of the BCD word. For this reason each quantity has been given and "artificial" MSC of zero and its actual MSC encoded in the next most significant character position of the word. SUPPLEMENT 3 TO ARINC SPECIFICATION 429 - Page 9 TABLE 6-2 BNR DATA ENCODING EXAMPLES NOTES: [1] "P" denotes pad "zero" or valid data.

Section 2.1.2 of this document refers. Note possible use of pad bits for discrete functions per Section 2.3.1.2. [2] Negative values are encoded as the two's complements of positive values and the negative sign is annunciated in the sign/status matrix. [3] Angles in the range 0 to 180o are encoded as positive numbers. Angles in the range 180 o to 360 o are subtracted from 360 o and the resulting number encoded as a negative value per note 2. Arc minutes and seconds are encoded as decimal degrees. [4] Latitude values are encoded as positive angles in the range 0 to 90 o with the sign/status matrix indicating North or South. Longitude values are encoded as positive angles in the range 0 to 180 o with the sign/status matrix indicating East or West. Arc minutes and seconds are encoded as decimal degrees. AERONAUTICAL RADIO, INC. 2551 Riva Road Annapolis, Maryland 21401 – 7645 USA SUPPLEMENT 4 TO ARINC SPECIFICATION 429 MARK 33 DIGITAL INFORMATION TRANSFER SYSTEM (DITS) Published: August 1, 1980 Prepared by the Airlines Electronic Engineering Committee Adopted by the Airlines Electronic Engineering Committee: June 17, 1980 SUPPLEMENT 4 TO ARINC SPECIFICATION 429 - Page 2 A. PURPOSE OF THIS SUPPLEMENT This Supplement introduces material on defining "No Computed Data" and "Failure Warning", priority assignment of SSM codes, description of fault tolerance and isolation, address capability of A/N messages, command/response protocol, modification of data standards, addition of new labels, change of some word formats, addition of material on signal characteristics, change of receiver impedance limits, expansion of the current label, change of the receiver voltage thresholds and modification of the HF and DME word formats. B. ORGANIZATION OF THIS SUPPLEMENT The first part of this document, printed on goldenrod paper, contains description of the changes introduced into the Specification by this Supplement, and, where appropriate, extracts from the original text for comparison purposes. The second part consists of replacement white pages for the Specification, modified to reflect these changes. The modified and added material on each replacement page is identified with "c-4" symbols in the margins. Existing copies of Specification 429 may be updated by simply inserting the replacement white pages where necessary and destroying the pages they replace. The goldenrod pages should be inserted inside the rear cover of the Specification. Copies of the Specification bearing the number 429-4 already contain this Supplement and thus do not require revisions by the reader. C. CHANGES TO SPECIFICATION 429 INTRODUCED BY THIS SUPPLEMENT This section presents a complete tabulation of the changes and additions to the Specification introduced by this Supplement. Each change or addition is entitled by the section number and title currently employed in the Specification, or the section number and title that will be employed when the Supplement is eventually incorporated. In each case there is included a brief description of the addition or change and, for other than very minor revisions, any text originally contained in the Specification is reproduced for reference.

2.1.3 INFORMATION IDENTIFIER Text changed to describe use of five-character label.

Commentary text partially deleted. ORIGINAL TEXT FOLLOWS: 2.1.3 Information Identifier The first eight bits of each word are assigned to a label function. Label will: a. identify the information contained within BNR and BCD numeric data words (e.g., DME distance, static air temperature, etc.) and b. identify the word application for Discrete, Maintenance and AIM data.

Label code assignments are set forth in Attachment 1 to this document. Special Note: In some ARINC 429 DITS applications, a bus will be dedicated to delivering a single information element from a source to one or more identical sink devices. In such circumstances, the sink device designer might be tempted to assume that decoding the word label is not necessary. Experience has shown, however, that system developments frequently occur that result in the need for additional information elements to appear on the bus. If a sink device designed for service prior to such a development cannot decode the original word label, it cannot differentiate between this word and the new data in the new situation. The message for sink designers should therefore be quite clear – provide label decoding from the outset, no matter how strong the temptation to omit it might be. COMMENTARY Attachment 1 defines 256 discrete label codes. This quantity is expected to meet label assignment needs for the foreseeable future. Should additional labeling capability be required in the longer term, it is envisaged that, rather than extend the length of the label field, a scheme will be devised in which existing label assignments are duplicated. For example, the system could readily accommodate the assignment of the same label to two dissimilar parameters for which the probability of transmission on the same bus is very low.

Adherence to the label code assignments of Attachment 1 is essential in inter-system communications and in intra-system communications where the system elements are defined as "unit interchangeable" per ARINC Report No. 403. The assignment of label codes for all such communications must be coordinated with the air transport industry if chaos is to be avoided. A manufacturer who finds that Attachment 1 does not specify the label he needs for such system application must not simply choose one from those unassigned and "drive on". He should contact ARINC for assistance. 2.1.5.1 BCD NUMERIC, DISCRETE, AIM DATA AND FILE TRANSFER WORDS Text describing "no computed data" modified. Commentary providing definitions added. ORIGINAL TEXT FOLLOWS: 2.1.5.1 BCD Numeric, Discrete, AIM Data and File Transfer Words The sign (Plus, minus, North, South, etc.) of BCD numeric data, the word type (first, intermediate, control, last) for AIM data, and the status of the transmitter hardware should be encoded in bit nos. 30 and 31 of the word as shown in the table below. The sign/status matrices of Discrete words should be encoded per the rules set forth for BCD numeric data. SUPPLEMENT 4 TO ARINC SPECIFICATION 429 - Page 3 Bit No. Designation 31 30 BCD Numeric Word AIM File Transfer 0 0 Plus, North East, Right To, Above Intermediate Word Intermediate Word, Plus, North, etc. 0 1 No Computed Data Initial Word Initial Word 1 0 Functional Test Final Word Final Word 1 1 Minus, South West, Left, From, Below ControlWord Intermediate Word Intermediate Word, Minus South, etc. Notes: 1.

A source system should annunciate any detected failure that causes one or more of the words normally output by that system to be unreliable by ceasing to supply the affected word or words to the data bus. 2. Bit nos. 30 and 31 of BCD numeric data words should be "zero" when no sign is needed. 3. The "no computed data" code should be generated for BCD numeric data words when computed data is not available for reasons other than equipment failure. 4. When it appears in a BCD numeric data word identified by its (label) as a system output, the "functional test" code should be interpreted as advice that the data in the word results from the execution of a functional test. When it appears in a BCD numeric data word identified by its label as an instruction, e.g., a radio channel change command, this code should be interpreted as a command to perform a functional test. A self-test should produce indications of 1/8 of positive full-scale values unless indicated otherwise in an ARINC Equipment Characteristic. 5. See Section 2.3.1.3 of this document for definitions of the terms "Initial Word", "Control Word", "Intermediate Word" and "Final Word." 2.1.5.2 BNR NUMERIC DATA WORDS Table modified to permit sign coding for "no computed data". Definition of "failure warning" and "no computed data" added. ORIGINAL TEXT FOLLOWS: 2.1.5.2 BNR Numeric Data Words The sign (plus, minus, north, south, etc.) of BNR numeric data words and the status of the transmitter hardware should be encoded in bit nos. 29, 30 and 31 of the word as shown in the table below. Bit No. 31 30 29 Designation BNR Data 0 0 0 Failure Warning/Plus, North, East Right, To 0 0 1 Failure Warning/Minus, South, West Left, From 0 1 0 No Computed Data 1 0 0 Functional Test/Plus, North, East, Right, To 1 0 1 Functional Test/Minus, South, West Left, From 1 1 0 Normal Operation/Plus, North, East, Right, To 1 1 1 Normal Operation/Minus, South West, Left, From 0 1 1 Not Used (Growth) Notes: 1. A source system should annunciate any detected failure that causes one or more of the words normally output by that system to be unreliable by setting bit nos. 30 and 31 in the affected word(s) to the "failure warning" code defined above. Words containing this code should continue to be supplied to the data bus during the failure condition. 2. Bit no. 29 should be "zero" when no sign is needed. 3. The "no computed data" code should be generated when computed data is not available for reasons other than equipment failure. 4. When it appears in a word identified by its label as a system output, the "functional test" code should be interpreted as advice that the data in the word results from the execution of a functional test.

A self-test should produce indications of 1/8 of positive full-scale values unless indicated otherwise in an ARINC Equipment Characteristic. 5. If, during the execution of a functional test, a source system detects a failure which causes one or more of the words normally output by that system to be unreliable, it should immediately change the states of bits nos. 30 and 31 in the annunciation to the "failure warning" annunciation. SUPPLEMENT 4 TO ARINC SPECIFICATION 429 - Page 4 2.1.5.3 STATUS PRIORITIES New section inserted. 2.2.1 TRANSMISSION SYSTEM INTERCONNECT Commentary expanded to provide description of possible solutions to single-wire fault conditions. ORIGINAL TEXT FOLLOWS: 2.2.1 Transmission System Interconnect A data source should be connected to the data sink(s) by means of a single twisted and shielded pair of wires. The shields should be grounded at both ends and at all production breaks in the cable. The interwiring diagram to be found in each ARINC Equipment Characteristic shows connector pins assigned to carry shields into black boxes for grounding. Equipment manufacturers should ensure, however, that their equipment will operate correctly if, instead of being terminated on these pins, shields are grounded in the aircraft close to the rack connector. COMMENTARY In practical wire line digital information transmission systems, cable characteristics and electrical mismatches can produce distortion of the digital data pulses. Also, noise due to electrical interference perturbs digital signals. The performance of a digital receiver depends upon the receiver input signal characteristics (data with distortion and noise) and the receiver design. Prior to the selection of the voltage and impedance parameters set forth in this Section of this document, the pulse distortion likely to be encountered in systems built around them in existing size commercial aircraft was evaluated and judged to be acceptable for a well-designed receiver. No restriction is placed by this specification, therefore, on the number or length of sturbs for installations on aircraft no larger than those existing, e.g., B 747.

See Appendix 1 to this document for a report of this investigation. 2.2.3.1 TRANSMITTER VOLTAGE LEVELS Text changed to improve clarity.

ORIGINAL TEXT FOLLOWS: 2.2.3.1 Transmitter Voltage Levels The differential output signal across the specified output terminals (balanced to ground at the transmitter) should be + 10 ± 1.0 volts, 0 ± 0.5 volts and –10 ± 1.0 volts respectively for the "HI", "NULL" and "LO" states when the transmitter is open circuit.

The output impedance of the transmitter should be as specified in Section 2.2.4.1 of this document. This output impedance should be present for the "HI", "NULL" and "LO" transmitter output conditions and also during transitions between these levels. 2.2.3.2 RECEIVER VOLTAGE LEVELS Receiver voltage thresholds changed. Fault voltage text deleted. Commentary revised to include description of receiver reaction to undefined voltages.

ORIGINAL TEXT FOLLOWS: 2.2.3.2 Receiver Voltage Levels The differential voltage presented at the receiver input terminals will be dependent upon line length, stub configuration and the number of receivers connected. In the absence of noise, the normal ranges of voltages presented to the receiver terminals (A and B) would be: "HI" +6V to 10V "NULL" +0.5 to –0.5V "LO" -6V to –10V In practice, these nominal voltages will be perturbed by noise and pulse distortion. Thus, receivers should associate the following voltage ranges with the three states indicated: "HI" +5V to 13V "NULL" +2.5V to –2.5V "LO" -5V to –13V Receivers should not be damaged by the application of up to 20VAC (RMS) across terminals A and B by the application of up to +28Vdc (min) bias between terminal A and ground and –28Vdc (min) bias between terminal B and ground. See Attachment 3 to this document for a pictorial representation of transmitter and receiver voltage levels. COMMENTARY Receiver input common mode voltages (terminal A to ground and terminal B to ground) are not specified because of the difficulties of defining ground with any satisfactory degree of precision. Receiver manufacturers are encouraged to work with the differential input voltage (line A to line B) and not line-to-ground voltages. The opinion is held by some people that conditions on transmission lines will be encountered which will require receivers to operate with less than the above-defined minimum difference of 2.5V between the NULL and HI and NULL and LO states. Receiver designers are encouraged to investigate the possibilities and problems of working with a minimum difference of 1 volt between these states and to report their findings. 2.2.4.1 TRANSMITTER OUTPUT IMPEDANCE Text added to improve clarity. SUPPLEMENT 4 TO ARINC SPECIFICATION 429 - Page 5 ORIGINAL TEXT FOLLOWS: 2.2.4.1 Transmitter Output Impedance The transmitter output impedance should be 75 ± 5 ohms, divided equally between line A and line B to provide an impedance balanced output. COMMENTARY The output impedance of the transmitter is specified as 75 ± 5 ohms to provide an approximate match to the characteristic impedance of the cable. The match can only be approximate due to the wide range of characteristic impedance which may be encountered due to the variety of conductor wire gages and insulation properties. Measurements on a few samples of wire showed a spread of characteristic impedance of 63 and 71 ohms. An extrapolation over the wire gages 20 to 26 for wrapped and extruded insulation indicate an expected characteristic impedance spread of 80 to 60 ohms approx. Twisted shielded wire specifications do not control the characteristic impedance of the cable, thus future developments in insulation techniques may result in cables having characteristic impedances outside the range estimated.

2.2.4.2 RECEIVER INPUT IMPEDANCE Value of RI changed. ORIGINAL TEXT FOLLOWS: 2.2.4.2 Receiver Input Impedance The receiver should exhibit the following characteristics, measured at the receiver input terminals: Differential Input Resistance RI = 6,000 ohms minimum Differential Input Capacitance CI = 50pF maximum Resistance to Ground RH and RG ≥ 12,000 ohms Capacitance to Ground CH and CG ≤ 50pF. No more than twenty receivers should be connected on to one digital data bus and each receiver should incorporate isolation provisions to ensure that the occurrence of any reasonably probable failure does not cause loss of data to the others. See Attachment 4 to this document for a pictorial representation of the input and output circuits standards. COMMENTARY The above characteristics apply to differential amplifier receivers. Opto-isolator technology is progressing and may soon find application in digital data receivers. Opto-isolator receivers impose slightly greater loads on data buses than differential amplifier receivers and the way in which they are characterized is different. It is probable, however, that a future revision of this Specification will include material specifically related to their use. 2.2.5 Fault Tolerance New section inserted. 2.2.5.1 Receiver External Fault voltage Tolerance New section inserted. 2.2.5.2 Transmitter External Fault Voltage Tolerance New section inserted. 2.2.5.3 Transmitter External Fault Load Tolerance New section inserted.

2.2.6 Fault Isolation New section inserted. 2.2.6.1 Receiver Fault Isolation New section inserted.

2.2.6.2 Transmitter Fault Isolation New section inserted. 2.3.1.2 Discretes Text modified to expand label examples. Reference to AIDS limitations deleted. ORIGINAL TEXT FOLLOWS: 2.3.1.2 Discretes In addition to handling numeric data as specified above, the Mark 33 DITS should also be capable of accommodating discrete items of information either in the unused (pad) bits of data words or, when necessary, in dedicated words. Any discrete information contained in a numeric data word assigned a label in Attachment 1 is specified in the definition for that word in Attachment 2. The rule to be followed in the assignments of bits to discretes in numeric data words is to start with the least significant bit of the word and to continue towards the most significant bit available in the word. Attachment 6 shows that this against the background of the generalized word structure. There are two types of discrete words. These are general purpose discrete words, and dedicated discrete words. Five labels (octal 270-274) are assigned to the general purpose words in Attachment 1. These words should be used in ascending label order (starting with octal 270) when the system receiving the data can identify its source by reference to the port at which it arrives. The dedicated words should be used when the SUPPLEMENT 4 TO ARINC SPECIFICATION 429 - Page 6 2.3.1.2 Discretes (cont'd) data is intended for the AIDS DFDAU which cannot identify sources in this way.

COMMENTARY The foregoing special provisions for the delivery of discrete data to an AIDS were made to compensate for the number of digital ports required when many ports are used is extremely difficult to achieve, which necessitated the development of the special AIDS words. These words should be limited to AIDS utilization. The few aircraft systems which deliver discretes to an AIDS by means of the Mark 33 DITS will be burdened very little by this. Similarly, the impact of label use will be small. 2.3.1.4 AIM DATA Text added to describe unit addressing. ORIGINAL TEXT FOLLOWS: 2.3.1.4 AIMS Data AIM data (Acknowledgement, ISO Alphabet No. 5 and Maintenance information encoded in dedicated words) should be handled in the manner described in this Section. All three of these applications may involve the transfer of more than 21 bits per "data package". Source equipment should format such long messages into groups of 32-bit DITS words, each word containing the relevant application label (see Attachment 1) in bit nos. 1 through 8, and a sign/status matrix code in bit nos. 30 and 31. Bit no. 32 should be encoded to render word parity odd. The first word of each group should contain the sign/status matrix code defined for "initial word" in Section 2.1.5.1 of this document. It should also contain, in bit nos. 9 through 16, the binary representation of the number of words in the group, except that when this word is the only word to be transmitted, i.e., the total number of information bits to be transmitted is 13 or less, bit nos. 9 through 16 should all be binary "zeros". When the word application label is assigned in Attachment 1 for Acknowledgement Data, bit nos. 17 through 29 of this initial word may be used for information transfer. When the word application label is either of those assigned in Attachment 1 for ISO Alphabet No. 5 data transfer or Maintenance Data (ISO Alphabet Not. 5), bit nos. 17 through 22 should be binary "zeros" (spares) and bit nos. 23 through 29 should take on the pattern of the ISO Alphabet No. 5 control character "STX". The second word of the ISO Alphabet No. 5 and Maintenance Data (ISO Alphabet No. 5) application groups is an optional control word containing the sign/status matrix code for "control" information for the display.

When it is used, bit nos. 9 through 13 should contain the binary representation of the line count, bit nos. 14 through 16 should encode the required color, bit nos. 17 and 18 the required intensity, bit nos. 19 and 20 the required character size and bit no. 21 should indicate whether or not the display is required to flash. See Attachment 6 to this document for the encoding standards. Bit nos. 22 through 29 of the word should be binary "zero" (spares).

Intermediate words, containing the sign/status matrix code for "intermediate word", follow the initial word of the group or the control word, when used. Intermediate words are optional in the sense that they are only transmitted if more words than the initial word and the final word (see below) are needed to accommodate the quantity of information to be transferred. When the word application group label that is assigned in Attachment 1 for Acknowledgement, Data bit nos. 9 through 29 of that word are available for information transfer.

When the word application label is either of those assigned in Attachment 1 for ISO Alphabet No. 5 data transfer or Maintenance Data (ISO Alphabet No. 5), bit nos. 9 through 29 of each word should be divided into three seven-bit bytes (bit nos. 9 through 15, 16 through 22 and 23 through 29), each of which contains one ISO Alphabet No. 5 character. Each AIM application group transmission other than single-word transmissions (see below) should be terminated with a word containing the sign/status matrix code for "final word" defined in Section 2.1.5.1 of this document. The data field of this word should be structured similarly to that of the intermediate word. Any unused bit positions in ISO Alphabet No. 5) final transfer or Maintenance Data (ISO Alphabet No. 5) final words resulting from the number of ISO Alphabet No. 5 characters in the message being one or two less than a number wholly divisible by three should be filled with binary "zeros". 2.3.1.5.1 COMMAND/RESPONSE PROTOCOL Text modified to describe transmitter reaction to lack of "Clear to send". ORIGINAL TEXT FOLLOWS: 2.3.1.5.1 Command/Response Protocol File data will consist of both ARINC 429 BNR numeric words and ISO alphabet No. 5 characters. A file may contain from 1 to 127 records. Each record may contain from 1 to 126 data words. A record will contain, at the minimum, one of the eight versions of the "initial word" described in Section 2.3.1.5.2. Records in which this initial word contains the "Data Follows" code will also contain from 1 to 126 "intermediate words" (data) and a "final word" (error control). The file data transfer protocol is as follows.

A transmitter having the data to send to a receiver transmits, on the bus connecting it to that receiver, the "Request to Send" initial word. The receiver responds, on the separate bus provided for return data flow, with the "Clear to Send" reply.

The transmitter then sends the "Data Follows" initial word, the "intermediate words" and the "final word". The receiver processes the error control information in the "final word" and, if no errors are revealed, closes out the transaction by SUPPLEMENT 4 TO ARINC SPECIFICATION 429 - Page 7 sending the "Data Received OK" word to the transmitter. If the receiver is not ready to accept data when the transmitter sends its "Request to Send" word, it will so indicate in its response (see Section 2.3.1.5.2). The transmitter should then wait 200 milliseconds and retransmit the "Request to Send". The transmitter should also repeat a "Request to Send" transmission 50 milliseconds after the initial transmission if no response is obtained from the receiver. An alert should be raised in the system containing the transmitter if 4 attempts to obtain a "Clear to Send" response from a receiver are unsuccessful. If the receiver detects a parity error during the transmission, it may request an error-correcting retransmission by sending a "Data Received Not OK" word to the transmitter in which is identified the record in which the error occurred. The transmitter will interrupt the data flow and back up to the start of the record so identified.

It will then send a "Data Follows" initial word identifying this record as the starting point of the retransmission and recommence its output of data, continuing through the "final word".

The receiver will then close out the transaction as before. An error detected by processing the error control information in the "final word" will also result in the receiver sending a "Data Received Not OK" word to the transmitter. In the absence of identification of the record in which the error occurred, this word should contain the sequence number of the first record of the file. The transmitter's response will be to retransmit the whole file. The receiver can signal loss of synchronization to the transmitter at any time by sending the "Synchronization Lost" initial word. On receiving this word the transmitter should curtail the data flow and back up to the beginning of the file.

It should then re-establish that the receiver can accept data by going through the request-to-send/clear-to-send routine.

Having done this it should send the "Data Follows" initial word, followed by the data and the "final word". The protocol also allows a transmitter to send file size information to a receiver without any commitment to send, or request to the receiver to accept, the file itself. The "Header Information" initial word is used for this purpose.

Additionally, a "Poll" initial word is defined for use in system in which continuous "handshaking" between two terminals is desired. The response to a "Poll" word will be either a "Request to Send" initial word when the polled terminal does have data to transmit, or another "Poll" word when it does not. An exchange of "Poll" words may be interpreted as the message, " I have nothing for you, do you have anything for me?" 2.4.2 INFORMATION RATES Commentary added to describe refresh rate. ORIGINAL TEXT FOLLOWS: 2.4.2 Information Rates The minimum update interval for each item of information transferred by the Mark 33 DITS is specified in the tables of Attachment 2.

Discretes contained within data words will be transferred at the bit rate and repeated at the update rate of the primary data. Words dedicated to discretes should be repeated continuously at the rates defined in Attachment 2.

COMMENTARY The time intervals between successive transmissions of a given BCD word specified in table 1 of Attachment 2 to this document are, in general, too short for the signal to be of use in driving a display device directly. If the signal was so used, the least significant character of the display would change too rapidly for human perception. Considerations other than human factors demand the time intervals specified. Thus, display designers should incorporate into their devices means for selecting those words to be used for updating the display from the greater quantity delivered. 3.1.4.2 DME Encoding and switch functions modified. ORIGINAL TEXT FOLLOWS: 3.1.4.2 DME Frequency Range: 108.00MHz to 135.95MHz Frequency Selection: 50kHz Increment: Characters encoded 10MHz, 1MHz, 0.1MHz, In DITS word: 0.01MHz, (100MHz Character is always Decimal 1) Switching Functions: Standby, DME Mode Select ILS Mode SUPPLEMENT 4 TO ARINC SPECIFICATION 429 - Page 8 FIGURE 3-1 Radio Systems Management Word Formats HF and DME words modified. ORIGINAL TEXT FOLLOWS: PAR ITY (od d) SIG N/S TA TU S MA TR IX 10M Hz (1) 1MH z (1) 0.1M Hz (5) 0.01 MH z (0) ILS Mod e Stan dby DM E M ode Sele ct RE SER VE D (SDI) LABEL DME Frequency DME Function Bit No. Example Notes 32 1 31 30 0 0 29 28 27 26 25 24 23 22 21 20 19 1 8 17 16 15 0 0 1 0 0 0 1 0 1 0 1 0 0 0 0 14 0 [1] 13 0 [2] 12 11 0 0 [3] 10 9 0 0 8 7 6 5 4 3 2 1 1 0 1 1 1 0 0 0 [1] Bit no. 14 should be set to "zero" for VOR frequencies and "one" for ILS frequencies by the tuning information source. [2] [3] Bit Zero One 11 12 DME Mode select coding per Section 4.1.6 of ARINC Char. 709 13 Standby off Standby on PAR ITY (od d) SIG N/S TA TU S M AT RIX 10M Hz (2) 1MH z (3) 0.1M Hz (5) 0.01 MH z (7) 0. 001M Hz (9) USB /LSB Mod e SSB /AM Mod e W ord Iden tifi er LABEL HF COM Frequency HF COM Word #1 Function Bit No. Example Notes 32 0 31 30 0 0 29 28 1 1 27 26 25 24 0 0 1 1 23 22 21 20 0 1 0 09 18 17 16 0 1 1 1 15 14 13 12 1 0 0 1 11 0 [1] 10 9 0 0 [2] [3] 8 7 6 5 4 3 2 1 1 1 1 1 1 1 0 0 0 [1] Bit no.

11 should be set to "zero" for LSB operation and "one" for USB operation. [2] Bit no. 10 should be set to "zero" for AM operation and "one" for SSB operation. [3] Bit no.

9 should be set to "zero" when the 100 Hz option is not used and "one" when it is. PAR ITY (od d) SIG N/S TA TU S MA TR IX .1K hz (5) NOT USED LABEL HF COM Frequency HF COM Word #2 Function Bit No. Example 32 0 31 30 0 0 29 28 27 26 0 1 0 1 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 10 9 0 0 8 7 6 5 4 3 2 1 1 1 1 1 1 0 0 0 Note: The HF COMM #2 word is used only when bit no. 9 of word #1 is "one". SUPPLEMENT 4 TO ARINC SPECIFICATION 429 - Page 9 ATTACHMENT 1: LABEL CODES Column "EQPT. ID (HEX)" has been added for five-character label implementation. Table containing "Equipment ID Codes" added. The following labels have been given new assignments: 004, 034, 056, 060-064, 070-106, 111, 114-122, 126, 127, 135, 136, 140-141, 144-162, 173-177, 202-212, 215, 217, 222-226, 242, 244-252, 256-265, 276, 310-322, 340-342, 344, 345, 347, 350, 370, 377. Label 226 (FWC #2) deleted. Labels 124 and 224 (C&W DFDR Discretes) deleted. ATTACHMENT 2: DATA STANDARDS The columns for "bandwidth", "noise level" and "update interval" have been deleted. A column for "minimum transmit interval" has been added.

The column for "transport delay" has been changed to "maximum transport delay". A column for "EQPT.ID (HEX)" has been added. Data standards added for new labels. Note [2]: A nominal interval description has been added. Note [3]: A definition for "maximum transport delay" has been added.

Note [4]: SDI assignments defined for labels 060-064. The following tables list the parameters for which the data standards have changed. An asterisk beside a particular value designates that a new value is suggested. TABLE 1 BCD DATA LABEL (OCTAL) PARAMETER NAMES UNITS RANGE (SCALE) SIG. DIG. POSITIVE SENSE RESOL. MAXIMUM TRANSMIT INTERVAL 010 Present Position – Lat. Deg:Min 90S-90N* 5* 0.1 500 017 Selected Runway Heading Deg 0-359.9 4 0.1 200* 024 Selected Course #1 Deg 0-359 3 1.0 200* 027 Selected Course #2 Deg 0-359 3 200* 033 ILS Frequency 200* 034 VOR/ILS Frequency 200* 041 Set Latitude Deg:Min 90S-90N* 5* N 0.1 500 065 Gross Weight 100lb. 0-10000* 5 1.0 200 067 Lateral CG Mlb-in.* ± 100.00* 4* 0.1* 200 200 Drift Angle Deg ± 90* 3* 0.1 200 231 Total Air Temperature oC -60-+90* 2* 1.0 500 232 Altitude Rate Ft/Min ± 20,000 4 Up 20.0* 62.5 233 Static Air Temperature oC -99-+60* 2* 1.0 500 TABLE 2 BNR DATA LABEL (OCTAL) PARAMETER NAME UNITS RANGE SIG. BITS POSITIVE SENSE APPROX. RESOL. MAXIMUM TRNASMIT INTERVAL 077 Lateral CG MLB/in ± 128* 14* 0.001 200 100 Selected Course #1 Deg/180 ± 180o 12 0.05 o 50* 105 Selected Runway Heading Deg/180 ± 180o 11 0.05 o 62.5* 110 Selected course #2 Deg/180 ± 180o 12 0.05 o 50* 173 Localizer Deviation DDM ± 0.4 12 0.0001 62.5* 174 Glideslope Deviation DDM ± 0.8 12 0.0002 62.5* 222 VOR Omnibearing Deg/180 ± 180o 12 0.044 o 62.5* 256 Fuel Quantity #1 Lbs. 131,072 15 4 200* 257 Fuel Quantity #2 Lbs. 131,072 15 4 200* 310 Present Position – Lat. Deg/180 0-90N-0-90S* 20 .000086 o* 200 SUPPLEMENT 4 TO ARINC SPECIFICATION 429 - Page 10 ATTACHMENT 2: DATA STANDARDS (cont'd) ORIGINAL TEX FOLLOWS: [2] Transmit intervals and the number of parameters to be transmitted are prime factors in bus loading. It was suggested that a Minimum Transmit Interval be specified (perhaps a value of ½ the Transmit Interval) to control bus loading.

The ability of receivers to reject unwanted words would also be effective in improving bus efficiency. Table 3.2 FCC DISCRETES – LABELS 270, 271 Existing tables replaced by new set of tables. ORIGINAL TEXT FOLLOWS: Table 3.2: FCC Discretes – Labels 270, 271 Discrete Word #1 Bit Status Bit No. Function 1 0 1 X 2 X 3 X 4 Label X 5 X 6 X 7 X 8 X 9* Capt. Flight Director On Off 10* F. O. Flight Director On Off 11 Turbulence Mode Requested Not Requested 12 Autopilot #1 Engaged Not Engaged 13 Autopilot #2 Engaged Not Engaged 14 RESERVED (A/P #3) Engaged Not engaged 15 Autothrottle #1 Armed Not Armed 16 RESERVED (A/T #2) Armed Not Armed 17 Airspeed Hold Mode Requested Not Requested 18 Airspeed Select Mode Requested Not Requested 19 Mach Select Mode Requested Not Requested 20 Mach Hold Mode Requested Not Requested 21 22 Bank Angle Limit See Below 23 24 Heading Select Mode Requested Not Requested 25 N1/EPR Select Mode Requested Not Requested 26 IAS on Throttle Requested Not Requested 27 Mach on Throttle Requested Not Requested 28 Spare 29 Spare 30 Sign/Status 31 Matrix 32 Parity (Odd) SUPPLEMENT 4 TO ARINC SPECIFICATION 429 - Page 11 ATTACHMENT 2: DATA STANDARDS (cont'd) Bank Angle Limit Encoding Bit nos. 21, 22 and 23 of Discrete Word #1 should be encoded to indicate selected bank angle limit as follows: *Bits 9 and 10, which are normally used for the SDI, have purposely been used for Discrete information. Bit No. Limit 21 22 23 Not used 0 0 0 5o 0 0 1 10 o 0 1 0 15 o 0 1 1 20 o 1 0 0 25 o 1 0 1 30 o 1 1 0 Spare 1 1 1 Discrete Word #2 Bit Status Bit No. Function 1 0 1 X 2 X 3 X 4 Label X 5 X 6 X 7 X 8 X 9* Altitude Hold Mode Requested Not Requested 10* Altitude Select Mode Requested Not Requested 11 Vertical Speed Select Mode Requested Not Requested 12 Vertical Speed Hold Mode Requested Not Requested 13 Horizontal Navigation Requested Not Requested 14 Vertical Navigation Requested Not Requested 15 Land Command Requested Not Requested 16 LOC Approach Command Requested Not Requested 17 Back Course Approach Command Requested Not Requested 18 CWS #1 Requested Not Requested 19 CWS #2 Requested Not Requested 20 CWS #3 Requested Not Requested 21 Pitch Upper Mode Cancel Requested Not Requested 22 Roll Upper Mode Cancel Requested Not Requested 23 Heading Hold Requested Not Requested 24 25 26 Spare 27 28 29 30 Sign/Status 31 Matrix 32 Parity (odd) * Bits 9 and 10, which are normally used for the SDI, have purposely been used for Discrete information. SUPPLEMENT 4 TO ARINC SPECIFICATION 429 - Page 12 TABLE 3.7 GPWS DISCRETE LABEL 270 23 Visual message bit assignments inserted. TABLE 3.8 TCC DISCRETES LABELS 272 03, 273 03, 274 03, 275 03 New tables inserted. ATTACHMENT 3: VOLTAGE LEVELS Hi and Lo thresholds changed from 5-13 volts to 6.5-13 volts. ATTACHMENT 4: INPUT/OUTPUT CIRCUIT STANDARDS RI increased from 6,000 to 12,000 ohms. Total system resistance range of 300-6000 ohms changed to 400-8000 ohms.

ATTACHMENT 6: GENERAL WORD FORMATS AND ENCODING EXAMPLES Format for alphanumeric message initial word modified. Slat/Flap angle word added. GMT binary word added. Label Fields changed in discrete word and maintenance (discrete) word.

In table 6-1b note [1] deleted and bits 21 and 22 of latitude word interchanged. In Table 6-2 examples corrected for Present Position (Latitude and Longitude).

Radio Height word added. ORIGINAL TEXT FOLLOW: P 32 SSM 31 (01) 30 "STX" 29 23 SPARES 22 (Zeros) 17 WORD COUNT 16 BNR EQUIV. 9 LABEL 8 (356/357) 1 ALPHA NUMERIC (ISO ALPHABET NO. 5) DATA – INITIAL WORD FORMAT P 32 SSM 31 (00) 30 DISCRETES 29 MSB 2 LSB 11 SDI 10 9 LABEL 8 (270-274) 1 DISCRETE WORD FORMAT P 32 SSM 31 (00) 30 MAINTENANCE DISCRETES DISCRETES 29 MSB LSB 11 SDI 10 9 LABEL 8 (350-354) 1 MAINTENANCE (DISCRETE) WORD FORMAT APPENDIX 3: DIGITAL SYSTEMS GUIDANCE (PART 1) Appendix added.

APPENDIX 4: DIGITAL SYSTEM GUIDANCE (PART 2) Appendix added. AERONAUTICAL RADIO, INC. 2551 Riva Road Annapolis, Maryland 21401 – 7645 USA SUPPLEMENT 5 TO ARINC SPECIFICATION 429 MARK 33 DIGITAL INFORMATION TRANSFER SYSTEM (DITS) Published: April 4 1981 Prepared by the Airlines Electronic Engineering Committee Adopted by the Airlines Electronic Engineering Committee: March 12, 1981 SUPPLEMENT 5 TO ARINC SPECIFICATION 429 – Page 2 A. PURPOSE OF THIS SUPPLEMENT This Supplement introduces material on fault detection, transmit intervals for words using multiple SDI codes, modification of IRS/AHRS discrete formats, expansion of error control definition, revision of ILS word, addition of new labels and change of existing data standards. B. ORGANIZATION OF THIS SUPPLEMENT The first part of this document, printed on goldenrod paper, contains descriptions of the changes introduced into the Specification by this Supplement, and, where appropriate, extracts from the original text for comparison purposes. The second part consists of replacement white pages for the Specification, modified to reflect these changes. The modified and added material on each replacement page is identified with "c-5" symbols in the margins. Existing copies of Specification 429 may be updated by simply inserting the replacement white pages where necessary and destroying the pages they replace. The goldenrod pages should be inserted inside the rear cover of the Specification. Copies of the Specification bearing the number 429-5 already contain this Supplement and thus do not require revisions by the reader. C. CHANGES TO SPECIFICATION 429 INTRODUCED BY THIS SUPPLEMENT This section presents a complete tabulation of the changes and additions to the Specification introduced by this Supplement. Each change or addition is entitled by the section number and title currently employed in the Specification, or by the section number and title that will be employed when the Supplement is eventually incorporated. In each case there is included a brief description of the addition or change and, for other than very minor revisions, any text originally contained in the Specification is reproduced for reference. 2.2.1 TRANSMISSION SYSTEM INTERCONNECT Text revised for break connections. Text added to Commentary describing increase of voltage threshold. ORIGINAL TEXT FOLLOWS: 2.2.1 Transmission System Interconnect A data source should be connected to the data sink(s) by means of a single twisted and shielded pair of wires. The shields should be grounded at both ends and at all production breaks in the cable to an aircraft ground close to the rack connector. COMMENTARY In practical wire line digital information transmission systems, cable characteristics and electrical mismatches can produce distortion of the digital data pulses. Also, noise due to electrical interference perturbs digital signals. The performance of a digital receiver depends upon the receiver input signal characteristics (data with distortion and noise) and the receiver design. Prior to the selection of the voltage and impedance parameters set forth in this Section of this document, the pulse distortion likely to be encountered in systems built around them in existing size commercial aircraft was evaluated and judged to be acceptable for a well-designed receiver. No restriction is placed by this specification, therefore, on the number or length of stubs for installations on aircraft no larger than those existing, e.g., B 747. See Appendix 1 to this document for a report of this investigation. Tests have shown that some receivers continue decoding data properly when one side of the transmission line is open or shorted to ground. When this condition exists noise immunity decreases and intermittent operation may occur. Users desire protection against non-annunciated system operation in this mode. This protection may consist of additional circuitry to detect and annunciate the fault.

2.2.3.2 RECEIVER VOLTAGE LEVELS Normal voltage ranges changed due to impedance changes. ORIGINAL TEXT FOLLOWS: 2.2.3.2 Receiver Voltage Levels The differential voltage presented at the receiver input terminals will be dependent upon line length, stub configuration and the number of receivers connected. In the absence of noise, the normal ranges of voltages presented to the receiver terminals (A and B) would be: "HI" +6.5V to 10V "NULL" +2.5V to –2.5V "LO" -6.5V to –13V In practice, these nominal voltages will be perturbed by noise and pulse distortion. Thus, receivers should associate the following voltage ranges with the three states indicated: "HI" +6.5V to 13V "NULL" +2.5V to –2.5V "LO" -6.5V to –13V COMMENTARY Receiver reaction is currently undefined in Specification 429 for voltages that fall in the range just above and below the "NULL" range. Respective equipment Characteristics should be referenced for desired receiver response in this range. However, it is desirable that all DITS receivers will discontinue operation when the voltage levels fall into the undefined regions. Manufacturers are urged, as new equipment is developed, to "design in" the rejection capability. The opinion is held by some people that conditions on transmission lines will be encountered which will require receivers to operate with less than the SUPPLEMENT 5 TO ARINC SPECIFICATION 429 – Page 3 above-defined minimum difference of 4.0V between the NULL and HI and NULL and LO states. Receiver designers are encouraged to investigate the possibilities and problems of working with a minimum difference of 1 volt between these states and to report their findings. Receiver input common mode voltages (terminal A to ground and terminal B to ground) are not specified because of the difficulties of defining ground with any satisfactory degree of precision. Receiver manufacturers are encouraged to work with the differential input voltage (line A to line B) and not line-to-ground voltages.

2.3.1.5.4 FINAL WORDS Text added to define checksum. ORIGINAL TEXT FOLLOWS: 2.3.1.5.4 Final Words The final word of each record contains error control information. Bit nos. 1 through 8 contain the file label. Bit nos.

9 through 29 contain an error control checksum computed from the states of bit nos.

9 through 31 of each intermediate word of the record.

Bit nos. 30 and 31 of this word contain the code identifying it as a final word. Bit no. 32 is encoded to render word parity odd.

2.3.4 ERROR DETECTION/CORRECTION Obsolete text deleted. ORIGIANL TEXT FOLLOWS: 2.3.4 Error Detection/Correction The last bit of each word should be encoded such that word parity is rendered odd to allow error detection in receivers. Note that the parity calculation encompasses all 31 label and information bits of the word. The Mark 33 DITS contains no provisions for message retransmission, the inclusion of redundant bits in words or other means of error correction. Fig. 3-1: RADIO SYSTEMS MANAGEMENT WORD FORMATS Bits 3 and 7 of transponder word changed to "0". (editorial) Bit 11 and 12 assigned to ILS category designation. Control Panel Function Matrix added to transponder word. ORIGINAL MATERIAL ON NEXT PAGE: 2.4.2 INFORMATION RATES Text added to describe transmission of labels with multiple SDI codes. ORIGINAL TEXT FOLLOWS: 2.4.2 Information Rates The minimum and maximum transmit intervals for each item of information transferred by the Mark 33 DITS are specified in the tables of Attachment 2. COMMENTARY There are no values given for refresh rates in this Specification. However, it is desirable that data be refreshed at least once per transmission. Those data actually requiring long processing times or a large number of samples are the only types not expected to be refreshed with every transmission. Discretes contained within data words should be transferred at the bit rate and repeated at the update rate of the primary data.

Words dedicated to discretes should be repeated continuously at the rates defined in Attachment 2.

COMMENTARY The time intervals between successive transmissions of a given BCD word specified in table 1 of Attachment 2 to this document are, in general, too short for the signal to be of use in driving a display device directly. If the signal was so used, the least significant character of the display would change too rapidly for human perception.

Considerations other than human factors demand the time intervals specified.

Thus, display designers should incorporate into their devices means for selecting those words to be used for updating the display from the greater quantity delivered. SUPPLEMENT 5 TO ARINC SPECIFICATION 429 – Page 4 Fig. 3-1: RADIO SYSTEMS MANAGEMENT WORD FORMATS (cont'd) PAR ITY (od d) SIG N/S TA TU S MA TR IX 10M Hz (0) 1MH z (9) 0.1M Hz (3) 0.01 MH z (0) SPA RE SPA RE SPA RE SPA RE RE SER VE D (SDI) LABEL ILS Frequency ILS Function Bit No. Example 32 1 31 30 0 0 29 28 27 0 0 0 26 25 24 23 1 0 0 1 22 21 20 19 0 0 1 1 18 17 16 15 0 0 0 0 14 0 13 0 12 0 11 0 10 9 0 0 8 7 6 5 4 3 2 1 1 1 0 1 1 0 0 0 ATTACHMENT 1: LABEL CODES The following labels have been given new assignments: 073 02, 073 A2, 112 02, 130 1A, 131 2D, 132 1A, 133 1A, 151 02, 154 02, 164 02, 164 03, 174 03, 205 1A, 207 0A, 211 1A, 215 1A, 242 1A, 245 0A, 256 0A, 260 31, 262 0A, 263 0A, 264 0A, 265 0A, 270 1A, 270 1E, 270 30, 271 06, 271 1A, 271 1E, 272 1A, 274 0A, 275 2B, 300 1A, 301 1A, 303 1A, 304 1A, 305 1A, 306 1A, 307 1A, 325 1A, 340 1A, 340 2D, 341 1A, 342 1A, 344 1A, 345 1A, 346 1A, 350 1A, 351 1A, 352 1A, 353 1A, 354 1A. Label 242** was deleted. Label 316 04 changed form "Wind Angle" to "Wind Direction (True)". ATTACHMENT 1: EQUIPMENT CODES New assignments were made for 0A and 2D. Note added to 1A. SUPPLEMENT 5 TO ARINC SPECIFICATION 429 – Page 5 ATTACHMENT 2: DATA STANDARDS Data standards were added for new labels. The following table lists the parameters for which the existing data standards have changed. An asterisk beside a particular value designates that a new value is suggested. LABEL EQPT ID (HEX) PARAMETER NAME UNITS RANGE SIG. DIG/ BITS POS. SENSE RESOL MIN. TR. INT. MAX. TR. INT. 004 01 Runway Distance to Go Feet 0-79900 3 100.0 200* 400* 165 07 Radio Height Feet ± 0-7999.9 5 0.1 100* 200* 205 06 Mach mMach* 4096* 13* 0.5* 62.5 125 210 06 True Airspeed Knots 2048* 13* 0.25* 62.5 125 215 06 Impact Pressure mb 512* 9* 1.0* 62.5 125 242 06 Total Pressure mb 2045* 11* 1.0* 62.5 125 313 04 Track Angle True Deg/180 ± 180o 12* 0.05 o 25 50 314 04 True Heading Deg/180 ± 180 o 12* 0.05 o 25 50 317 05 Track Angle Magnetic Deg/180 ± 180 o 12* 0.05 o 25 50 317 05 Track Angle Magnetic Deg/180 ± 180 o 12* 0.05 o 25 50 320 04 Magnetic Heading Deg/180 ± 180 o 12* 0.05 o 25 50 320 05 Magnetic Heading Deg/180 ± 180 o 12* 0.05 o 25 50 323 04 Flight Path Acceleration g 2* 14* 0.0001* 10 20 323 05 Flight Path Acceleration g 2* 14* 0.0001* 10 20 324 04 Pitch Angle Deg/180 ± 180 o 14 0.01 o 25* 50* 324 05 Pitch Angle Deg/180 ± 180 o 14 0.01 o 25* 50* 325 04 Roll Angle Deg/180 ± 180 o 14 0.01 o 25* 50* 325 05 Roll Angle

Deg/180 ± 180 o 14 0.01 o 25* 50* 360 04 Potential Vertical Speed Ft/min 16384* 10* 16* 25 50 360 05 Potential Vertical Speed Ft/min 16384* 10* 16* 25 50 361 04 Altitude (Inertial) Feet 131,072 18* 0.5* 32.25* 62.5* 361 05 Altitude (Inertial) Feet 131,072 18 0.5 31.25* 62.5* 365 04 Inertial Vert. Vel. (EFI) Ft/min 16384* 10* 16* 20 40 365 05 Inertial Vert. Vel.
(EFI) Ft/min 16384* 10* 16* 20 40 375 05 Along Heading Accel. g 4 12 0.001 25* 50* 376 05 Cross Heading Accel. g 4 12 0.001 25* 50* Note [2]: Guidance added for transmission intervals of labels with multiple SDI codes. ORIGINAL TEXT FOLLOWS: [2] Transmit intervals and the number of parameters to be transmitted are prime factors in bus loading. The interval for transmission of parameters should fall between the minimum and maximum specified intervals and nominally should be near the center of the range at equal intervals between transmissions.
When heavy bus loading dictates a shift from the center of the range, the shift should be toward the maximum transmit interval.
TABLE 3.1: INTERVAL DISCRETES – LABEL 270 Discrete word formats revised. SUPPLEMENT 5 TO ARINC SPECIFICATION 429 – Page 6 ORIGINAL TEXT FOLLOWS: Table 3.1: Inertial Discretes – Label 270 Notes: [1] Attitude invalid is equivalent to IRS failure. [2] Bit 14 “1” condition indicates that the “Magnetic Heading” outputs are no longer being computer and have the characteristics of a “free DG” which is subject to control by a “Set Heading” input to the IRU. (See Section 3.2.4 for further explanation). SUPPLEMENT 5 TO ARINC SPECIFICATION 429 – Page 7 TABLE 3.4: AIR DATA DISCRETES Discrete word #1 format changed. Discrete word #2 added. ORIGINAL TEXT FOLLOWS: Table 3.4: Air Data Discretes – Label 270 ATTACHMENT 6 – GENERAL WORD FORMATS AND ENCODING EXAMPLES Examples revised to agree with adopted data standards changes. (editorial) AERONAUTICAL RADIO, INC. 2551 Riva Road Annapolis, Maryland 21401 – 7645 USA SUPPLEMENT 6 TO ARINC SPECIFICATION 429 MARK 33 DIGITAL INFORMATION TRANSFER SYSTEM (DITS) Published: January 22, 1982 Prepared by the Airlines Electronic Engineering Committee Adopted by the Airlines Electronic Engineering Committee: December 9, 1981 SUPPLEMENT 6 TO ARINC SPECIFICATION 429 – Page 2 A. PURPOSE OF THIS SUPPLEMENT This Supplement introduces the assignment of octal labels and hexadecimal equipment identifiers, the addition of guidance for label selection, a revision of failure warning annunciation in discrete words, deletion of the weight & balance words, editorial revisions to the label tables and addition of EEC discrete word formats. B.
ORGANIZATION OF THIS SUPPLEMENT The first part of this document, printed on goldenrod paper, contains descriptions of the changes introduced into the Specification by this Supplement, and, where appropriate, extracts from the original text for comparison purposes.
The second part consists of replacement white pages for the Specification, modified to reflect these changes. The modified and added material on each replacement page is identified with “c-6” symbols in the margins. Existing copies of Specification 429 may be updated by simply inserting the replacement white pages they replace. The goldenrod pages should be inserted inside the rear cover of the Specification. Copies of the Specification bearing the number 429-6 already contain this Supplement and thus do not require revisions by the reader. C. CHANGES TO SPECIFICATION 429 INTRODUCED BY THIS SUPPLEMENT This section presents a complete tabulation of the changes and additions to the Specification introduced by this Supplement.
Each change or addition is entitled by the section number and title currently employed in the Specification, or by the section number and title that will be employed when the Supplement is eventually incorporated.
In each case there is included a brief description of the addition or change and, for other than very minor revisions, any text originally contained in the Specification is reproduced for reference. 2.1.5.1 BCD, NUMERIC, DISCRETE, AIM DATA AND FILE TRANSFER WORDS Commentary revised to reflect use of failure warning flags in discrete words. ORIGINAL TEXT FOLLOWS: COMMENTARY Definitions Invalid Data – is defined as any data generated by a source system whose fundamental characteristic is the inability to convey reliable information for the proper performance of a user system. There are two categories of invalid data namely, “No Computed Data” and “Failure Warning”. No Computes Data – is a particular case of data invalidity where the source system is unable to compute reliable data for reasons other than system failure. This inability to compute reliable data is caused exclusively be a definite set of events or conditions whose boundaries are uniquely defined in the system characteristic. When such a condition exists, the source system should annunciate its outputs to be invalid by setting the sign/status matrix of the affected words to the “NCD” code, as defined in sections2.1.5.1 and 2.1.5.2. The system indicators may or may not be flagged depending on system requirements. Failure Warning – is a particular case of data invalidity where the system monitors have detected one or more failures. These failures are uniquely characterized by boundaries defined in the system characteristic. When such a condition exists, the source system should annunciate its outputs to be invalid by either ceasing to supply the affected words to the data bus (the case of BCD data and ILS-LRRA installations with provisions for the interruption of AFS BNR data – see ARINC characteristics 707 and 710) or by setting the sign/status matrix of the affected words to the “Failure Warning” code (BNR case), as defined in sections 2.1.5.1 and 2.1.5.2. The system indicators should always be flagged during a “Failure Warning” condition. 2.1.5.2 BNR NUMERIC DATA WORDS Commentary for failure warning revised. ORIGINAL TEXT FOLLOWS: COMMENTARY Definitions Invalid Data – is defined as any data generated by a source system whose fundamental characteristic is the inability to convey reliable information for the proper performance of a user system. There are two categories of invalid data, namely, “No Computed Data” and “Failure Warning”. No Computed Data – is a particular case of data invalidity where the source system is unable to compute reliable data for reasons other than system failure. This inability to compute reliable data is caused exclusively by a definite set of events or conditions whose boundaries are uniquely defined in the system characteristic. When such a condition exists the source system should annunciate its outputs to be invalid by setting the sign/status matrix of the affected words to the “NCD” code, as defined in sections 2.1.5.1 and 2.1.5.2. The system indicators may or may not be flagged depending on system requirements. Failure Warning – is a particular case of data invalidity where the system monitors have detected one or more failures. These failures are uniquely characterized by boundaries defined in the system characteristic. When such a condition exists, the source system should annunciate its outputs to be invalid by either ceasing to supply the affected words to the data bus (the case of BCD data and ILS-LRRA Installations with provisions for the interruption of AFS BNR data – see ARINC Characteristics 707 and 710) or by setting the SUPPLEMENT 6 TO ARINC SPECIFICATION 429 – Page 3 sign/status matrix of the affected words to the “Failure Warning” code (BNR case), as defined in sections 2.1.5.1 and 2.1.5.2. The system indicators should always be flagged during a“Failure Warning” conditions. Fig. 3.1 RADIO SYSTEMS MANAGEMENT WORD FORMATS Assignments for bits 12, 15 and 17 removed from table for note 1 of ATC transponder word (editorial).
ATTACHMENT 1: LABEL CODES The following labels have been given new assignments: 021 02, 041 02, 042 02, 043 02, 066 02, 071 33, 072 2F, 072 33, 074 33, 075 02, 077 02, 114 2F, 115 2F, 130 2F, 131 2F, 132 33, 133 2F, 155 33, 156 33, 157 33, 160 33, 161 33, 241 2C, 244 33, 250 2B, 252 2F, 260 33, 261 33, 262 02, 262 33, 263 33, 264 2F, 264 33, 265 33, 267 0A, 267 33, 270 2F, 270 3A, 271 2F, 271 3A, 273 2F, 272 2F, 273 33, 274 2F, 274 33, 275 2F, 315 02, 340 2F, 341 2F, 342 2F, 344 2F, 344 33, 345 2F, 346 2F, 350 2F, 351 2E, 351 2F, 352 2E, 352 2F, 353 2F, 354 2F, 375 33, 376 33. The following labels have been deleted: 060 32, 061 32, 062 32, 063 32, 064 32. Editorial changes were made to provide for consistency between Attachment 1 and Attachment 2.
“Predictive” deleted from 207 0A.
ATTACHMENT 1: EQUIPMENT CODES New assignments were made for 0D, 2E, 2F, 3A, 3B, 33, and 34. Nomenclature modified for 2C and 32.
ATTACHMENT 2: DATA STANDARDS Data standards were added for new labels. Editorial changes made. Resolutions revised for 315 04, 315 05, 316 04, 321 04, 321 05, 322 04, 334 04, and 334 05 to match ARINC 704 and 705. EEC discrete words added. ATTACHMENT 6: GENERAL WORD FORMATS AND CODING EXAMPLES Format added for label 262 02. Bit 12 corrected in DME distance word (editorial). Example added for GMT binary word. APPENDIX 5: LABEL SELECTION GUIDANCE Appendix added. AERONAUTICAL RADIO, INC. 2551 Riva Road Annapolis, Maryland 21401 7645 USA SUPPLEMENT 7 TO ARINC SPECIFICATION 429 MARK 33 DIGITAL INFORMATION TRANSFER SYSTEM (DITS) Published: January 3, 1983 Prepared by the Airlines Electronic Engineering Committee Adopted by the Airlines Electronic Engineering Committee: November 4, 1982 SUPPLEMENT 7 TO ARINC SPECIFICATION 429 – Page 2 A. PURPOSE OF THIS SUPPLEMENT This Supplement introduces new label assignments, data standards and equipment identification codes, and means for transmitting data with reduced accuracy. B. ORGANIZATION OF THIS SUPPLEMENT The first part of this document, printed on goldenrod paper, contains descriptions of the changes introduced into the Specification by this Supplement, and, where appropriate, extracts from the original text for comparison purposes. The second part consists of replacement white pages for the Specification, modified to reflect these changes. The modified and added material on each replacement page is identified with “c-7” symbols in the margins. Existing copies of Specification 429 may be updated by simply inserting the replacement white pages they replace. The goldenrod pages should be inserted inside the rear cover of the Specification. Copies of the Specification bearing the number 429-7 already contain this Supplement and thus do not require revisions by the reader.
C. CHANGES TO SPECIFICATION 429 INTRODUCED BY THIS SUPPLEMENT This section presents a complete tabulation of the changes and additions to the Specification introduced by this Supplement.
Each change or addition is entitled by the section number and title currently employed in the Specification, or by the section number and title that will be employed when the Supplement is eventually incorporated. In each case there is included and, for other than very minor revisions, any text originally contained in the Specification is reproduced for reference. 2.1.5.1 BCD, NUMERIC, DISCRETE, AIM DATA AND FILE TRANSFER WORDS Note [6] added. 2.1.5.2 BNR NUMERIC DATA WORDS Note [6] added. ATTACHMENT 1 – LABEL CODES The following labels have been given new assignments: 046 33, 047 33, 114 3F, 115 3F, 127 33, 130 30, 130 3F, 131 30, 131 33, 132 30, 133 3F, 164 3B, 173 3B, 174 3B, 175 33, 212 3B, 242 3B, 244 3B, 245 3B, 246 3B, 247 3B, 252 3F, 264 3F, 270 30, 270 33, 270 3B, 270 3F, 271 30, 271 33, 271 3B, 271 3F, 272 3B, 272 3F, 273 3B, 273 3F, 274 3B, 274 3F, 275 3B, 275 3F, 311 3B, 214 3B, 325 2F, 325 3F, 340 33, 340 3F, 341 3F, 342 3B, 342 3F, 344 3F, 345 3F, 346 33, 346 3F, 347 30, 350 3F, 351 3F, 352 3F, 353 3F, 354 3F, 377 30. The terminology has been modified for the following labels: 072 33, 074 33, 132 33, 244 33, 262 33, 263 33, 264 33, 265 33. Station identifiers deleted on engine related parameters. ATTACHMENT 1 – EQUIPMENT CODES Code 2F changed from “EEC (Full Authority)” to “Full Authority EEC-A”. Code 30 assigned as “Airborne Separation Assurance System”. Description of Code OD changed to “AIDS Data Management Unit (DMU)” Code 3F assigned as “Full Authority EEC_B”. ATTACHMENT 2 – DATA STANDARDS Data standards were added for new labels. Data standards added for the following existing labels: 270 3A, 271 3A, 270 2F-275 2F, 350 2F,-354 2F. Note added to label 072 33. Digits of label 014 changed from 3 to 4 (previously adopted). Range of label 014 changed from 359 to 359.9 (previously adopted). Significant bits of label 321 changed from 12 to 11 (typo). Note [4] added. Note [5] added. Note flag [5] added to following labels: 074 2C, 075 2C, 247 2C 250 2C, 256 2C, 257 2C, 260 2C, 262 2C. ATTACHMENT 6 – GENERAL WORD FORMATS AND ENCODING EXAMPLES Formats for engine serial number words added. Formats for ASAS words added. AERONAUTICAL RADIO, INC. 2551 Riva Road Annapolis, Maryland 21401 – 7645 USA SUPPLEMENT 8 TO ARINC SPECIFICATION 429 MARK 33 DIGITAL INFORMATION TRANSFER SYSTEM (DITS) Published: December 3, 1984 Prepared by the Airlines Electronic Engineering Committee Adopted by the Airlines Electronic Engineering Committee: November 4, 1983 SUPPLEMENT 8 TO ARINC SPECIFICATION 429 – Page 2 A.
PURPOSE OF THIS SUPPLEMENT This Supplement introduces new label assignments, revised data standards, expanded text describing SDI codes and makes note of a change in the resolution of the Magnetic Heading label incorporated in Supplement 7. B. ORGANIZATION OF THIS SUPPLEMENT The first part of this document, printed on goldenrod paper, contains descriptions of the changes introduced into the Specification by this Supplement, and, where appropriate, extracts from the original text for comparison purposes. The second part consists of replacement white pages for the Specification, modified to reflect these changes. The modified and added material on each replacement page is identified with “c-8” symbols in the margins. Existing copies of Specification 429 may be updated by simply inserting the replacement white pages they replace. The goldenrod pages should be inserted inside the rear cover of the Specification. Copies of the Specification bearing the number 429-8 already contain this Supplement and thus do not require revisions by the reader. C. CHANGES TO SPECIFICATION 429 INTRODUCED BY THIS SUPPLEMENT This section presents a complete tabulation of the changes and additions to the Specification introduced by this Supplement. Each change or addition is entitled by the section number and title currently employed in the Specification, or by the section number and title that will be employed when the Supplement is eventually incorporated.
In each case there is included a brief description of the addition or change and, for other than very minor revisions, any text originally contained in the Specification is reproduced for reference. 2.1.4 SOURCE DESTINATION IDENTIFIER Text added to clarify use of SDI on combined source/sink equipment. ORIGINAL TEXT FOLLOWS: 2.1.4 Source/Destination Identifier Bit nos. 9 and 10 of numeric data words should be reserved for a data source/destination identification function. They are not available for this function in alpha/numeric (ISO Alphabet No. 5) data words (See Section 2.3.1.3 of this document) or when the resolution needed for numeric (BNR/BCD) data necessitates their use for valid data. The source/destination identifier function may find application when specific words need to be directed to a specific system of a multi-system installation or when the source system of a multi-system installation needs to be recognizable from the word content. When it is used, a source equipment should encode its aircraft installation number in bit nos. 9 and 10 as shown in the table below. A sink equipment should recognize words containing its own installation number code and words containing code “00”, the “all-call” code.
Bit No. 10 9 Installation No. 0 0 See Note Below 0 1 1 1 0 2 1 1 3 Note: In certain specialized application of the SDI function the all-call capability may be forfeited so that code “00” is available as an “installation no. 4” identifier. When the SDI function is not used, binary zeros or valid data should be transmitted in bit nos. 9 and 10. COMMENTARY This document does not address the practical question of how the SDI bits will be set in those multi-installation systems in which the source/destination function is desired. One way would be to use program pins on the individual installation black boxes which would be wired to set up the appropriate code. The ARINC Characteristics devoted to the individual systems will define the method actually to be used. ATTACHMENT 1 – LABEL CODES The following labels have been given new assignments: 012 25, 060 3C, 061 3C, 062 3C, 063 3C, 064 3C, 137 2F, 137 3F, 140 25, 141 25, 142 25, 151 27, 152 27, 153 27, 154 27, 155 27, 156 27, 157 27, 160 27, 161 27, 162 27, 163 27, 164 25, 164 27, 165 27, 170 C5, 173 25, 270 25, 271 C5, 272 C5, 273 C5, 274 25, 275 25, 313 25, 314 25, 317 25, 320 25, 324 25, 325 25, 330 2F, 330 3F, 331 2F, 332 2F, 332 3F, 333 3F, 334 2F, 334 3F, 350 25, 351 25, 352 25, 353 25, 370 C5. ATTACHMENT 1 - EQUIPMENT CODES Code 3C assigned to Tire Pressure System. ATTACHMENT 2 – DATA STANDARDS Table 1 had been modified in Supplement 7 to reflect the resolution of label 014 as 0.1, rather than 1.0, which had been incorrectly introduced in a previous Supplement. This change is hereby noted. Data standards added for new labels.
Data standards revised for labels 115 2F, 115 3F, 325 2F, 325 3F. ATTACHMENT 6 – GENERAL WORD FORMATS Tire pressure SDI bit coding added. AERONAUTICAL RADIO, INC. 2551 Riva Road Annapolis, Maryland 21401 – 7645 USA SUPPLEMENT 9 TO ARINC SPECIFICATION 429 MARK 33 DIGITAL INFORMATION TRANSFER SYSTEM (DITS) Published: April 30, 1985 Prepared by the Airlines Electronic Engineering Committee Adopted by the Airlines Electronic Engineering Committee: October 11, 1984 SUPPLEMENT 9 TO ARINC SPECIFICATION 429 - Page 2 A. PURPOSE OF THIS SUPPLEMENT This Supplement introduces new label assignments and equipment identification codes. This Supplement also corrects a word format bit error introduced in a previous Supplement. B. ORGANIZATION OF THIS SUPPLEMENT The first part of this document, printed on goldenrod paper, contains descriptions of the changes introduced into the Specification by this Supplement, and, where appropriate, extracts from the original text for comparison purposes. The second part consists of replacement white pages for the Specification, modified to reflect these changes. The modified and added material on each replacement page is identified with “c-9” symbols in the margins. Existing copies of Specification 429 may be updated by simply inserting the replacement white pages they replace.
The goldenrod pages should be inserted inside the rear cover of the Specification. Copies of the Specification bearing the number 429-9 already contain this Supplement and thus do not require revisions by the reader. C. CHANGES TO SPECIFICATION 429 INTRODUCED BY THIS SUPPLEMENT This section presents a complete tabulation of the changes and additions to the Specification introduced by this Supplement. Each change or addition is entitled by the section number and title that will be employed when the Supplement is eventually incorporated. In each case there is included a brief description of the addition or change and, for other than very minor revisions, any text originally contained in the Specification is reproduced for reference. ATTACHMENT 1 – LABEL CODES The following labels have been given new assignments: 075 3E, 076 3E, 103 1B, 104 1B, 105 1B, 106 1B, 107 1B, 130 35, 131 35, 132 35, 203 18, 270 1B, 270 35, 270 3E, 270 4A, 271 18, 271 35, 272 18, 272 35, 273 18, 273 35, 274 18, 274 35, 275 18, 275 4A, 276 18, 300 3D, 336 1A, 337 1A, 347 18, 347 35, 350 18, 350 35, 350 3E, 370 04, and 370 05. ATTACHMENT 1 – EQUIPMENT CODES Codes 3D, 3E, 4A, 4B, 4C and 90-9F given new assignments. ATTACHMENT 2 – DATA STANDARDS Data standards entered for new labels. Range for labels 012 and 170 changed to 7999. ATTACHMENT 6 – GENERAL WORD FORMATS AND ENCODING EXAMPLES Label 150 and 323 examples corrected. AERONAUTICAL RADIO, INC. 2551 Riva Road Annapolis, Maryland 21401 – 7645 USA SUPPLEMENT 10 TO ARINC SPECIFICATION 429 MARK 33 DIGITAL INFORMATION TRANSFER SYSTEM (DITS) Published: November 17, 1986 Prepared by the Airlines Electronic Engineering Committee Adopted by the Airlines Electronic Engineering Committee: November 7, 1985 SUPPLEMENT 10 TO ARINC SPECIFICATION 429 – Page 2 A PURPOSE OF THIS SUPPLEMENT This Supplement introduces new label assignments, equipment identification codes and revised data standards. B. ORGANIZATION OF THIS SUPPLEMENT The first part of this document, printed on goldenrod paper, contains descriptions of the changes introduced into the Specification by this Supplement, and, where appropriate, extracts from the original text for comparison purposes. The second part consists of replacement white pages for the Specification, modified to reflect these changes. The modified and added material on each replacement page is identified with “c-10” symbols in the margins. Existing copies of Specification 429 may be updated by simply inserting the replacement white pages they replace. The goldenrod pages should be inserted inside the rear cover of the Specification. Copies of the Specification bearing the number 429-10 already contain this Supplement and thus do not require revisions by the reader. C. CHANGES TO SPECIFICATION 429 INTRODUCED BY THIS SUPPLEMENT This section presents a complete tabulation of the changes and additions to the Specification introduced by this Supplement. Each change or addition is entitled by the section number and title that will be employed when the Supplement is eventually incorporated. In each case there is included a brief description of the addition or change and, for other than very minor revisions, any text originally contained in the Specification is reproduced for reference. 3.1.4 FREQUENCY RANGES AND SWITCHING FUNCTIONS Note 6 deleted on DME Frequency Word. Attachment 1 – Label Codes The following labels have been given new assignments: 072 02, 075 0B, 076 0B, 077 0B, 176 5A, 177 5A, 200 5A, 201 5A, 202 5A, 203 5A, 204 5A, 205 5A, 206 18, 213 8D, 227 7E, 241 4D, 242 09, 242 10, 242 11, 242 12, 244 8D, 247 4D, 251 1A, 255 2F, 255 3F, 256 4D, 270 0B, 272 3A, 272 5A, 273 5A, 274 5A, 275 5A, 276 2F, 276 3F, 335 2F, 336 2F, 336 3F, 356 XX, 371 00. Labels for ARINC Characteristic 737 WBT and ARINC Characteristic 738 ADIRS added. Attachment 1 – Equipment Codes The following codes have been given new assignments: 0B, 35, 36, 37, 38, 4D, 4E, 5A, 5B, 5C, 5D, 5E, 5F, 6A, 6B, 6C, 6D, 6E, 6F, 7A, 7B, 7C, 7D, 7E, 7F, 8A, 8B, 8C, 8D, AD, C3. Attachment 2 – Data Standards Data standards entered for new labels. Data standards revised for the following labels: 060 36, 061 3C, 062 3C, 063 3C, 064 3C, 150 31, 176 03, 176 29, 270 3A, 270 2F, 270 3F, 271 2F, 271 3F, 272 2F, 272 3F, 273 2F, 273 3F, 274 2F, 274 3F, 275 2F, 275 3F, 350 2F, 350 3F, 351 2F, 351 3F, 352 2F, 352 3F, 353 2F, 353 3F, 354 2F, 354 3F.
Labels 060 37-064 3C significant bits changed from 9 to 10 and range changed from 512 to 1024. Following note added to words (labels 270 3B-275 3B): Typical discrete functions are shown in the above tables. Slight variations of bit usage may arise according to the specific application. Label 203 35 changed to 203 18 (typographical error). Transmit interval range added to label 150 31.
Labels 176 03 and 176 29 resolutions changed from 0.05 to 0.5 (typographical error). Original bit assignments for remaining labels listed in following pages. Attachment 6 – General Word Formats and Encoding Examples Example added for label 251 1A, 077 0B and 206 18. For TPIS word formats: Wheel #519 label corrected to read “060”. SDI labels clarified. For BTMS word formats: Wheel #10, #11, #12 labels corrected to read “116”.
Bit 27 assigned to a value of “1024”. SDI labels clarified. Special expanded format word example added for label 260 31. Attachment 9A – General Aviation Labels and Data Standards New attachment added. Attachment 9B – General Aviation Word Examples New attachment added. Attachment 9C – General Aviation Equipment Identifiers New attachment added. SUPPLEMENT 10 TO ARINC SPECIFICATION 429 – Page 3 Table 3.11 Propulsion Discrete Interface Unit – Labels 270 3A and 271 3A Label 270 3A Bit Status Bit No. Function 1 0 Notes 1 X 2 X 3 X 4 Label X 5 X 6 X 7 X 8 X 9 10 SDI 1 0 Left Engine Right Engine SDI 0 1 11 PDIU Status Flag Failed OK 12 T2 / P2 Probe Heat HEAT OFF HEAT ON 13 TLA Interlock Fault FAULT OK 1 14 Idle Select MINIMUM APPROACH 15 Air/Ground Switch GROUND AIR 16 Opposite Engine Status SHUT DOWN RUNNING 17 Spare X 2 18 Spare X 19 N2 Mode Trim Release (PROV) RELEASED FIXED 1 20 Spare X 21 Spare X 22 Spare X 23 Maintenance Test (Provisional) ON OFF 1 24 Ground Test Power ON OFF 25 Spare X 26 T/R Indication Power Failed (PROV) FAILED OK 1 27 T/R Not Stowed NOT STOWED STOWED 1 28 T/R Deployed Indication DEPLOYED NOT DEPLOYED 1 29 Engine Fire Warning ON OFF 1 30 SSM 31 SSM 32 Parity (Odd) 1 = RETURN TO SPARE 2 = CHANGE SPARE TO DEFINITION ON NEXT PAGE
SUPPLEMENT 10 TO ARINC SPECIFICATION 429 – Page 4 Table 3.12 EEC Status – Labels 270 2F, 270 3F, 271 2F, 271 3F, 272 2F, 272 3F, 273 2F, 273 3F, 274 2F, 274 3F, 275 2F, 275 3F Label 270 2F Bit Status Bit No. Function 1 0 Notes 1 X 2 X 3 X 4 Label X 5 X 6 X 7 X 8 X 9 SDI 10 SDI 11 PAD X 12 PAD X 13 PAD X 14 Spare X 2 15 Data Entry Plug Failed Normal 1 16 Auto Mode Selected Not Selected 3 17 Channel Manually Selected Selected Not Selected 3 18 N2 Droop Control Mode Engaged Not Engaged 19 Reverser System Failed Failed OK 20 Channel Controlling Status Controlling Not Controlling 21 Bleed Fall-Safe Open Fall-Safe Operational 3 22 TCA Valve Failed Closed Failed OK 23 Spare X 2 24 Overspeed Self-Test Failed Failed OK 3 25 Channel Incapable (Failed) Incapable Capable 26 Abnormal Start Abnormal OK (Provision) 3 27 SVA Fall-Safe Fall-Safe 3 28 Starter Cutout Command Cutout Not Cutout 29 Oil Overtemperature Overtemp OK 1 30 SSM 31 SSM 32 Parity (Odd) 1 = RETURN TO SPARE 2 = CHANGE SPARE TO DEFINITION ON NEXT PAGE 3 = CHANGE DEFINITION TO DEFINITION ON NEXT PAGE
SUPPLEMENT 10 TO ARINC SPECIFICATION 429 – Page 5 Label 270 3F Bit Status Bit No. Function 1 0 Notes 1 X 2 X 3 X 4 Label X 5 X 6 X 7 X 8 X 9 SDI 10 SDI 11 PAD X 12 PAD X 13 PAD X 14 Spare X 2 15 Data Entry Plug Failed Normal 1 16 Auto Mode Selected Not Selected 3 17 Channel Manually Selected Selected Not Selected 3 18 N2 Droop Control Mode Engaged Not Engaged 19 Reverser System Failed Failed OK 20 Channel Controlling Status Controlling Not Controlling 21 Bleed Fall-Safe Open Fall-Safe Operational 3 22 TCA Valve Failed Closed Failed OK 23 Spare X 2 24 Overspeed Self-Test Failed Failed OK 3 25 Channel Incapable (Failed) Incapable Capable 26 Abnormal Start Abnormal OK (Provision) 3 27 SVA Fall-Safe Fall-Safe 3 28 Starter Cutout Command Cutout Not Cutout 29 Oil Overtemperature Overtemp OK 1 30 SSM 31 SSM 32 Parity (Odd) SUPPLEMENT 10 TO ARINC SPECIFICATION 429 – Page 6 Label 271 2F Bit Status Bit No. Function 1 0 Notes 1 X 2 X 3 X 4 Label X 5 X 6 X 7 X 8 X 9 SDI 10 SDI 11 PAD X 12 PAD X 13 PAD X 14 Reverser Deploy Command ON OFF 15 Turbine Cooling Air Valve Solenoid ON OFF 16 Oil Cooler Bypass Valve Solenoid ON OFF 3 17 Cowl Vent Solenoid ON OFF 1 18 Breather Compartment Ejector Sol. ON OFF 1 19 Spare X 2 20 Spare X 21 Spare X 22 Spare X 23 Autostar Relay ON OFF (Provision) 1 24 TLA Interlock Actuator Command Block Fwd Block Rev 25 Spare Reverser Group Relay ON OFF (Provision) 1 26 Spare X 2 27 Spare X 2 28 Spare X 2 29 Spare X 2 30 SSM 31 SSM 32 Parity (Odd) SUPPLEMENT 10 TO ARINC SPECIFICATION 429 – Page 7 Label 271 3F Bit Status Bit No. Function 1 0 Notes 1 X 2 X 3 X 4 Label X 5 X 6 X 7 X 8 X 9 SDI 10 SDI 11 PAD X 12 PAD X 13 PAD X 14 Reverser Deploy Command ON OFF 15 Turbine Cooling Air Valve Solenoid ON OFF 16 Oil Cooler Bypass Valve Solenoid ON OFF 3 17 Cowl Vent Solenoid ON OFF 1 18 Breather Compartment Ejector Sol. ON OFF 1 19 Spare X 2 20 Spare X 21 Spare X 22 Spare X 23 Autostar Relay ON OFF (Provision) 1 24 TLA Interlock Actuator Command Block Fwd Block Rev 25 Spare Reverser Group Relay ON OFF (Provision) 1 26 Spare X 2 27 Spare X 2 28 Spare X 2 29 Spare X 2 30 SSM 31 SSM 32 Parity (Odd) SUPPLEMENT 10 TO ARINC SPECIFICATION 429 – Page 8 Label 272 2F Bit Status Bit No. Function 1 0 Notes 1 X 2 X 3 X 4 Label X 5 X 6 X 7 X 8 X 9 SDI 10 SDI 11 PAD X 12 PAD X 13 PAD X 14 N1 Loop Engaged Not Engaged 15 N2 Loop Engaged Not Engaged 16 N2 Topping Loop Engaged Not Engaged 17 PB Topping Loop Engaged Not Engaged 18 PB Topping Loop Minimum Engaged Not Engaged 19 EPR Loop Engaged Not Engaged 20 Acceleration Schedule Loop Engaged Not Engaged 21 Deceleration Schedule Loop Engaged Not Engaged 22 T4.9 Topping Loop Engaged Not Engaged 1 23 Back Up Mode Engaged Not Engaged 24 Spare X 2 25 Spare X 26 Spare X 27 Spare X 28 Spare X 29 Spare X 30 SSM 31 SSM 32 Parity (Odd) SUPPLEMENT 10 TO ARINC SPECIFICATION 429 – Page 9 Label 272 3F Bit Status Bit No. Function 1 0 Notes 1 X 2 X 3 X 4 Label X 5 X 6 X 7 X 8 X 9 SDI 10 SDI 11 PAD X 12 PAD X 13 PAD X 14 N1 Loop Engaged Not Engaged 15 N2 Loop Engaged Not Engaged 16 N2 Topping Loop Engaged Not Engaged 17 PB Topping Loop Engaged Not Engaged 18 PB Topping Loop Minimum Engaged Not Engaged 19 EPR Loop Engaged Not Engaged 20 Acceleration Schedule Loop Engaged Not Engaged 21 Deceleration Schedule Loop Engaged Not Engaged 22 T4.9 Topping Loop Engaged Not Engaged 1 23 Back Up Mode Engaged Not Engaged 24 Spare X 2 25 Spare X 26 Spare X 27 Spare X 28 Spare X 29 Spare X 30 SSM 31 SSM 32 Parity (Odd) SUPPLEMENT 10 TO ARINC SPECIFICATION 429 – Page 10 Label 273 2F Bit Status Bit No. Function 1 0 Notes 1 X 2 X 3 X 4 Label X 5 X 6 X 7 X 8 X 9 SDI 10 SDI 11 PAD X 12 PAD X 13 PAD X 14 P4.9 Interface Failed Failed OK 3 15 PB Interface Failed Failed OK 3 16 P2 (Pamb) Interface Failed* Failed OK 3 17 C3C Interface Failed Failed OK 3 18 T2 Interface Failed Failed OK 3 19 T4.9 Interface Failed Failed OK 3 20 Tfuel Interface Failed Failed OK 3 21 A/D Interface Failed Failed OK 3 22 RES/LVDT Interface Failed Failed OK 3 23 SVA Interface Failed Failed OK 3 24 N1 Interface Failed Failed OK 3 25 N2 Interface Failed Failed OK 3 26 P4.9 Sensor Prom Failed Failed OK 3 27 P2 (Pamb) Sensor Prom Failed* Failed OK 3 28 PB Sensor Prom Failed Failed OK 3 29 Background is not Executing Not Executing Executing 3 30 SSM 31 SSM 32 Parity (Odd) * Primary channel uses P2, Secondary channel uses Pamb. SUPPLEMENT 10 TO ARINC SPECIFICATION 429 – Page 11 Label 273 3F Bit Status Bit No. Function 1 0 Notes 1 X 2 X 3 X 4 Label X 5 X 6 X 7 X 8 X 9 SDI 10 SDI 11 PAD X 12 PAD X 13 PAD X 14 P4.9 Interface Failed Failed OK 3 15 PB Interface Failed Failed OK 3 16 P2 (Pamb) Interface Failed* Failed OK 3 17 C3C Interface Failed Failed OK 3 18 T2 Interface Failed Failed OK 3 19 T4.9 Interface Failed Failed OK 3 20 Tfuel Interface Failed Failed OK 3 21 A/D Interface Failed Failed OK 3 22 RES/LVDT Interface Failed Failed OK 3 23 SVA Interface Failed Failed OK 3 24 N1 Interface Failed Failed OK 3 25 N2 Interface Failed Failed OK 3 26 P4.9 Sensor Prom Failed Failed OK 3 27 P2 (Pamb) Sensor Prom Failed* Failed OK 3 28 PB Sensor Prom Failed Failed OK 3 29 Background is not Executing Not Executing Executing 3 30 SSM 31 SSM 32 Parity (Odd) * Primary channel uses P2, Secondary channel uses Pamb. SUPPLEMENT 10 TO ARINC SPECIFICATION 429 – Page 12 Label 274 2F Bit Status Bit No. Function 1 0 Notes 1 X 2 X 3 X 4 Label X 5 X 6 X 7 X 8 X 9 SDI 10 SDI 11 PAD X 12 PAD X 13 PAD X 14 Parity Test Hardware Fault Error OK 3 15 ROM Checksum Failure Failed OK 3 16 Ram Test Failure Failed OK 3 17 Instruction Test Failure Failed OK 3 18 High Speed Cross Link Failure Failed OK 3 19 Foreground Software Execution Incorrectly Correctly 20 Watch Dog Timer Fault Error OK 3 21 Watch Dog/Parity Counter Latch Latched Not Latched 1 22 EAROM Failure Failed OK 3 23 ROM Parity Error Caused Reset Yes No 24 RAM Parity Error Caused Reset Yes No 25 Watchdog Timer Error Caused Reset Yes No 26 Status Buffer or Watchdog/Parity Failed OK 3 27 Loss of Clock Caused Reset Yes No 28 SDD Output #1 W/A Failed OK 29 SDD Output #2 W/A Failed OK 30 SSM 31 SSM 32 Parity (Odd) SUPPLEMENT 10 TO ARINC SPECIFICATION 429 – Page 13 Label 274 3F Bit Status Bit No. Function 1 0 Notes 1 X 2 X 3 X 4 Label X 5 X 6 X 7 X 8 X 9 SDI 10 SDI 11 PAD X 12 PAD X 13 PAD X 14 Parity Test Hardware Fault Error OK 3 15 ROM Checksum Failure Failed OK 3 16 Ram Test Failure Failed OK 3 17 Instruction Test Failure Failed OK 3 18 High Speed Cross Link Failure Failed OK 3 19 Foreground Software Execution Incorrectly Correctly 20 Watch Dog Timer Fault Error OK 3 21 Watch Dog/Parity Counter Latch Latched Not Latched 1 22 EAROM Failure Failed OK 3 23 ROM Parity Error Caused Reset Yes No 24 RAM Parity Error Caused Reset Yes No 25 Watchdog Timer Error Caused Reset Yes No 26 Status Buffer or Watchdog/Parity Failed OK 3 27 Loss of Clock Caused Reset Yes No 28 SDD Output #1 W/A Failed OK 29 SDD Output #2 W/A Failed OK 30 SSM 31 SSM 32 Parity (Odd) SUPPLEMENT 10 TO ARINC SPECIFICATION 429 – Page 14 Label 275 2F Bit Status Bit No. Function 1 0 Notes 1 X 2 X 3 X 4 Label X 5 X 6 X 7 X 8 X 9 SDI 10 SDI 11 PAD X 12 PAD X 13 PAD X 14 Lamp (1,2 &/or 3) W/A Failed Failed OK 3 15 Other Channels Depower Discrete Disagree Agree 16 PB Sensor Failed Failed OK 3 17 PT4.9 Sensor Failed Failed OK 3 18 PT2 (Pamb)* Sensor Failed Failed OK 3 19 EEC Temperature Status High OK 3 20 2 21 2 22 2 23 2 24 2 25 Spare (all “o” states) 2 26 2 27 2 28 2 29 30 SSM 31 SSM 32 Parity (Odd) [3] Primary channel uses PT2, Secondary channel uses Pamb. SUPPLEMENT 10 TO ARINC SPECIFICATION 429 – Page 15 Label 275 3F Bit Status Bit No. Function 1 0 Notes 1 X 2 X 3 X 4 Label X 5 X 6 X 7 X 8 X 9 SDI 10 SDI 11 PAD X 12 PAD X 13 PAD X 14 Lamp (1,2 &/or 3) W/A Failed Failed OK 3 15 Other Channels Depower Discrete Disagree Agree 16 PB Sensor Failed Failed OK 3 17 PT4.9 Sensor Failed

the definition of bits 28-25 for protocol words and to specify the relevant addition for error conditions. 2.5.6.2 Destination Code This section was updated, and a commentary added, to clarify the role of the link layer protocol for upward compatibility with changing network functionality. The requirement for Destination code validation is not a link layer function. 2.5.6.3 Word Count This section was renumbered. 2.5.7 Request to Send (RTS) This section was previously titled "Response to TS", and has been renumbered. The title was changed for consistency, and an introductory paragraph added to clarify the basic RTS function. 2.5.7.1 Clear to Send (CTS) This section was renumbered. 2.5.7.2 Not Clear to Send (NCTS) This section was renumbered. 2.5.7.3 Destination Busy This section was renumbered, and an introductory replacement paragraph inserted to clarify the "optional" BUSY response, which may be used when a system cannot accept a transmission by the source in a "timely manner". New commentary equates a "timely manner" to the shorter retry sequence of the NCTS series. 2.5.7.4 No Response to RTS This section was renumbered, and the ALOHA word was included in the logic for error determination. 2.5.10 Start of Transmission (SOT) Timer T13 was added as a requirement on the source to begin transmission of an LDU within a specified interval after receipt of the CTS word from the sink. 2.5.10.1 General Format Identifier (GFI) This section was updated, and commentary added to clarify the role of the GFI in pre-OSI as well as OSI environments. Validation of the GFI code is required by a high level entity (network layer) in both environments to determine the format of the data words to follow. GFI validation is not necessarily a link layer function. AEEC STAFF NOTE: THESE CHANGES APPLY TO ARINC 429, PART 3 ONLY. SUPPLEMENT 14 TO ARINC SPECIFICATION 429 - Page 3 2.5.11 Data All references to Character Data words in this section were deleted. The Character Data Word format was removed from Supplement 14, as the format is incompatible with those for Full and Partial Data word formats. Currently, both binary and character data are transmitted in octets defined by the other two data word formats. The special character data format is not required. 2.5.12.1 CRC Encoding References to character data words were deleted. The text for equation: M(x) = x16G(x) + R(x) was corrected by moving the "bar" from G(x) to R(x). 2.5.13 Negative Acknowledgement (NAK) NAK word interpretation was changed to remove constraint on source for specific order of file sequence (i.e. Allows source to restart file with new FSN if necessary). 2.5.14.1 Duplicate LDU This first paragraph was rewritten to clarify. 2.5.14.3 Incomplete File Timer This section was added to allow the sink to discard a partial file of multiple LDUs when the T14 timeout between LDU transmissions is exceeded. It ensures that a source device cannot "lock-up" a sink. 2.5.15 SYN Word The LDU sequence anomalies which generate a SYN response by the sink were clarified. 2.5.16 Response to ACK/NAK/SYN The T16 timer was introduced to replace T10 and T8. Also, the action taken by the source upon receipt of a SYN word was updated, which relaxes requirements to make a specific File Sequence ordering by the source. 2.5.19 Protocol Initialization 2.5.19.1 Bit-Oriented Protocol Version, 2.5.19.2 ALOHA Response, and 2.5.19.3 Character-429 Determination This section has been added to replace and expand on the definition of the process to determine the link layer protocol version supported by an interfacing system. These sections replace three sections from Supplement 13. 2.3.1.5.1 Bit-Oriented Protocol Determination 2.5.19 ALO Response, and 2.5.20 Bit Protocol Verification 2.6 Windowed Bit-Oriented Protocol This is a completely new section which contains the system description of the new LLC(2)like bit-oriented link layer protocol (Version 2). It is based on Section 2.5, "Bit-Oriented Communications Protocol", with expanded text as specified to allow for more efficient use of the 429 high (or low) speed data bus through "windowing". The definition includes provision for a Link Control Word prior to each LDU. ATTACHMENT 1 – EQUIPMENT CODES New Equipment Code Identifiers were added. ATTACHEMENT 6 – WORD FORMATS AND ENCODING EXAMPLES Example added for label 171. ATTACHMENT 10 – VARIABLES OF BIT ORIENTED PROTOCOL Table 10-1 was updated to include a standard value for N7, the maximum number of LDUs in a window (see Section 2.6 "Windowed Bit-Oriented Protocol"). Table 10-3 deleted Option 6 (06) for NAK Send Time, and deleted Option 9 (09) for the Character Data Word, both of which are no longer used. Table 10-4 was revised to include columns for low speed maximum and minimum values. These values were established for timers and as response time design goals for incoming transmissions. Timers T13 through T16 were added. Table 10-5 was added to include a definition of high speed maximum and minimum values for timers and response time design goals. The format is the same as the revised Table 10-4. Timer T10 is not used in the high speed protocol. Table 10-6 was added to include notes to Tables 10-1 through 10-5. ATTACHMENT 11 - BIT-ORIENTED DATA FILE TRANSFER WORD FORMATS Table 11-1A was added "spares" for the deleted Character Data Formats and corrected "Protocol Data Word" to read "Protocol Word". Table 11-4 updated definitions for bits 9 through 24 of the ALO and ALR words, and added the LCW (LDU Control Word) format definition. Table 11-4A was added as a partial replacement for ATTACHMENT 11C and Table 11-4B was added to define the new window definitions for the Windowed Bit-Oriented protocol in Section 2.6. Table 11-6A was revised, changing the former GFI bit pattern (0001) for ISO 8208 to "unassigned". The bit pattern (0100) for ISO 8473 was changed to a more SUPPLEMENT 14 TO ARINC SPECIFICATION 429 - Page 4 ATTACHMENT 11 - BIT-ORIENTED DATA FILE TRANSFER WORD FORMATS (cont'd) generic ISO 9577 definition. The bit pattern 1110 (hex"E") is now defined as "ACARS VHF Format". The "NOTES" in ATTACHMENT 11 have been renumbered to correspond to the new table definitions. ATTACHMENT 11C – ALOHA/ALOHA RESPONSE PROTOCOL WORD DEFINITION This Attachment has been deleted. This information has been moved to Tables 11-4, 11-4A, and 11-4B. ATTACHMENT 13A – ALOHA VERSION DETERMINATION SEQUENCE This Attachment was added to support the ALOHA version determination sequence called out in Section 2.5.19.1. ATTACHMENT 14 – SYSTEM ADDRESS LABELS New System Address Labels were added. ATTACHMENT 16 – SEQUENCE OF PROTOCOL AND DATA WORDS IN WINDOW TRANSFER This Attachment was added to illustrate the window transfers for new Section 2.6. ATTACHMENT 17 – FLOW DIAGRAM USED TO DETERMINE CHARACTER-ORIENTED VS BIT-ORIENTED PROTOCOL This Attachment was added to illustrate the logic flow that determines whether a character-oriented or bit-oriented link layer protocol interface is to be used. AERONAUTICAL RADIO, INC. 2551 Riva Road Annapolis, Maryland 21401 - 7645 USA SUPPLEMENT 15 TO ARINC SPECIFICATION 429 MARK 33 DIGITAL INFORMATION TRANSFER SYSTEM (DITS) Published: September 1, 1995 Prepared by the Airlines Electronic Engineering Committee Adopted by the Airlines Electronic Engineering Committee: April 18, 1995 SUPPLEMENT 15 TO ARINC SPECIFICATION 429 - Page 2 A. PURPOSE OF THIS DOCUMENT This Supplement introduces new label assignments, equipment IDs, system address labels and updates to the 429W protocol. B. ORGANIZATION OF THIS SUPPLEMENT The first part of this document, printed on goldenrod paper contains descriptions of changes introduced into this Specification by this Supplement. The second part consists of replacement white pages for the Specification, modified to reflect the changes. The modified and added material on each page is identified by a c-15 in the margins. Existing copies of ARINC Specification 429 may be updated by simply inserting the replacement white pages where necessary and destroying the pages they replace. The goldenrod pages are inserted inside the rear cover of the Specification. C. CHANGES TO ARINC SPECIFICATION 429 INTRODUCED BY THIS SUPPLEMENT This section presents a complete tabulation of the changes and additions to the Specification introduced by this Supplement. Each change or addition is defined by the section number and the title currently employed in the Specification or by the section name and title that will be employed when the Supplement is eventually incorporated. In each case a brief description of the change or addition is included. 2.0 Digital Information Transfer System Standards Numerous changes were made to the protocol throughout this section. 2.1.5.3 Discrete Data Words The technique for encoding SSM bits in discrete words were revised. ORIGINAL TEXT FOLLOWS: 2.1.5.3 Discrete Data Words A source system should annunciate any detected failure that could cause one or more of the words normally output by that system to be unreliable. Three methods are defined. The first method is to set bit numbers 30 and 31 in the affected word(s) to the "Failure Warning" code defined in the table below. This is the preferred method. Words containing the "Failure Warning" code should continue to be supplied to the data bus during the failure condition. When using the second method, the equipment may stop transmitting the affected word or words on the data bus. The third method applies to data words which are defined such that they contain failure information within the data field. For these applications, the associated ARINC equipment characteristic to determine the proper SSM reporting. The "No Computed Data" code should be annunciated in the affected Discrete Data word(s) when a source system is unable to compute reliable data for reasons other than system failure. When the "Functional Test" code appears as a system output, it should be interpreted as advice that the data in the Discrete Data word contents are the result of the execution of a functional test.

DISCRETE DATA WORDS Bit Meaning 31 30 0 0 1 1 0 1 1 Verified Data, Normal Operation No Computed Data Functional Test Failure Warning 2.2.2 Modulation The following Commentary was added: "Avionics manufacturers are warned that bus activity monitoring should be implemented with caution. Crossed wiring (interchanging A and B) at one end of the bus, which will cause improper LRU/system operation, may not necessarily be detected by a "simple" bus activity monitor." 2.2.4.2 Receiver Input Impedance The word "parallel" was changed to "combination". Figure 3.1 Radio Systems Management Word Formats VHF Com Frequency Word - Bits 7,8,20,23 changed to "0" and bits 15,16,21,28 changed to "1". ATTACHMENT 1 - LABEL CODES This attachment was updated according to the tables on the following pages. Designated label 155 027 changed from BCD to BNR. The following new equipment codes were assigned: 03B, 053, 05A, 090, 0E0, 12C, 160, 19F, 13B ATTACHMENT 2 - DATA STANDARDS This attachment was updated according to the tables on the following pages. Newly assigned discrete word formats are included. In word 270 115, bit 12 was changed from "pad" to "Tune". AUTOTUNE was assigned for "1" and NO AUTOTUNE was assigned to "0". Word 155 027 moved from Table 1 to Table 2. In Table 2 "SIG DIG" was changed to "SIG BIT". In Table 2 under label 077, "0--" was changed to "037". Duplicate 244 089 word removed. SUPPLEMENT 15 TO ARINC SPECIFICATION 429 - Page 3 ATTACHMENT 6 - GENERAL WORD FORMATS AND ENCODING EXAMPLES Table 2 - examples for Flight Director Pitch and Total Air Temperature Corrected. Examples for the following labels added. Manufacturer Specific Data Word 010101 assigned to Garmin 010110 assigned to ARNAV Systems ATTACHMENT 8 - OUTPUT SIGNAL TIMING TOLERANCES Text for word 011010 was modified for label 150 to include reference to precision source. Word format for label 077 008 removed (from two places). ATTACHMENT 9B - GENERAL AVIATION WORD EXAMPLES Manufacturer Specific Data Word 010101 assigned to Garmin 010110 assigned to ARNAV Systems ATTACHMENT 10 - VARIABLES OF BIT ORIENTED PROTOCOL Revised Notes 1 and 4. Table 10-3 BIT-ORIENTED PROTOCOL OPTIONS - Added Option 02 Table 10-5 VARIABLES OF HIGH SPEED BIT-ORIENTED PROTOCOL - Revised Time T10 min and max values. ATTACHMENT 11 - BIT-ORIENTED DATA FILE TRANSFER WORD FORMATS Table 11-6A GENERAL FORMAT IDENTIFIER (GFI) - Revised "Reserved ISO 9577" to "ISO 9577" ATTACHMENT 11A - DESTINATION CODES Added Cabin Packet Data Function. Corrected Ground Station bit encoding. ATTACHMENT 11B - STATUS CODES Revised description of Code 86. Added entries for Code 88 through 95.

ATTACHMENT 14 - SYSTEM ADDRESS LABELS The following labels were added: 170 DFDAU (Mandatory Load Function) 266 Cabin Video System (Airshow) 334 Cabin Telecommunications Unit (CTU) 340 HF Data Radio/Data Unit #1 344 HF Data Radio/Data Unit #2 The following labels were revised: 175 HGA HPA 176 Spare 177 LGA HPA APPENDIX 8 - INTEROPERABILITY OF BIT- ORIENTED LINK LAYER PROTOCOL Appendix added. APPENDIX 9 - SDL DIAGRAMS OF THE WILLIAMSBURG PROTOCOL Appendix added. NE N A N D RE VI SE ED BN R L AB EL AS SIG NM EN TS LA BE L EQ ID P AR AM ET ER B INA RY UN ITS RA NG E SIG R ES OL M IN TI MA X TI NO TE S New 06 1 00 2 A CN S In form atio n See Att . 6 New 06 2 00 2 A CN S In form atio n See Att . 6 New 06 4 00 2 A CN S In form atio n See Att . 6 New 145 002 TA CA N C ontr ol See Sect 3.1 .4 18 02 0Se e A tt. 4 de 226 002 Min Op. Fue l Tem p in on-c ontl ictn ing n/ New 233 002 AC MS Info rmat ion See A tt. 6 New 234 002 AC MS Info rmat ion See A tt. 6 New 235 002 AC MS Info rmat ion See A tt. 6 New 236 002 AC MS Info rmat ion See A tt. 6 R evis e 2 6 5 00 2 Min Bu ffet Air sp ee d 6 17 Fl ight info rmat ion Se e A tt. 6 R evis e 36 0 00 2 Fl ight info rmat ion Se e A tt. 6 R evis e 37 0 00 4 Fu el fl ow d 0 00 S M agne tic H ead ing Deg New 137 0 00 S Rev ise 205 0Sh 0 91N A ach 40% 0 Re se rv ed for BCS New 20 Rev ise 0 OTS 64 0 Fu el Qua ntity Rev ise 2 0 SSM Pre M NT Vari abl E ing 64 New 0 04 Heig ht ft Sig Bit 14 ...

[illegible]

2551 Riva Road Annapolis, Maryland 21401 – 7645 USA SUPPLEMENT 16 TO ARINC SPECIFICATION 429 MARK 33 DIGITAL INFORMATION TRANSFER SYSTEM (DITS) Published: September 27, 2001 Prepared by the Airlines Electronic Engineering Committee Adopted by the Airlines Electronic Engineering Committee: November 14, 2000 SUPPLEMENT 16 TO ARINC SPECIFICATION 429 PART 1 - Page 2 A. PURPOSE OF THIS SUPPLEMENT This Supplement introduces new label assignments, equipment IDs, and System Address Labels (SAL) to ARINC Specification 429. B. ORGANIZATION OF THIS SUPPLEMENT The material in Supplement 16 is integrated into ARINC Specification 429 to form an updated version of the standard. Changes introduced by Supplement 16 are identified using change bars and are labeled by a "c-16" symbol in the margin. C. CHANGES TO ARINC SPECIFICATION 429 INTRODUCED BY THIS SUPPLEMENT This section presents a complete tabulation of the changes and additions to the Specification introduced by this Supplement. Each change or addition is defined by the section number and the title currently employed in the Specification or by the section name and title that will be employed when the Supplement is eventually incorporated. In each case a brief description of the change or addition is included. ATTACHMENT 1-1 - LABEL CODES Attachment 1-1 was updated to include new label assignments, of these new assignments 35 labels were revised and 3 label assignment deletions. A summary of label codes added by Supplement 16 is reproduced as Attachment 1-16 to this Supplement. The deleted labels are: Label Code PARAMETER 053 Track Angle Magnetic 217 Average Static Pressure 231 Total Air Temperature ATTACHMENT 1-2 - EQUIPMENT CODES Attachment 1-2 was updated to include new equipment codes: EQ ID EQUIPMENT TYPE 055 Multi-Mode Receiver (MMR) (755) 056 GNSS Navigation Landing Unit (GNLU) (756) 057 Cockpit Voice Recorder (CVR) (757) 058 Communication Management Unit Mark 2 (758) 060 GNSS Navigation Unit (GNU) (760) 061 Satellite Terminal Unit (STU) (761) 0BB Flap Control Unit (B747-400)/Flap Slat Electronics Unit (B767-400) 108 Electronic Engine Control (EEC) Channel A (B737- 700) 109 Electronic Engine Control (EEC) Channel B (B737- 700) 122 Ground Auxiliary Power Unit (A320/319/321) 12D Logic Drive Control Computer (B747/B767) 12E Cargo Control Logic Unit (B767) 12F Cargo Electronics Interface Unit (B767) 13B Audio Entertainment System (AES) Controller (Boeing) 13F Camera Interface Unit (A340/B777) 130 Load Management Unit (LMU) Airbus 140 Supersonic Air Data Computer (Honeywell) 142 ADS-B Link Display Processor Unit (LPDU) 143 Vertical/Horizontal Gyro (Litton) 167 Air Traffic Service Unit (Airbus) 168 Integrated Standby Instrument System (A340/330, A320/319/321) 169 Data Link Control and Display Unit (A340/330) 200 Versatile Integrated Avionics Unit (B717/MD-10) 201 Electronic Spoiler Control Unit (B717) 202 Brake Control Unit (B717) 203 Pneumatic Overheat Detection Unit (B717) 204 Proximity Switch Electronics Unit (B717) 205 APU Electronic Control Unit (B717) 206 Aircraft Interface Unit (MD-10) 207 Fuel Quantity Gauging Unit (MD-10) ATTACHMENT 2 - DATA STANDARDS Attachment 2 was updated to reflect new data standards. The basis of the changes introduced in Supplement 16 are reproduced as Attachment 1-16 to this Supplement. ATTACHMENT 4 - INPUT/OUTPUT CIRCUIT STANDARDS Text was added to identify the drawing as defining total system characteristics. ATTACHMENT 6 - GENERAL WORD FORMATS AND ENCODING EXAMPLES The text describing Label 150 bit 11 was revised to reflect the contents of ARINC Characteristic 743A, GNSS Sensor. The text describing Label 214 and Label 216 was revised to reflect the contents of ARINC Characteristic 758, Communications Management Unit.

ATTACHMENT 8 - OUTPUT SIGNAL TIMING TOLERANCES The text was modified to define pulse rise and fall times. SUPPLEMENT 16 TO ARINC SPECIFICATION 429 PART 1 - Page 3 ATTACHMENT 11 - SYSTEM ADDRESS LABELS The following System Address Labels were added: SAL OCTAL LABEL SYSTEM 157 CVR 210 FCMC Com A340-500/600 211 FCMC Mon A340-500/600 212 FCMC Int A340-500/600 225 HUD 241 APM-MMR 242 MMR 244 ILS 245 MLS 246 AHRS 251 VDR #1 252 VDR #2 253 VDR #3 310 GPWS 311 GNLU 1 312 GNLU 2 313 GNLU 3 314 GNU 1 315 GNU 2 316 GNU 3 321 AUTOTHROTTLE COMPUTER 322 FCC 1 323 FCC 2 324 FCC 3 325 APU 326 APU CONTROLLER 327 Mode Control Panel (MCP) 330 FMC 3 331 ATC TRANSPONDER 332 DADC 362 Passenger Services System (PSS) 767-300,400 363 Cabin Service System (CSS) 747-400 364 Audio Entertainment System (AES) Boeing 366 Multicast 367 Bridge APPENDIX E – GUIDELINES FOR LABEL ASSIGNMENTS Labels 171, 172, 214 and 216 were removed from spare labels (item 3). SUPPLEMENT 16 TO ARINC SPECIFICATION 429 PART 1 – Page 4 ATTACHMENT 1-16 SUPPLEMENT 16 UPDATES TO LABEL CODES Code No. (Octal) Data Eqpt. ID (Hex) Parameter Units Range Sig Bits Resolution MIN TX MAX TX 001 BCD 056 Distance To Go The Same Parameters as the FMS EQ ID 002 001 BCD 060 Distance To Go The Same Parameters as the FMS EQ ID 002 002 BCD 056 Time To Go The Same Parameters as the FMS EQ ID 002 002 BCD 060 Time To Go The Same Parameters as the FMS EQ ID 002 012 BCD 056 Ground Speed The Same Parameters as the FMS EQ ID 002 012 BCD 060 Ground Speed The Same Parameters as the FMS EQ ID 002 017 BCD 055 Selected Runway Heading Degrees 0-359.9 4 0.1 020 Discrete 06D Landing Gear Position Infor & System Status 90 100 021 Discrete 06D Landing Gear Position Infor & System Status 90 100 022 Discrete 06D Landing Gear Position Infor & System Status 90 100 023 Discrete 06D Landing Gear Position Infor & System Status 90 100 024 Discrete 06D Landing Gear Position Infor & System Status 90 100 027 BCD 056 TACAN Selected Course The Same Parameters as the FMS EQ ID 002 027 BCD 060 TACAN Selected Course (Bcd) The Same Parameters as the FMS EQ ID 002 033 BCD 055 Landing System Mode/Frequency 033 BCD 056 ILS Frequency The Same Parameters as the FMS EQ ID 002 033 BCD 060 ILS Frequency The Same Parameters as the FMS EQ ID 002 034 BCD 056 VOR/ILS Frequency The Same Parameters as the FMS EQ ID 002 034 BCD 060 VOR/ILS Frequency #1 The Same Parameters as the FMS EQ ID 002 035 BCD 055 Paired DME Frequency MHz 1008-135.9 4 0.05 035 BCD 056 DME Frequency The Same Parameters as the FMS EQ ID 002 035 BCD 060 DME Frequency #1 The Same Parameters as the FMS EQ ID 002 036 BCD 055 MLS Channel Selection 500-600 3 1 036 BCD 056 MLS Frequency Channel The Same Parameters as the FMS EQ ID 002 036 BCD 060 MLS Frequency/Channel The Same Parameters as the FMS EQ ID 002 041 BCD 056 Set Latitude The Same Parameters as the FMS EQ ID 002 041 BCD 060 Set Latitude The Same Parameters as the FMS EQ ID 002 042 BCD 056 Set Longitude The Same Parameters as the FMS EQ ID 002 042 BCD 060 Set Longitude The Same Parameters as the FMS EQ ID 002 043 BCD 056 Set Magnetic Heading The Same Parameters as the FMS EQ ID 002 043 BCD 060 Set Magnetic Heading The Same Parameters as the FMS EQ ID 002 052 BNR 004 Body Pitch Accel Deg/Sec2 ± 64 15 0.002 50 Hz 117 Hz 052 BNR 038 Body Pitch Accel Deg/Sec2 ± 64 15 0.002 50 Hz 117 Hz 053 BCD 004 Track Angle Magnetic Degree 1 3 1 250 500 053 BNR 004 Body Roll Accel Deg/Sec2 ± 64 15 0.002 50 Hz 117 Hz 053 BNR 038 Body Roll Accel Deg/Sec2 ± 64 15 0.002 50 Hz 117 Hz 054 BNR 004 Body Yaw Accel Deg/Sec2 ± 64 15 0.002 50 Hz 117 Hz 054 BNR 038 Body Yaw Accel Deg/Sec2 ± 64 15 0.002 50 Hz 117 Hz 056 BCD 056 ETA (Active Waypoint) The Same Parameters as the FMS EQ ID 002 056 BCD 060 ETA (Active Waypoint) The Same Parameters as the FMS EQ ID 002 061 BNR 00B Pseudo Range Meters ±268435456 20 256 200 1200 061 BNR 056 ACMS Information The Same Parameters as the FMS EQ ID 002 061 BNR 060 ACMS Information The Same Parameters as the FMS EQ ID 002 062 BNR 00B Pseudo Range Fine Meters 256 11 0.125 200 1200 062 BNR 056 ACMS Information The Same Parameters as the FMS EQ ID 002 062 BNR 060 ACMS Information The Same Parameters as the FMS EQ ID 002 063 BNR 00B Range Rate M/S ±4096 20 0.0039 200 1200 063 BNR 056 ACMS Information The Same Parameters as the FMS EQ ID 002 063 BNR 060 ACMS Information The Same Parameters as the FMS EQ ID 002 064 BNR 00B Delta Range Meters ±4096 20 0.0039 200 1200 065 BNR 00B SV Position X Meters ±67108864 20 64 200 1200 066 BNR 00B SV Position X Fine Meters 64 14 0.0039 200 1200 070 BNR 00B SV Position Y Meters ±67108864 20 64 200 1200 070 BNR 056 Reference Airspeed (Vref) The Same Parameters as the FMS EQ ID 002 070 BNR 060 Reference Airspeed (Vref) The Same Parameters as the FMS EQ ID 002 071 BNR 00B SV Position Y Fine Meters 64 14 0.0039 200 1200 072 BNR 00B SV Position Z Meters ±67108864 20 64 200 1200 073 BNR 00B SV Position Z Fine Meters 64 14 0.0039 200 1200 074 BNR 00B UTC Measure Time Seconds 10.0 20 9.536743µs 200 1200 SUPPLEMENT 16 TO ARINC SPECIFICATION 429 PART 1 – Page 5 ATTACHMENT 1-16 SUPPLEMENT 16 UPDATES TO LABEL CODES Code No. (Octal) Data Eqpt.

ID (Hex) Parameter Units Range Sig Bits Resolution MIN TX MAX TX 074 BNR 056 Zero Fuel Weight The Same Parameters as the FMS EQ ID 002 074 BNR 060 Zero Fuel Weight The Same Parameters as the FMS EQ ID 002 074 BNR 114 Zero Fuel Weight Pounds 1310680 15 40 100 400 075 Discrete 008 Maximum Hazard Alert Level Output 075 BNR 114 Aircraft Gross Weight Pounds 1310680 15 40 100 200 076 BNR 00B GNSS Altitude (Msl) Feet ±131072 20 0.125 200 1200 076 Discrete 008 Hazard Azimuth Output 076 BNR 114 Aircraft Longitudinal Center Of Gravity Percent 163.83% 14 0.01% 100 200 077 Discrete 008 Hazard Range Output 077 BNR 056 Target Airspeed The Same Parameters as the FMS EQ ID 002 077 BNR 060 Target Airspeed The Same Parameters as the FMS EQ ID 002 077 BNR 114 Zero Fuel Center Of Gravity Percent 163.83% 14 0.01% 100 200 100 BNR 056 Selected Course #1 The Same Parameters as the FMS EQ ID 002 100 BNR 060 Selected Course #1 The Same Parameters as the FMS EQ ID 002 101 BNR 00B HDOP N/A 1024 15 0.031 200 1200 102 BNR 00B VDOP N/A 1024 15 0.031 200 1200 102 BNR 056 Selected Altitude The Same Parameters as the FMS EQ ID 002 102 BNR 060 Selected Altitude The Same Parameters as the FMS EQ ID 002 103 BNR 00B GNSS Track Angle Degrees ±108° 15 0.0055° 200 1200 103 BNR 056 Selected Airspeed The Same Parameters as the FMS EQ ID 002 103 BNR 060 Selected Airspeed The Same Parameters as the FMS EQ ID 002 104 BNR 056 Selected Vertical Speed The Same Parameters as the FMS EQ ID 002 104 BNR 060 Selected Vertical Speed The Same Parameters as the FMS EQ ID 002 105 BNR 055 Selected Runway Heading Degrees ± 180 11 0.1 105 BNR 056 Selected Runway Heading The Same Parameters as the FMS EQ ID 002 105 BNR 060 Selected Runway Heading The Same Parameters as the FMS EQ ID 002 106 BNR 060 Selected Mach The Same Parameters as the FMS EQ ID 002 106 BNR 056 Selected Mach The Same Parameters as the FMS EQ ID 002 107 BNR 056 Selected Cruise Altitude The Same Parameters as the FMS EQ ID 002 107 BNR 060 Selected Cruise Altitude The Same Parameters as the FMS EQ ID 002 110 BNR 00B GNSS Latitude Degrees ±108° 20 0.000172° 200 1200 111 BNR 00B GNSS Longitude Degrees ±108° 20 0.000172° 200 1200 112 BNR 00B GNSS Ground Speed Knots 4096 15 0.125 200 1200 114 BNR 056 Desired Track The Same Parameters as the FMS EQ ID 002 114 BNR 060 Desired Track The Same Parameters as the FMS EQ ID 002 115 BNR 056 Waypoint Bearing The Same Parameters as the FMS EQ ID 002 115 BNR 060 Waypoint Bearing The Same Parameters as the FMS EQ ID 002 116 BNR 00B Horizontal GLS Deviation Rectilinear Feet ± 24000 18 .00915 100 116 BNR 055 Horizontal GLS Deviation Rectilinear Feet ± 24000 18 00915 100 116 BNR 056 Cross Track Distance The Same Parameters as the FMS EQ ID 002 116 BNR 060 Cross Track Distance The Same Parameters as the FMS EQ ID 002 117 BNR 00B Vertical GLS Deviation Rectilinear Feet ± 1024 14 .0625 100 117 BNR 055 Vertical GLS Deviation Rectilinear Feet ± 1024 14 .0625 100 117 BNR 056 Vertical Deviation The Same Parameters as the FMS EQ ID 002 117 BNR 060 Vertical Deviation The Same Parameters as the FMS EQ ID 002 120 BNR 00B GNSS Latitude Fine Degrees 0.000172° 11 8.38-E-8° 200 1200 120 BNR 056 Range to Altitude The Same Parameters as the FMS EQ ID 002 120 BNR 060 Range To Altitude The Same Parameters as the FMS EQ ID 002 121 BNR 00B GNSS Longitude Fine Degrees 0.000172° 11 8.38-E-8° 200 1200 121 BNR 056 Horizontal Command Signal The Same Parameters as the FMS EQ ID 002 121 BNR 060 Horizontal Command Signal The Same Parameters as the FMS EQ ID 002 122 BNR 056 Vertical Command Signal The Same Parameters as the FMS EQ ID 002 122 BNR 060 Vertical Command Signal The Same Parameters as the FMS EQ ID 002 124 Discrete 00B Digital Time Mark - 200 1200 125 BCD 00B UTC Hr:Min 23:59.9 5 0.1 Min 200 1200 125 BCD 002 Universal Coordinate Time Hr-Min 0-23.59.9 4 0.1 100 200 125 BCD 056 Universal Coordinated Time (UTC) The Same Parameters as the FMS EQ ID 002 125 BCD 060 Universal Coordinated Time (UTC) The Same Parameters as the FMS EQ ID 002 SUPPLEMENT 16 TO ARINC SPECIFICATION 429 PART 1 – Page 6 ATTACHMENT 1-16 SUPPLEMENT 16 UPDATES TO LABEL CODES Code No. (Octal) Data Eqpt.

ID (Hex) Parameter Units Range Sig Bits Resolution MIN TX MAX TX 126 BNR 056 Vertical Deviation (Wide) The Same Parameters as the FMS EQ ID 002 126 BNR 060 Vertical Deviation (Wide) The Same Parameters as the FMS EQ ID 002 130 BNR 00B Aut Horiz Integ Limit NM 16 17 1.2E-4 200 1200 133 BNR 00B Aut Vert Integ Limit Feet 32, 768 18 0.125 200 1200 136 BNR 00B Vertical Figure Of Merit Feet 32, 768 18 0.125 200 1200 137 BNR 140 Flap Angle Degrees 180 12 0.05 62.5 200 140 BNR 00B UTC Fine Seconds 1 20 0.953674µs 200 1200 140 Discrete 114 Pump Contactor States 141 BNR 00B UTC Fine Fractions Seconds 0.9536743µs 10 0.9313225ns 200 1200 141 Discrete 114 Pump Contactor and Pushbutton States 142 Discrete 114 Pump Push Button and LP Switch State 143 Discrete 114 Pump LP Switch State and FCMC Commands 144 Discrete 114 Valve Feedback 145 Discrete 114 Valve Feedback 146 Discrete 114 Valve Feedback 147 Discrete 114 Valve Feedback 150 BNR 00B UTC Hr:Min:S ±23:59:59 17 1.0 sec 200 1200 150 BNR 056 Universal Coordinated Time The Same Parameters as the FMS EQ ID 002 150 BNR 060 Universal Coordinated Time The Same Parameters as the FMS EQ ID 002 150 Discrete 114 FCMC Valve Commands 151 BNR 055 MLS AZ Deviation mV ± 2400 15 0.0732 151 BNR 056 Localizer Bearing (True) The Same Parameters as the FMS EQ ID 002 151 BNR 060 Localizer Bearing (True) The Same Parameters as the FMS EQ ID 002 151 Discrete 114 FCMC Valve Commands 152 BNR 055 MLS GP Deviation mV ± 2400 15 0.0732 152 Discrete 114 Overhead Panel Switch/ Pushbutton & Refuel Panel Battery Power Supply Switch States 153 BNR 055 MLS Selected Azimuth Degrees 0-359 9 1 153 Discrete 114 Level States 154 BNR 055 MLS Max Selectable GP Degrees ±51.1 9 1 154 BNR 056 Runway Heading (True) The Same Parameters as the FMS EQ ID 002 154 BNR 060 Runway Heading (True) The Same Parameters as the FMS EQ ID 002 154 Discrete 114 Level States and Low Warning and Transfer Indications 155 BNR 055 MLS Selected Glide Path Degrees ±51.1 9 0.01 155 Discrete 114 XFR Pump Faults & Wing Imbalance Warning 156 BNR 055 MLS Basic Data Wd 1 N/A N/A N/A N/A 156 Discrete 114 Refuel Panel Switch States 157 SAL System Address Label For CVR 157 BNR 055 MLS Basic Data Wd 2 N/A N/A N/A N/A 157 BCD 114 Trim Tank Probe Capacitance pf 0-400 14 0.1 160 BNR 055 MLS Basic Data Wd 3 N/A N/A N/A N/A 160 Discrete 114 Valve Feedback 161 BNR 055 MLS Basic Data Wd 4 N/A N/A N/A N/A 161 Discrete 114 Indicated Pump Status 162 BNR 055 MLS Basic Data Wd 5 N/A N/A N/A N/A 162 Discrete 114 Indicated Pump Status 162 BNR 140 Density Altitude Feet 131072 16 2 250 500 163 BNR 055 MLS Basic Data Wd 6 N/A N/A N/A N/A 163 Discrete 114 Indicated Pump Status 164 BNR 055 MLS ABS GP Angle Degrees ± 41 15 0.00125 164 Discrete 114 Indicated Pump Status 165 BNR 00B Vertical Velocity Feet/Min ±32768 15 1.0 200 1200 165 BNR 055 MLS ABS Azimuth Angle Degrees ± 82 16 0.00125 165 Discrete 114 Indicated Valve Status 166 BNR 00B North/South Velocity Knots ±4096 15 0.125 200 166 Discrete 114 Indicated Valve Status 167 BNR 002 EPU Estimate Position Uncertainty/ (ANP) Actual Navigation Performance NM 0-128 16 0.00195 SUPPLEMENT 16 TO ARINC SPECIFICATION 429 PART 1 – Page 7 ATTACHMENT 1-16 SUPPLEMENT 16 UPDATES TO LABEL CODES Code No. (Octal) Data Eqpt. ID (Hex) Parameter Units Range Sig Bits Resolution MIN TX MAX TX 167 Discrete 114 Indicated Valve Status 170 Discrete 114 Wing Imbalance And FQI Failure Warning 171 BNR 002 RNP Reduced Navigation Performance NM 0-128 16 0.001953 171 BNR 056 Current RNP The Same Parameters as the FMS EQ ID 002 171 BNR 060 Current RNP The Same Parameters as the FMS EQ ID 002 172 Subsystem Identifier 173 BNR 055 Localizer Deviation DDM ± 0.4 12 0.0001 174 BNR 00B East/West Velocity Knots ±4096 15 0.125 200 1200 174 BNR 055 Glide Slope Deviation DDM ± 0.8 12 0.0002 176 BNR 00B GLONASS Satellite Deselection W #1 17 176 BNR 0AD Static Pressure Left, Uncorrected, mb mb 2048 18 0.008 20 200 176 BNR 038 Left Static Pressure Uncorrected, mb mb 2048 18 0.008 20 200 176 BNR 114 Left Outer Tank Fuel Temp & Advisory Warn Degree C ±512 11 0.025 177 BNR 00B GLONASS Satellite Deselection W #2 17 177 BNR 0AD Static Pressure Right, Uncorrected, mb mb 2048 18 0.008 20 200 177 BNR 038 Right Static Pressure, Uncorrected, mb mb 2048 18 0.008 20 200 177 BNR 055 Distance To Runway Threshold Nmiles 1024 16 0.007812 177 BNR 114 Inner Tank 1 Fuel Temp & Advisory Warning Degree C ±512 11 0.025 200 BCD 056 Drift Angle The Same Parameters as the FMS EQ ID 002 200 BCD 060 Drift Angle The Same Parameters as the FMS EQ ID 002 200 BNR 114 Inner Tank 2 Fuel Temp & Advisory Warning Degree C ±512 11 0.025 201 BNR 114 Inner Tank 3 Fuel Temp & Advisory Warning Degree C ±512 11 0.025 201 BNR 140 Mach Maximum Operation (Mmo) Mach 4.096 12 0.001 62.5 125 201 BNR 142 Projected Future Latitude Degrees ± 180 20 0.000172 150 400 202 BNR 114 Inner Tank 4 Fuel Temp & Advisory Warning Degree C ±512 11 0.025 202 BNR 140 Mach Rate M/minute 4.096 12 0.001 62.5 125 202 BNR 142 Projected Future Latitude Fine Degrees .000172 11 2-E-32 Cir 150 400 203 BNR 114 Trim Tank Fuel Temp & Advisory Warning Degree C ±512 11 0.025 203 BNR 140 Altitude Feet 131072 17 1 31.25 62.5 204 BNR 056 Baro Altitude The Same Parameters as the FMS EQ ID 002 204 BNR 060 Baro Altitude The Same Parameters as the FMS EQ ID 002 204 BNR 114 Right Outer Tank Fuel Temp & Advisory Warning Degree C ±512 11 0.025 204 BNR 140 Baro Corrected Altitude Feet 131072 17 1 31.25 62.5 205 BNR 140 Mach Mach 4.096 16 0.0000625 62.5 125 206 BNR 056 Computed Airspeed The Same Parameters as the FMS EQ ID 002 206 BNR 060 Computed Airspeed The Same Parameters as the FMS EQ ID 002 206 BNR 140 Computed Airspeed (CAS) Knots 1024 14 0.0625 62.5 125 207 BNR 140 Airspeed Maximum Operating (VMO) Knots 1024 12 .025 62.56 125 210 BNR 140 True Airspeed Knots 2048 15 0.0625 62.5 125 210 SAL FCMC Com A340-500/600 211 BNR 0AD Total Air Temperature Indicated Degree C 512 12 0.125 250 500 211 BNR 140 Total Air Temp (TAT) Degree C 512 11 0.25 250 500 211 BNR 142 Projected Future Longitude Degrees ± 180 20 0.000172 150 400 211 SAL FCMC M on A340-500/600 212 BNR 056 Altitude Rate The Same Parameters as the FMS EQ ID 002 212 BNR 060 Altitude Rate The Same Parameters as the FMS EQ ID 002 212 BNR 140 Altitude Rate Ft/Min 32768 11 16 31.25 62.5 212 BNR 142 Projected Future Longitude Fine Degrees .000172 11 2E -32 Cir 150 400 212 SAL FCMC Int A340-500/600 213 BNR 140 Static Air Temp (SAT) Degree C 512 11 0.25 250 500 213 BNR 142 Vertical Time Interval Minute 265 min 10 .25 mile 500 2000 215 BNR OAD Impacted Pressure, Uncorrected, mb mb 512 16 0.008 20 40 215 BNR O38 Impacted Pressure, Uncorrected, mb mb 512 14 0.03125 62.5 125 215 BNR 006 Impacted Pressure, Uncorrected, mb mb 512 14 0.03125 62.5 125 215 BNR 140 Impact Pressure Subsonic mb 512 14 0.03125 62.5 125 217 BNR 0AD Average Static Pressure mb 2048 18 0.008 20 200 217 BNR 002 Geometric Vertical Rate Ft/Min 20000 11 16 SUPPLEMENT 16 TO ARINC SPECIFICATION 429 PART 1 – Page 8 ATTACHMENT 1-16 SUPPLEMENT 16 UPDATES TO LABEL CODES Code No. (Octal) Data Eqpt. ID (Hex) Parameter Units Range Sig Bits Resolution MIN TX MAX TX 217 BNR 006 Static Pressure, Corrected (In. Hg) Inches Hg 64 16 0.001 20 200 217 BNR 038 Static Pressure, Average, Corrected (In. Hg) Inches Hg 64 16 0.001 20 200 217 BNR 140 Static Pressure Corrected (In. Hg) Inches Hg 64 16 0.001 62.5 125 220 056 MCDU #1 Address Label The Same Parameters as the FMS EQ ID 002 220 060 MCDU #1 Address Label The Same Parameters as the FMS EQ ID 002 220 BNR 140 Baro Corrected Altitude #2 Feet 131072 17 1 31.25 62.5 221 056 MCDU #2 Address Label The Same Parameters as the FMS EQ ID 002 221 060 MCDU #2 Address Label The Same Parameters as the FMS EQ ID 002 221 BNR 140 Angle Of Attack Indicated Average Degrees 180 12 0.05 31.25 62.5 222 056 MCDU #3 Address Label The Same Parameters as the FMS EQ ID 002 222 060 MCDU #3 Address Label The Same Parameters as the FMS EQ ID 002 222 BNR 140 Angle Of Attack, Indicated #1 Left Degrees 180 12 0.05 31.5 62.5 223 056 Printer #1 Address Label The Same Parameters as the FMS EQ ID 002 223 060 Printer #1 Address Label The Same Parameters as the FMS EQ ID 002 223 BNR 140 Angle Of Attack, Indicated #1 Right Degrees 180 12 0.05 31.5 62.5 224 056 Printer #2 Address Label The Same Parameters as the FMS EQ ID 002 224 060 Printer #2 Address Label The Same Parameters as the FMS EQ ID 002 224 BNR 140 Angle Of Attack, Indicated #2 Left Degrees 180 12 0.05 31.5 62.5 225 SAL System Address Label For HUD 225 BNR 056 Minimum Maneuvering Air Speed The Same Parameters as the FMS EQ ID 002 225 BNR 060 Minimum Maneuvering Air Speed The Same Parameters as the FMS EQ ID 002 225 BNR 140 Angle Of Attack, Indicated #2 Right Degrees 180 12 0.05 31.5 62.5 226 00B Data Loader Responses 200 1200 227 Discrete 019 CFDS Bite Command Summary For HFDR 227 Discrete 053 CFDS Bite Command Word For HFDU 230 BCD 114 Left Outer Probes Capacitance pf 0-400 14 0.1 231 BCD 0AD Total Air Temperature Degree C 512 12 20 200 231 BCD 114 Inner 2 Tank Probe Capacitance pf 0-400 14 0.1 232 File Format 002 Active Intent Data Block 232 DISC 055 GLS Airport ID 232 Discrete 056 Active Intent Data Block 232 060 Active Intent Data Block The Same Parameters as the FMS EQ ID 002 232 BCD 114 Inner 4 Tank Probe Capacitance pf 0-400 14 0.1 233 BNR 056 ACMS Information The Same Parameters as the FMS EQ ID 002 233 BNR 060 ACMS Information The Same Parameters as the FMS EQ ID 002 233 BCD 114 Right Outer Probe Capacitance pf 0-400 14 0.1 234 BNR 056 ACMS Information The Same Parameters as the FMS EQ ID 002 234 BNR 060 ACMS Information The Same Parameters as the FMS EQ ID 002 235 BNR 056 ACMS Information The Same Parameters as the FMS EQ ID 002 235 BNR 060 ACMS Information The Same Parameters as the FMS EQ ID 002 236 BNR 056 ACMS Information The Same Parameters as the FMS EQ ID 002 236 BNR 060 ACMS Information The Same Parameters as the FMS EQ ID 002 237 BNR 00B Horizontal Uncertainty Level Nm 16 17 0.000122 1200 237 BNR 002 ACMS Information 237 BNR 056 ACMS Information The Same Parameters as the FMS EQ ID 002 237 BNR 060 ACMS Information The Same Parameters as the FMS EQ ID 002 241 SAL System Address Label For APM-MMR 241 BNR 056 Min. Airspeed for Flap Extension The Same Parameters as the FMS EQ ID 002 241 BNR 060 Min. Airspeed for Flap Extension The Same Parameters as the FMS EQ ID 002 241 BNR 140 Angle Of Attack, Corrected Degrees 180 12 0.05 31.5 62.5 242 SAL System Address Label for MMR 242 BNR 0AD Total Pressure, Uncorrected, mb 242 File Format 002 Modified Intent Data Block 242 BNR 056 Modified Intent Data Block The Same Parameters as the FMS EQ ID 002 242 060 Modified Intent Data Block The Same Parameters as the FMS EQ ID 002 242 BNR 140 Total Pressure mb 2048 16 0.03125 62.5 125 243 DISC 055 GLS Runway Selection SUPPLEMENT 16 TO ARINC SPECIFICATION 429 PART 1 – Page 9 ATTACHMENT 1-16 SUPPLEMENT 16 UPDATES TO LABEL CODES Code No. (Octal) Data Eqpt. ID (Hex) Parameter Units Range Sig Bits Resolution MIN TX MAX TX 244 SAL System Address Label for ILS 244 BNR 140 Angle Of Attack, Normalized Ratio 2 11 0.001 62.5 125 245 SAL System Address Label For MLS 245 BNR 0AD Average Static Pressure mb, Uncorrected mb 2048 18 0.008 20 200 245 BNR 038 Average Static Pressure mb, Uncorrected 245 BNR 056 Minimum Airspeed The Same Parameters as the FMS EQ ID 002 245 BNR 060 Minimum Airspeed The Same Parameters as the FMS EQ ID 002 245 BNR 140 Static Pressure, Uncorrected mb 2048 16 0.03125 62.5 125 246 SAL System Address Label for AHRS 246 BNR 038 Average Static Pressure mb, Corrected 246 BNR 056 General Max Speed (Vcmax) The Same Parameters as the FMS EQ ID 002 246 BNR 060 General Max Speed (Vcmax) The Same Parameters as the FMS EQ ID 002 246 BNR 140 Static Pressure, Corrected mb 2048 16 0.03125 62.5 125 247 BNR 00B Horizontal Figure Of Merit NM 16 18 6.1 E-5 200 1200 247 BNR 056 Control Minimum Speed (Vcmin) The Same Parameters as the FMS EQ ID 002 247 BNR 060 Control Minimum Speed (Vcmin) The Same Parameters as the FMS EQ ID 002 247 BNR 114 Fuel On Board Pounds 655320 13 40 247 BNR 140 Airspeed Minimum Vmc Knots 512 11 0.25 62.5 125 250 BNR 0AD Indicated Side Slip Angle or AOS Deg/180 ±180 14 0.01 31.3 200 250 BNR 114 Preselected Fuel Quantity Pounds 655320 13 40 251 SAL System Address Label VDR #1 252 SAL System Address Label VDR #2 253 SAL System Address Label VDR #3 254 Discrete 055 GBAS ID 200 254 BNR 140 Altitude Rate Ft/Min 131072 13 16 31.25 62.5 255 Discrete 055 GBAS Airport ID 200 255 BNR 140 Impact Pressure mb 4096 17 0.03125 62.5 125 256 BLOCK 055 MLS Station ID #1 256 BNR 056 Time For Climb The Same Parameters as the FMS EQ ID 002 256 BNR 060 Time For Climb The Same Parameters as the FMS EQ ID 002 256 BNR 114 Left Outer Tank Fuel Quantity Pounds 131068 15 4 256 BNR 140 Equivalent Airspeed Knots 1024 14 0.0625 62.5 125 257 BLOCK 055 MLS Station ID #2 257 BNR 056 Time For Descent The Same Parameters as the FMS EQ ID 002 257 BNR 060 Time For Descent The Same Parameters as the FMS EQ ID 002 257 BNR 114 Inner Tank 1 Fuel Quantity Pounds 131068 15 4 257 BNR 140 Total Pressure (High Range) mb 4096 17 0.03125 62.5 125 260 BCD 00B Date dd:Mo:Yr dd:mm:yr 6 1 day 200 1200 260 BCD 056 Date/Flight Leg The Same Parameters as the FMS EQ ID 002 260 BCD 060 Date/Flight Leg The Same Parameters as the FMS EQ ID 002 260 BNR 114 Collector Cell 1 and 2 Fuel Quantity Pounds 131068 15 4 261 BCD 056 Flight Number (BCD) The Same Parameters as the FMS EQ ID 002 261 BCD 060 Flight Number (BCD) The Same Parameters as the FMS EQ ID 002 261 BNR 114 Fuel On Board At Engine Start Pounds 131068 15 4 262 BNR 056 Documentary Data The Same Parameters as the FMS EQ ID 002 262 BNR 060 Documentary Data The Same Parameters as the FMS EQ ID 002 262 BNR 114 Center Tank Fuel Quantity Pounds 131068 15 4 263 BLOCK 055 Ground Station/Approach 263 BNR 056 Min. Airspeed For Flap Retraction The Same Parameters as the FMS EQ ID 002 263 BNR 060 Min. Airspeed For Flap Retraction The Same Parameters as the FMS EQ ID 002 263 BNR 114 Collector Cell 3 And 4 Fuel Quantity Pounds 131068 15 4 264 BLOCK 055 Ground Station/Approach 264 BNR 056 Time To Touchdown The Same Parameters as the FMS EQ ID 002 264 BNR 060 Time To Touchdown The Same Parameters as the FMS EQ ID 002 264 BNR 114 Spare 265 BNR 056 Min. Buffet Airspeed The Same Parameters as the FMS EQ ID 002 265 BNR 060 Min.

Buffet Airspeed The Same Parameters as the FMS EQ ID 002 265 BNR 114 Inner Tank 3 Fuel Quantity Pounds 131068 15 4 SUPPLEMENT 16 TO ARINC SPECIFICATION 429 PART 1 – Page 10 ATTACHMENT 1-16 SUPPLEMENT 16 UPDATES TO LABEL CODES Code No. (Octal) Data Eqpt. ID (Hex) Parameter Units Range Sig Bits Resolution MIN TX MAX TX 266 BNR 114 Inner Tank 2 Fuel Quantity Pounds 131068 15 4 267 BNR 056 Max. Maneuver Airspeed The Same Parameters as the FMS EQ ID 002 267 BNR 060 Max. Maneuver Airspeed The Same Parameters as the FMS EQ ID 002 267 BNR 114 Inner Tank 4 Fuel Quantity Pounds 131068 15 4 270 Discrete 024 MU Output Data Word, Communication Link Status 270 Discrete 039 MCDU Normal Discrete Word 270 Discrete 041 SDU To ACARS MU/CMU Status Word 270 Discrete 050 VDR Status Word 270 Discrete 053 HFDL Status Word 270 DISC 055 MLS Discrete 270 Discrete 056 Status Discretes 270 Discrete 058 Output Status Word #1 270 DISC 060 Intent Status 270 DISC 060 Status Discretes 270 DISC 060 Discrete Data #1 270 Discrete 114 Unusable, and Empty Warning 270 Discrete 140 Discrete Data # 1 250 500 270 Discrete 142 Aircraft Category (Disc Data 1) 5000 15000 271 Discrete 041 SDU To ACARS MU/CMU Join /Leave Message 271 DISC 055 MMR Discrete 271 Discrete 056 Discrete Data #2 271 DISC 060 Discrete Data #2 271 Discrete 114 Fuel Transfer Indication 271 Discrete 140 Discrete Data # 2 250 500 271 Discrete 142 Altitude Filter Limits (Disc Data 2) 500 2000 272 Discrete 053 HFDL Slave (Disc Data 3) 272 Discrete 056 Discrete Data #3 272 DISC 060 Discrete Data #3 272 Discrete 114 Fuel Transfer Indication 272 Discrete 140 Discrete Data # 3 250 500 273 DIS 00B GNSS Sensor Status N/A 200 1200 273 DISC 055 GNSS Status 273 Discrete 114 Memos And Status 274 Discrete 114 Fuel Transfer Indications 275 Discrete 038 IR Discrete Word #2 275 Discrete 056 Discrete Data #6 275 DISC 060 Discrete Data #6 275 Discrete 114 Miscellaneous Warning 276 Discrete 024 MU Output Data Word, Pin Program Status 276 Discrete 041 SDU To EICAS/ECAM/EDU For Dual SATCOM 276 Discrete 050 VDR Mode Command 276 Discrete 056 Discrete Data #7 276 Discrete 058 Output Status Word #2 276 DISC 060 Discrete Data #7 276 Discrete 114 Miscellaneous Discrete 277 Discrete 004 IRS Maintenance Discrete 277 Discrete 114 Fuel Transfer and CG Status 301 056 Application Dependent The Same Parameters as the FMS EQ ID 002 301 060 Application Dependent 302 056 Application Dependent The Same Parameters as the FMS EQ ID 002 302 060 Application Dependent 303 056 Application Dependent The Same Parameters as the FMS EQ ID 002 303 060 Application Dependent 310 SAL System Address Label for GPWS 310 BNR 056 Present Position Latitude The Same Parameters as the FMS EQ ID 002 310 BNR 060 Present Position Latitude The Same Parameters as the FMS EQ ID 002 SUPPLEMENT 16 TO ARINC SPECIFICATION 429 PART 1 – Page 11 ATTACHMENT 1-16 SUPPLEMENT 16 UPDATES TO LABEL CODES Code No. (Octal) Data Eqpt. ID (Hex) Parameter Units Range Sig Bits Resolution MIN TX MAX TX 310 BNR 114 Right Outer Tank Fuel Quantity Pounds 131068 15 4 311 SAL System Address Label for GNLU 1 311 BNR 056 Present Position Longitude The Same Parameters as the FMS EQ ID 002 311 BNR 060 Present Position Longitude The Same Parameters as the FMS EQ ID 002 311 BNR 114 Trim Tank Fuel Quantity Pounds 131068 15 4 312 SAL System Address Label for GNLU 2 312 BNR 056 Ground Speed The Same Parameters as the FMS EQ ID 002 312 BNR 060 Ground Speed The Same Parameters as the FMS EQ ID 002 312 BNR 114 Additional Center Tank (Act 1) Fuel Quantity Pounds 131068 15 4 313 SAL System Address Label For GNLU 3 313 BNR 056 Track Angle True The Same Parameters as the FMS EQ ID 002 313 BNR 060 Track Angle True The Same Parameters as the FMS EQ ID 002 313 BNR 114 Additional Center Tank (Act 2) Fuel Quantity Pounds 131068 15 4 314 SAL System Address Label For GNU 1 314 BNR 114 Rear Center Tank (RCT) Fuel Quantity Pounds 131068 15 4 315 SAL System Address Label For GNU 2 315 BNR 056 Wind Speed The Same Parameters as the FMS EQ ID 002 315 BNR 060 Wind Speed The Same Parameters as the FMS EQ ID 002 316 SAL System Address Label For GNU 3 316 BNR 056 Wind Direction (True) The Same Parameters as the FMS EQ ID 002 316 BNR 060 Wind Direction (True) The Same Parameters as the FMS EQ ID 002 317 BNR 056 Track Angle Magnetic The Same Parameters as the FMS EQ ID 002 317 BNR 060 Track Angle Magnetic The Same Parameters as the FMS EQ ID 002 320 BNR 05A Fuel Quantity Act 3 320 BNR 056 Magnetic Heading The Same Parameters as the FMS EQ ID 002 320 BNR 060 Magnetic Heading The Same Parameters as the FMS EQ ID 002 321 SAL System Address Label for Autothrottle Computer 321 BNR 056 Drift Angle The Same Parameters as the FMS EQ ID 002 321 BNR 060 Drift Angle The Same Parameters as the FMS EQ ID 002 322 SAL System Address Label for FCC 1 322 BNR 056 Flight Path Angle The Same Parameters as the FMS EQ ID 002 322 BNR 060 Flight Path Angle The Same Parameters as the FMS EQ ID 002 323 SAL System Address Label For FCC 2 323 BNR 002 Geometric Altitude Feet 50000 17 1 323 BNR 056 Geometric Altitude The Same Parameters as the FMS EQ ID 002 323 BNR 060 Geometric Altitude The Same Parameters as the FMS EQ ID 002 324 SAL System Address Label For FCC 3 324 BNR 056 Estimated Position Uncertainty The Same Parameters as the FMS EQ ID 002 324 BNR 060 Estimated Position Uncertainty The Same Parameters as the FMS EQ ID 002 324 BNR 114 Effective Pitch Angle Degrees ±180 13 0.02 325 SAL System Address Label For APU 325 BNR 114 Effective Roll Angle Degrees ±180 13 0.02 326 SAL System Address Label For APU Controller 327 SAL SAL Mode Control Pane (MCP) 330 SAL System Address Label For FMC 3 331 SAL System Address Label For ATC Transponder 332 SAL System Address Label For DADC 335 BNR 002 Track Angle Rate Deg/Sec 32 11 0.015 10 20 335 BNR 056 Track Angle Rate The Same Parameters as the FMS EQ ID 002 335 BNR 060 Track Angle Rate The Same Parameters as the FMS EQ ID 002 340 BNR 004 Inertial Yaw Rate Deg/Sec 128 13 0.015 10 20 340 BNR 004 Track Angle Grid Degree ± 180 15 0.0055 20 Hz 110 Hz 340 BNR 005 Inertial Yaw Rate Deg/Sec 128 13 0.015 10 20 340 BNR 140 Pressure Ratio (Pt/Ps) Ratio 16 14 0.001 62.5 125 341 BNR 004 Grid Heading Degree ± 180 15 0.0055 20 Hz 110 Hz 341 BNR 038 Grid Heading Degree ± 180 15 0.0055 20 Hz 110 Hz 341 BNR 140 Pressure Ratio (Ps/Pso) Ratio 4 12 0.001 62.5 125 SUPPLEMENT 16 TO ARINC SPECIFICATION 429 PART 1 – Page 12 ATTACHMENT 1-16 SUPPLEMENT 16 UPDATES TO LABEL CODES Code No. (Octal) Data Eqpt.

ID (Hex) Parameter Units Range Sig Bits Resolution MIN TX MAX TX 342 BNR 140 Air Density Ratio Ratio 4 12 0.001 250 500 350 Discrete 004 IRS Maintenance Discrete 350 Discrete 018 Maintenance Data #1 350 Discrete 019 CFDS Bite Fault Summary Word For HFDR 350 Discrete 024 MU Output Data Word Failure Status 350 Discrete 038 IRS Maintenance Word #1 350 Discrete 050 VDR Fault Summary Word 350 Discrete 053 CFDS Bite Fault Summary Word For HFDU 350 DISC 055 ILS Maintenance Word 350 Discrete 058 Maintenance Word #1 350 BCD 114 Fuel Density kg/l 0-.999 4 0.01 350 Discrete 140 Maintenance Data # 1 250 500 351 Discrete 024 MU Output Data Word, Failure Status 351 Discrete 038 IRS Maintenance Word #2 351 DISC 055 MMR Maintenance Word 351 Discrete 058 Maintenance Word #2 351 BCD 114 Inner Tank 1 Probe Capacitance pf 0-400 14 0.1 351 Discrete 140 Maintenance Data # 2 250 500 352 DISC 055 MLS Bite Status 352 Discrete 058 Maintenance Word 352 BCD 114 Center, ACT & RCT Probe Capacitance pf 0-400 14 0.1 352 Discrete 140 Maintenance Data # 3 Flight Count 524287 250 500 353 Discrete 038 IRS Maintenance Word #3 353 BCD 114 Inner Tank 3 Probe Capacitance pf 0-400 14 0.1 354 056 Maintenance Data #5 The Same Parameters as the FMS EQ ID 002 354 060 Maintenance Data #5 355 DIS 00B GNSS Fault Summary - 21 200 1200 355 Discrete 038 IRS Maintenance Word #4 357 ISO-5 056 ISO Alphabet #5 Message The Same Parameters as the FMS EQ ID 002 357 ISO-5 060 ISO Alphabet #5 Message The Same Parameters as the FMS EQ ID 002 360 BNR 056 Flight Information The Same Parameters as the FMS EQ ID 002 360 BNR 060 Flight Information The Same Parameters as the FMS EQ ID 002 360 BNR 142 RAIM Status Word NM 16 13 0.00195 362 SAL System Address Label For PSS 363 SAL System Address Label For CSS 364 SAL System Address Label For AES 366 SAL System Address Label For Multicast 367 SAL System Address Label For Bridge 370 BNR 00B GNSS Height WGS-84 (Hae) Feet ±131,072 20 0.125 1200 370 BNR 00B GNSS Height Feet ±131,072 20 0.125 200 1200 375 BNR 004 Along Hdg Accel Gs 4 18 1.53E-5 50 Hz 110Hz 375 BNR 038 Along Hdg Accel Gs 4 18 1.53E-5 50 Hz 110Hz 376 BNR 004 Cross Hdg Accel Gs 4 18 1.53E-5 50 Hz 110Hz 376 BNR 038 Cross Hdg Accel Gs 4 18 1.53E-5 50 Hz 110Hz AERONAUTICAL RADIO, INC.

2551 Riva Road Annapolis, Maryland 24101-7465 SUPPLEMENT 17 TO ARINC SPECIFICATION 429 P1 MARK 33 DIGITAL INFORMATION TRANSFER SYSTEM (DITS) PART 1 FUNCTIONAL DESCRIPTION, ELECTRICAL INTERFACE, LABEL ASSIGNMENTS AND WORD FORMATS Published: May 17, 2004 Prepared by the Airlines Electronic Engineering Committee Adopted by the Airlines Electronic Engineering Committee: May 5, 2004 SUPPLEMENT 17 TO ARINC SPECIFICATION 429P1 – Page 2 A. PURPOSE OF THIS DOCUMENT This Supplement introduces new label assignments, equipment IDs, system address labels and updates to ARINC Specification 429. B. ORGANIZATION OF

THIS SUPPLEMENT The material in Supplement 17 is integrated into ARINC Specification 429 to form an updated version of the standard. Changes introduced by Supplement 17 are identified using change bars and are labeled by a “c-17” symbol in the margin. C. CHANGES TO ARINC SPECIFICATION 429 INTRODUCED BY THIS SUPPLEMENT This section presents a complete tabulation of the changes and additions to the Specification introduced by this Supplement. Each change or addition is defined by the section number and the title currently employed in the Specification or by the section name and title that will be employed when the Supplement is eventually incorporated. In each case a brief description of the change or addition is included. 3.1.4.6 VHF Communications The Frequency Range and Frequency Selection Increments were revised to reflect 8.33 kHz spacing. ATTACHMENT 1-1 LABEL CODES This Attachment was updated according to ARINC 429 New and Revised Label Assignments Table on page 3. A Note was added to label 377 to clarify the SSM.
ATTACHMENT 1-2 - EQUIPMENT CODES The following Equipment Codes were added: EQ ID EQUIPMENT TYPE 061 High-Speed Data Unit (HSDU) 0C4 A429W SDU Controller 11E Integrated Static Probe 120 Multifunctional Air Data Probe 144 CDTI Display Unit 14A Slide Slip Angle (SSA) 171 Electronic Flight Bag 1E2 ADS-B LDPU Controller ATTACHMENT 2 - DATA STANDARDS This Attachment was updated according to ARINC 429 New and Revised Label Assignments Table on page 3. ATTACHMENT 6 – GENERAL WORD FORMATS AND ENCODING EXAMPLES Table 6-17 was revised to correct the error in the SSM. Table 6-24 was revised to correctly identify SPI. In addition, bit 17 was revised to indicate Hijack Mode. Table 6-39 (ICAO Address) will be removed from Part I and added to Part II Tables 6-49, 6-50, and 6-51 were added by this Supplement. ATTACHMENT 10 – MANUFACTURER-SPECIFIC STATUS Bits 9 and 10 were revised to indicate SDI and Note B was added. Company identification was added for RYAN. ATTACHMENT 11 - SYSTEM ADDRESS LABELS The following System Address Labels were added or revised: SAL OCTAL LABEL SYSTEM 156 CVR #2 174 HGA/IGA HPA 175 HGA/HPA Starboard 177 LGA HPA 247 High-Speed Data (HSDU #1) 250 High-Speed Data (HSDU #2) 254 Network Server System 255 Electronic Flight Bag Left 256 Electronic Flight Bag Right 345 Remote Data Concentrator APPENDIX E – GUIDELINES FOR LABEL ASSIGNMENTS Item 2 was revised to clarify the confusion on the SSM for label 377 Equipment Identification. LA BE L Dat a E Q ID PA RA ME TE R UN ITS R AN GE S IG Bits R ESO L MIN TX M AX T X New 10 1 B inar y 05 A FQ IC Lbs 4- 655 32 14 4 90 0 11 00 New 12 4 B inar y 1E 2 H oriz onta l Ala rm L imit M eter s 0 – 81 90 13 1met er 800 1200 N ew 124 Bin ary 0A5 Cli ent D evic e fo r G NS S R ecei ver Met ers 8192 13 1 met er 20 0 N ew 127 Bin ary 1E2 Ver tica l Ala rm L imit M eter s 0 – 25 5 8 1 m eter 80 0 12 00 Rev ised 14 1 B inar y 00 B UT C F ine Fra ctio ns Sec onds 0. 9536 743µ s 10 0. 9312 25ns 20 0 12 00 New 15 2 B inar y 03 8 C abin Pre ssur e m B 2048 16 0. 0312 5 62 .5 125 New 15 2 B inar y 0A D Cab in P ress ure mB 20 48 18 0.00 8 20 20 0 R evis ed 155 Dis cret e 05 A FQ IC 90 0 11 00 New 15 6 S AL CV R # 2 Rev ised 17 1 M anuf actu rer- Spe cifi c S tatu s New 17 1 B INA RY 0A 5 V erti cal A larm lim it (VA L) and SB AS S yste m I dent ifie r M eter s 25 6 8 1 m eter 200 Rev ised 21 4 D iscr ete xxx ICA O A ircr aft A ddre ss P art 1 Rev ised 21 6 D iscr ete xxx ICA O A ircr aft A ddre ss P art 2 New 24 7 S AL Hig h-S peed Dat a U nit # 1 (H SD U # 1) N ew 250 SA L H igh- Spe ed D ata Uni t #2 (HS DU #2) New 25 4 S AL Net wor k S erve r S yste m (NS S) N ew 255 SA L E lect roni c F ligh t Bag – L eft N ew 256 SA L E lect roni c F ligh t Bag – R ight New 26 1 B inar y 14 4 R ange Rin g R adiu s N M 512 15 1/64 NM 80 0 12 00 New 26 2 B inar y 14 4 D ispl ay R ange N M 512 14 1/32 NM 80 0 12 00 New 27 0 D iscr ete 144 Dis play Mod e 80 0 12 00 New 27 1 D iscr ete 144 Alt itud e F ilte r S etti ng 800 1200 N ew 272 Dis cret e 14 4 T arge t Sel ecti on W ord 800 1200 N ew 272 Dis cret e 00 5 A ir D ata AH AR S 250 500 New 27 6 D iscr ete 058 VD R M ode 25 0 50 0 de lete d 32 0 B inar y 05 A Fue l Qua ntit y A CT 3 N ew 345 S AL Rem ote Dat a C once ntra tor N ew 350 Dis cret e 14 4 C DT I F ault Sum mar y W ord 800 1200 N ew 357 Dis cret e 05A P art N umbe r (m anuf actu rer- Spe cifi c) N ew 377 Dis cret e xx x E quip men t Ide ntif icat ion SUPPLEMENT 17 TO ARINC SPECIFICATION 429P1 - Page 3 ARINC 429 NEW AND REVISED LABEL ASSIGNMENTS ARINC Project Initiation/Modification 05/19/04 69_APIM-VerJ.doc Page 1 ARINC IA Project Initiation/Modification (APIM) Guidelines for Submittal (Wednesday, May 19, 2004) 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. ARINC Project Initiation/Modification 05/19/04 69_APIM-VerJ.doc Page 2 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 Project Initiation/Modification 05/19/04 69_APIM-VerJ.doc Page 3 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. ARINC Project Initiation/Modification 05/19/04 69_APIM-VerJ.doc Page 4 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 _____ 70_ARINC Errata.doc 5/19/2004 ARINC Standard – Errata Report 1. Document Title ARINC Specification 429P1-17: Mark 33 Digital Information Transfer System (DITS) Part 1, Functional Description, Electrical Interface, Label Assignments and Word Formats 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